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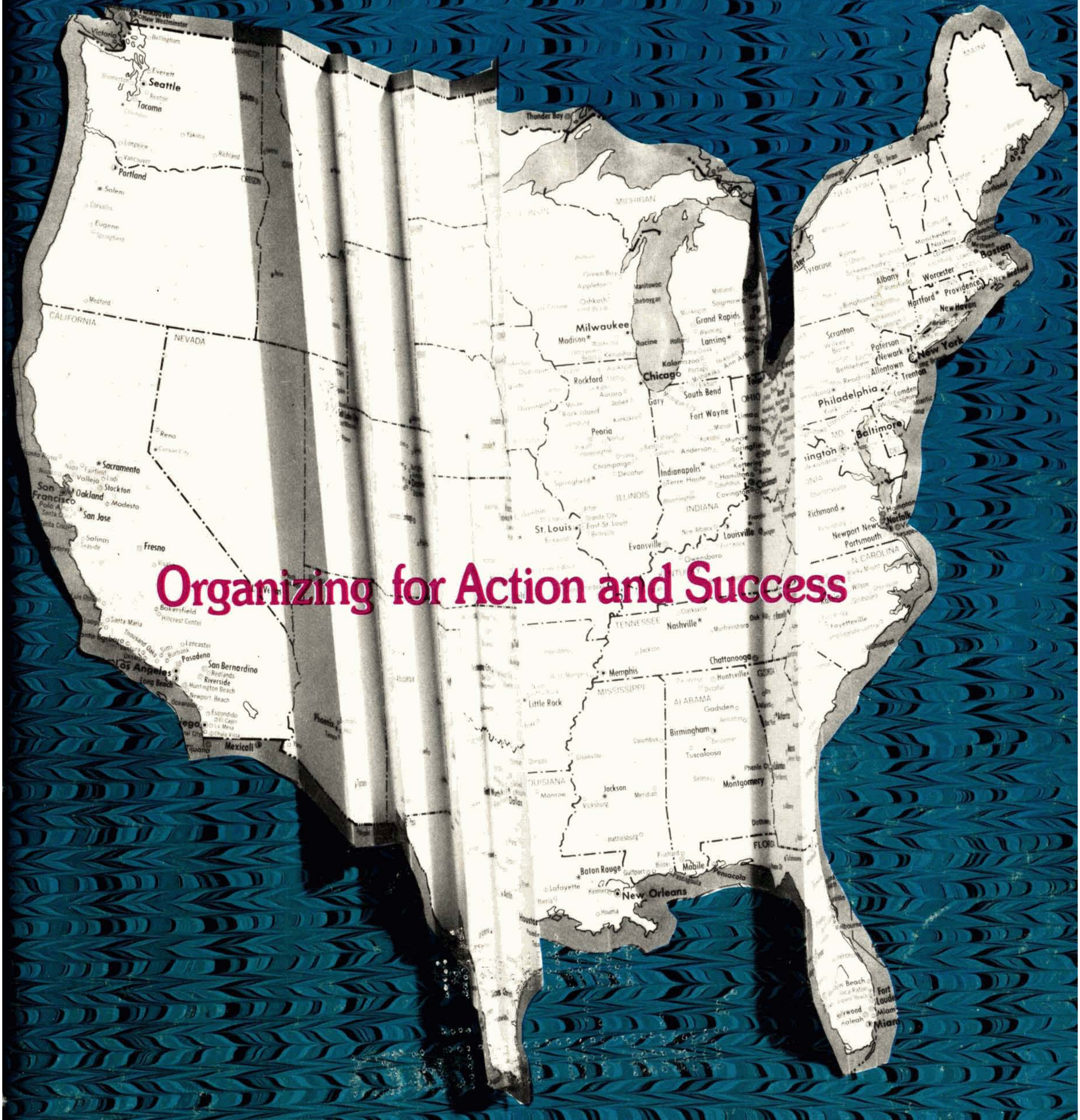

Organizing for Action and Success

MAY 1977

JOURNAL OF COATINGS TECHNOLOGY

Volume 49 Number 628

Features

Federation Activities

Departments

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology at Cresent & Mulberry Streets, Harrisburg, Pa. 17104. Editorial and executive offices are located at 1315 Walnut St., Philadelphia, Pa. 19107. Phone: (215) 545-1507.

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1315 Walnut St., Phila., Pa. 19107

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Comment

E. A. G. O. T. !

Efforts to cope with the increasing torrent of governmental rules and regulations are consuming more and more of the coatings industry's time and resources. Much of our research and development activities are expended in these non-productive areas as we attempt to deal with the latest directives on lead in paint, aerosols, solvent emissions (see story on the California Air Resources Board hearing on Pages 32-35), toxic substances, and on and on.

Of paramount significance is the fact that government officials involved in drafting legislation so often seem unaware of, or indifferent to, either the consequences or ramifications of their proposals.

One way industry can help is E.A.G.O.T.—Educate A Government Official Today. It is naive to expect that people in government would be knowledgable about all facets of the industries they are trying to regulate. They must have input. So, let's communicate to these officials what is really involved in the formulation, manufacture, and application of coatings.

In this regard, several of our Societies have been sponsoring meetings which present an up-date on legislative matters. These efforts could well be expanded—with special attention given to inviting local government officials to attend such meetings for a discussion of mutual points of interest regarding such legislation.

While membership in the Federation and other such industry groups is important, it is simply not enough. We must do more ourselves in order to find ways to help educate those who make the rules and regulations that so vitally affect all of us. —TJM, Technical Editor.

Cut Your Energy Costs With Pfizer's New Fast Dispersing Pure Yellow Iron Oxides

Also make significant labor and time savings, and improve equipment utilization for increased profits.

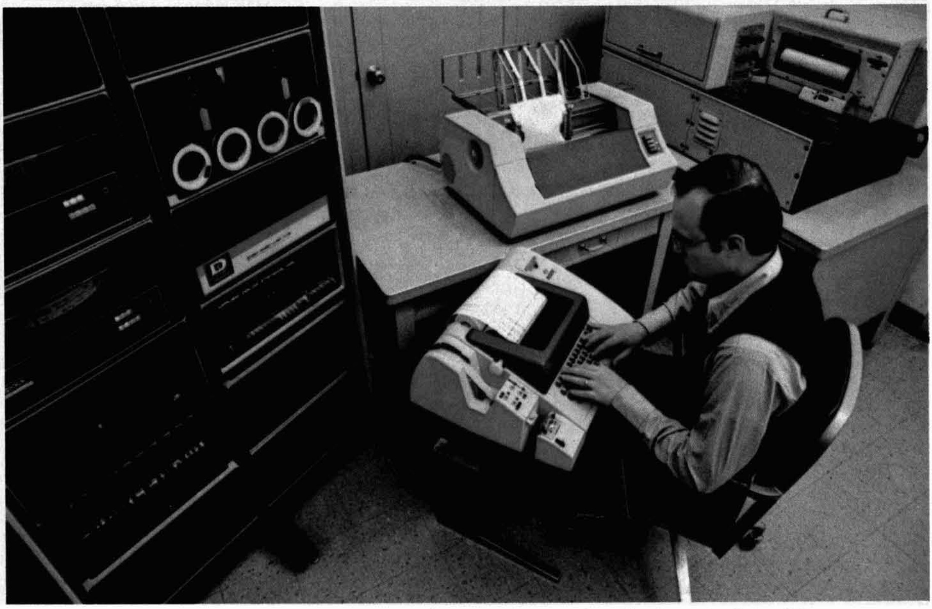
Pfizer's unmatched range of yellow synthetic iron oxide pigments is now available in both standard and new easy dispersing grades.

Unsurpassed in the market place to improve paint manufacturers' profitability, our new "D" grade yellows are produced by a sophisticated method that's the latest achievement of Pfizer's engineering expertise.

These new yellow iron oxides disperse with great ease, speed, and economy. They also achieve almost instantaneous full color development, and high, clean Hegmans.

Pfizer's new "D" grade yellows are offered in shades ranging from light lemon to dark orange. The more popular shades are available in both regular and low oil absorption versions for maximum utility in different formulations.

Their acicular shaped particles are controlled in size to an average of less than one micron, and the uniformity of their color from lot to lot is verified by a sophisticated color computer system.



Pfizer's computer-controlled color measuring system incorporates a Hardy spectrophotometer and Chromascan abridged spectrophotometer, interfaced with a disc-based PDP-11 computer.

Pfizer

MINERALS, PIGMENTS & METALS DIVISION

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Abstracts of Papers in This Issue

AMORPHOUS PRECIPITATED SILICA FLATTING AGENTS FOR COATINGS—H. S. Ritter and H. J. Golden

Journal of Coatings Technology, 49, No. 628, 39 (May 1977)

The properties and performance of precipitated amorphous hydrated silica flatting agents show that this type of silica is ideal for flatting various types of coatings and is at least as effective as other types of silica, either synthetic or natural. The ability of the micro-porous structure in individual agglomerates to cause concentration near the surface of films increases flatting efficiency beyond that attainable from even distribution throughout the film. Easy stir-in dispersion combined with high flatting efficiency provide economies with precipitated hydrated silica that are not achieved with other types of snythetic silicas.

INHIBITION OF YELLOWING IN LINSEED OIL PAINT—H. Rakoff, F.L. Thomas, and L.E. Gast

Journal of Coatings Technology, 49, No. 628, 48 (May 1977)

Ozonized commercial monoolein and acetoacetic ester were evaluated, in several concentrations, as potential yellowing inhibitors for a linseed oil paint. Contrary to expectations, the acetoacetic ester, in which the methylene hydrogens are alpha to two carbonyl groups, was less effective than the ozonized monoolein in which methylene hydrogens are alpha to only one carbonyl group.

REVIEW OF UNDERWATER CLEANING METHODS AND THEIR INTERACTION ON NAVY ANTI-FOULING PAINT SYSTEMS—C.P. Cologer, G.S. Bohlander, and H.S. Preiser

Journal of Coatings Technology, 49, No. 628, 51 (May 1977)

Periodic underwater cleaning of Naval shipbottom antifouling paint systems can maintain high level ship performance with attendant reduction in fuel consumption, for extended periods between drydockings. Power brush cleaning at present offers the most effective method of removing fouling from shipbottoms and restoring the AF surface to toxic levels. Removal of slimes, grasses and early calcareous forms can be routinely accomplished without paint damage. Semi-automatic multibrush vehicles are operational on a commercial basis and are used for cleaning large ships where diver held brushes would be excessively labor intensive. More work is required to address frequency of cleaning, cleaning of sea chests and techniques for underwater repair.

WATER DILUTABLE, DISPERSIBLE, AND EMULSIFIABLE EPOXY RESINS—E.G. Bozzi and R.C. Nelson

Journal of Coatings Technology, 49, No. 628, 61 (May 1977)

Three procedures have been developed for introducing epoxy resins into water-borne ecologically acceptable systems: (1) Epoxy resins modified with hydrophilic moieties that make the polymer water dilutable; (2) Resin/surfactant combinations that can be dispersed in water; and (3) Resin/surfactant/solvent mixtures that can subsequently be emulsified. Each procedure results in systems that have specific advantages and disadvantages. Recently, formulations containing a water dilutable epoxy resin in the aqueous phase and either an emulsified or dispersed resin in the particulate phase were prepared.

Preliminary data indicate that these systems possess the processing and handling properties of standard solvent systems and the performance of epoxy resins.

COATINGS IN TRANSITION—T.J. Miranda

Journal of Coatings Technology, 49, No. 628, 66 (May 1977)

This paper reviews some significant developments which have occurred in the coating industry. These include the evolution of water borne coatings, electrodeposition, radiation curing and engineered polymers.

The impact of a number of constraints are discussed which include government, materials and energy.

An attempt is made to forecast some significant changes in the coatings field specifically for appliances.

Finally, there are discussions of alternatives to porcelain and the profile methodology for improving the transition from laboratory to production of new finishes.

FUTURE OF WASTE DISPOSAL IN THE PAINT AND COATINGS INDUSTRY—E. E. Baumhart

Journal of Coatings Technology, 49, No. 628, 70 (May 1977)

A brief presentation of recent legislation (The Resource, Conservation, and Recovery Act of 1976) and its immediate and future impact on the coatings industry concerning the disposal of waste and hazardous materials is presented. Also discussed are state and local regulations and the relatively new development of waste exchanges.


N6575R

Exhibitors Reserve 95% of Booth Space As Paint Industries' Show Nears Sell Out

Supplier firms have reserved all but a handful of booths for the 1977 Paint Industries' Show, to be held in conjunction with the Annual Meeting of the Federation of Societies for Coatings Technology at the Astrohall, Houston, Texas, on October 26-28.

A total of 110 companies have already purchased 258 exhibit spaces, representing over 95% of available booth space.

The Paint Industries' Show is the only national exhibit of raw materials and equipment used in the formulation, testing, and manufacture of coatings.

Show hours will be: 12:00 noon to 5:00 pm on Wednesday, October 26; 9:00 am to 5:00 pm on Thursday, October 27; and 9:00 am to 4:00 pm on Friday, October 28.

Program Highlights

Program Chairman Elder C. Larson, of Shell Development Co., Houston, and the members of his Program Steering Committee are developing presentations around the theme, "Energy Efficient Coatings," and to date, nine papers have been selected by the Committee for presentation:

"Micro-Emulsions, a Means to Replace Solvents in Paints"—Dr. Stig Friberg, of the University of Missouri-Rolla.

"Economic and Energy Savings Through Coatings"—Harold R. Powers, of Sherwin-Williams Co.

"Surface Preparation Profile for Anti-Corrosive Coatings"—John D. Keane, of Steel Structures Painting Council.

"Energy Savings Opportunities in Coatings Manufacture"—Tom Greer, of PPG Industries, Inc.

"Polyurethanes as Energy Efficient Coatings"—J.C. Hixenbaugh, of Mobay Chemical Corp.

"Conservation—Higher Solids—Lower Energy"—G.H. Wilhelm, of Ashland Chemical Co.

"Energy Conservation Utilization Coupling Agents"—Al Mersberg, of Briner Paint Manufacturing Co.

"Specular Reflectance Infrared Absorption Measurement of Phosphate Coating Weight"—G. Dale Cheever, of General Motors Corp.

Registration Fees

Advance registration will be available for $35 for members and $50 for non-members. Regular on-site registration will be $40 for members and $55 for non-members.

The fee for Ladies' Activities will be $20 in advance, and $25 on-site.

There will again be a special $15 advance registration only fee for retired members.

"Photodegradation and Photoxidation of Paint Film Surfaces by Singlet Oxygen"—Dr. Bengt Ranby, of the Federation of Scandinavian Paint and Varnish Technologists.

The Houston and Dallas Societies for Coatings Technology will serve as joint hosts for the event—the first ever to be held by the Federation in Texas.

Other featured program presentations will include:

- Mattiello Lecture by Dr. Walter K. Asbeck, Coatings Consultant.
- Keynote Address
- Constituent Society Papers
- Roon Awards Papers
- PRI Seminar
- Manufacturing and Education Seminars

1977 Paint Show Exhibitors to Date

Abbott Labs., Chem. Div.
Air Products and Chemicals
Alcan Metal Powders
Alpine American Corp.
C. M. Ambrose Co.
American Nepheline Corp.
AMF Cuno Div.
Amoco Chemicals Corp.
AMSCO Div., Union Oil Co.
Applied Color Systems, Inc.
ASARCO Incorporated
Ashland Chemical Co.
Atlas Electric Devices Co.

B.A.G. Corp.
BASF Wyandotte Corp.
Bennett's Colorant Div.
Big "H" Equipment Corp.
Brookfield Engineering Labs.
Buckman Labs., Inc.
Burgess Pigment Co.
Byk-Mallinckrodt Chem. Prod. GmbH

Cabot Corp.
Carborundum Co.
Cargill, Inc.
CDI Dispersions
Celanese Chemical Co.
Chicago Boiler Co.
Cities Service — Columbian Div.
Color Corp. of America
Cosan Chemical Corp.

Daniel Products Co.
DEGUSSA, Inc.
Desert Sunshine Exposure Tests
Diamond Shamrock, Process Chem. Div.
Diano Corp.
D/L Laboratories
Dresser Minerals

Eastman Chemical Products, Inc.
Ebonex Corp.
Elcometer International Ltd.
Engelhard Minerals & Chem. Corp.
Epworth Mfg. Co., Inc.

Filter Specialists, Inc.

GAF Corp.
Gardner Lab., Inc.
Paul N. Gardner Co.
General Mills Chemicals, Inc.
W.R. Grace & Co., Davison Chem. Div.

Halox Pigments,
Harshaw Chemical Co.
Henkel, Inc.
Hercules Incorporated
J.M. Huber Corp.
Hunter Associates Lab.

IMC Chem. Ind. Groups, Inc.
Interstab Chemicals, Inc.

Johns-Manville

Kelco, Div. of Merck & Co.
Kenrich Petrochemicals, Inc.
Kerr-McGee Chemical Corp.

Labelette Co.
Leneta Co.

Macbeth Div., Kollmorgen Corp.
Malvern Minerals Co.
Mateer-Burt Co.
Meadowbrook Corp.
Merck Chemical Div.
M&M Machine Inc., Vorti-Siv Div.
Modern Paint & Coatings
Montedison USA, Inc.
Morehouse Industries, Inc.
MRM/Elgin, Domain Industries
Myers Engineering, Inc.

Nalco Chemical Co.
Neville Chemical Co.
New Way Packaging Machinery
Netzsch Brothers, Inc.
N L Industries, Inc.

Pennsylvania Glass Sand Corp.
PFD/Penn Color, Inc.
Pfizer, MPM Div.
Polyvinyl Chemical Industries
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Productos de Zinc y Plomo

Q-Panel Co.

Reichard-Coulston, Inc.
Reichhold Chemicals, Inc.
Rohm and Haas Co.
Russell Finex, Inc.

Sales Y Oxidos, S.A.
Shell Chemical Co.
Sherwin-Williams Co.
Silberline Mfg. Co., Inc.
Spartan Color & Chemical
Spencer Kellogg Div., Textron, Inc.
Sun Chemical Corp., Pigments Div.
Synres Chemical Corp.

TAMMSCO, Inc.
Tenneco Chemicals, Inc.
Tokheim Corp.
Torco Engineered Prods. Div.
Troy Chemical Corp.

Union Camp, Chemical Div.
Union Carbide Corp., Chem. & Plastics
Universal Color Dispersions

R. T. Vanderbilt Co., Inc.
Viking Pump Div., Houdaille Ind., Inc.

Warren Rupp Co.
Wilden Pump & Engineering Co.

After Channel Blacks... What?

The last U.S. Channel Black production facility has shut down. Fewer grades are available in Europe. What can Channel Black users do?

For years high-color channel blacks were considered irreplaceable as colorants in coatings such as automotive lacquers and enamels, where extremely dark, jet color is required.

But a decade ago Cabot scientists, realizing that channel blacks would someday be phased out, began developing new high-color furnace blacks that would serve as effective replacements.

The result . . . MONARCH®/BLACK PEARLS® 1300 — furnace blacks uniquely qualified to replace — and improve on — obsolete channel blacks. Throughout the coatings industry these new blacks have taken over for BLACK PEARLS 607, BLACK PEARLS 2/46/46X and CARBOLAC® 2/46, which for years were considered industry standards in applications involving critical masstone jetness. Compared with the old blacks they replace, they provide equal or superior jetness, a brilliant, sharp gloss, and excellent viscosity stability.

Best of all, Cabot's MONARCH/BLACK PEARLS 1300 cost less. And of course, *availability* is assured *anywhere in the world.* For complete details, send for Technical Service Report S-23A.

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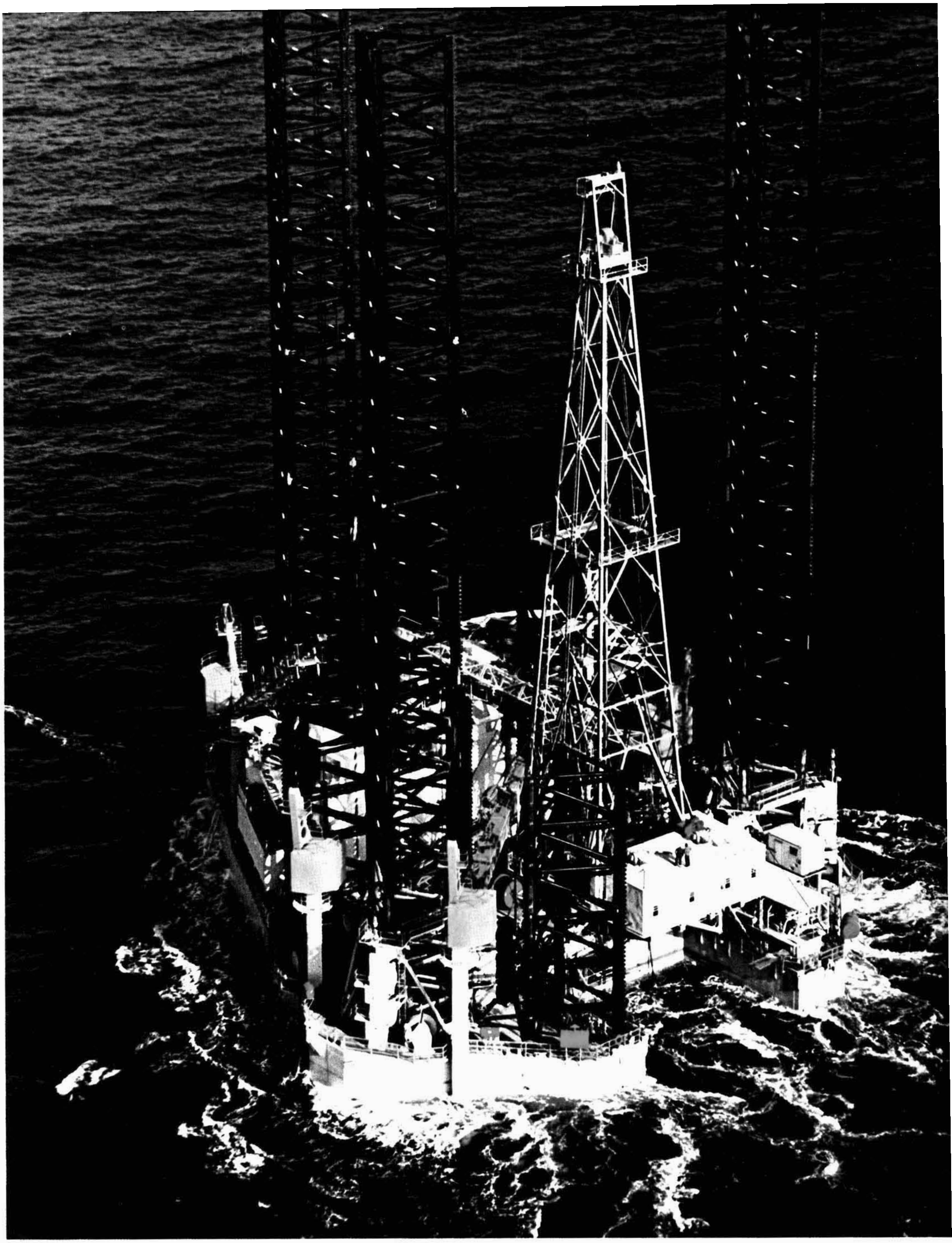


RHOPLEX®

Latex paints made with Rhoplex acrylic emulsions provide excellent corrosion protection on offshore oil drilling rig.

On the rig* in the photo, many metal parts of the platform are coated with latex paints based on Rohm and Haas Rhoplex acrylic emulsions. The paints were made by Porter Coatings, Division of Porter Paint Company. Coated parts include steel superstructures, deck housings, railings, plus walls and ceilings of living quarters. The acrylic paints were applied over conventional and zinc-rich primers. The rig was constructed in 1974-75. Paints were inspected in March 1976. All were in very good condition.

A paint that holds up in the fiercely corrosive environment that an offshore drilling rig calls home is a good bet to be a winner in almost any maintenance or marine application.

Rohm and Haas offers 4 latex maintenance paint polymers: Rhoplex MV-1, Rhoplex MV-17, Rhoplex MV-2, and Rhoplex MV-9. All provide excellent corrosion protection and weatherability. The last 2 are second-generation polymers. Improved properties offered by one or both include flash-rust resistance, solvent resistance, and hardness allowing formulation of gloss topcoats.

Like more data and performance proof? Call or write for polymer literature and an appointment to tour painted equipment at our Philadelphia and Bristol plants.

*Photo shows rig being towed, with legs in raised position. Rig is put into operating state by lowering legs and raising platform above water. Rig in photo is owned by Field International Drilling Offshore. Is currently in operation on west coast of Africa.

ROHM AND HAAS
PHILADELPHIA, PA. 19105

corrosion protection

ACRYLICS

AROBRIEFS

NEWS FOR ALL
COATINGS FORMULATORS
ASHLAND CHEMICAL COMPANY
RESINS & PLASTICS DIVISION

Ecology and Economy.
You benefit both ways with water soluble primers.

20 years ago we introduced our first water soluble industrial primer resin. Probably ahead of its time, that first resin system offered users ecology and economy benefits important to all of us today.

Benefits such as ecology-safe coatings that can meet today's stringent clean air and worker environment regulations. And the economy of energy conservation through lower temperature cures and reduced metal pretreatment drying requirements. Although that first resin system is no longer available—our 20 years' experience has led to improved products for specific needs—those same benefits are available in primers formulated with Ashland's new generation of water soluble primer resins.

Arolon 525 Red Primer
Brown rust inhibitive bake primer
Formula (031412-P1441A)

Lbs.	Gals.	
125.26	14.40	Arolon 585-W-43
52.40	1.22	Synthetic Red Iron Oxide[1]
1.05	.07	Lampblack
78.59	2.31	Basic Lead Silico Chromate[2]
104.79	2.88	Micronized Barytes[3]
52.40	2.33	Micronized Talc, Western Type[4]
34.93	4.19	Deionized Water
Pebble Mill 18 Hours and Add		
62.60	7.20	Arolon 525-W-37
Mix 15 Minutes and Let Down With		
438.03	50.35	Arolon 525-W-37
56.59	7.73	Butoxy Propanol[5]
2.10	.27	6% Manganese Naphthenate
58.68	7.05	Deionized Water
1,067.42	100.00	
	48.8	Percent Nonvolatile
	150.	Approximate Yield in Gallons
	1.25	Pigment/Binder by Weight
	30.50	Viscosity #4 Ford Cup Seconds

[1] R-2199 (Pfizer) or equal
[2] Oncor M-50 (National Lead) or equal
[3] Primex (Delore Div.. National Lead) or equal
[4] #399 Lo Micron (Whittaker-Clark-Daniels) or equal
[5] Propanol B (Union Carbide) or equal

Thin Film Performers

For example, AROLON® 507 primer resin has been designed for excellent thin film performance. In fact, it delivers equal protection to our first system, but at only 20 percent of the film thickness.

Typical performance properties illustrated in the photo at right are 250 hours salt spray at 0.2 mils—proven by millions of gallons of paint.

Flow Coat

Our 20 years' experience has also led to resins designed to solve particular problems. AROLON 525, for example, was designed to reduce the foaming on flow coating lines. It worked, and is still working, and has provided other benefits as well. One customer has reported that a formulation based on AROLON 525 has helped reduce his gas consumption in the metal pretreatment area because no metal drying is necessary prior to paint application.

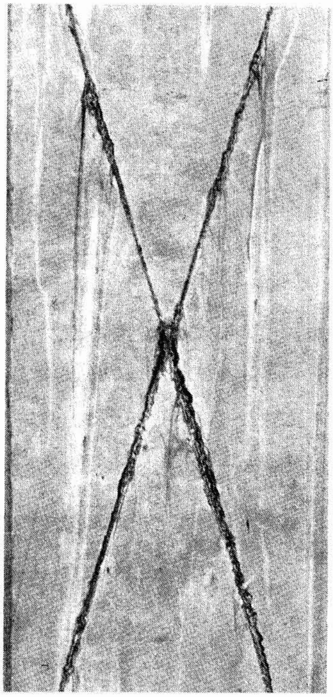
Air Dry or Low Bake

When some customers couldn't cope with baking requirements, we designed AROLON 376 for versatile air dry or bake primers or top coats. And since that wasn't fast enough for some, 'lacquer-like dry" AROLON 585 was developed, and serves as a modifier.

When cost became a problem for some, lower cost AROLON 378 was produced as the soya counter to AROLON 376. Still offering the excellent performance properties but at lower cost. And AROLON 969 water-dispersible copolymer reduces costs two ways, as a lower cost resin, and in shipping (no water).

Don't Get Pushed

Don't get pushed into water, make the decision yourself. And a switch to water soluble primers (or top coats) may be the way for you to start reaping the ecology and economy benefits from water based resins. And Ashland has the right resin for your formulation. Write for more information: Resins & Plastics Division, P.O. Box 2219, Columbus, Ohio 43216.



Ashland

Ashland Chemical Company
DIVISION OF ASHLAND OIL, INC.

Organizing For Action and Success

Robert A. Roland
President, National Paint and Coatings Association*

INTRODUCTION

After accepting President Dunn's kind invitation to be your Keynoter, I thought a little bit about what a keynote speaker is supposed to do. He can motivate, he can excite, he can anger, he can inform. But best of all, he should focus on some of the thoughts, some of the actions which concern your group. In other words, he is a "fall guy" Your Board of Directors asks him to tell you the things that they are not too sure they want to get involved in. Now that is a good keynote speaker. A bad keynote speaker would talk about something totally irrelevant which would give you a warm feeling, but not help you an awful lot in the jobs that you have ahead.

You have a big Paint Show and I think too many people look at the mass of exhibits and lose sight of the fact that the heart of the Federation is not the Paint Show; the heart of the Federation is the men and women who do the work—the technical papers, Board meetings, Society meetings, Council meetings. That is the heart of the Federation, and so I will address myself to some of the things that I think ought to be, and maybe are concerning you.

Every keynote speaker has to have a speech title, I have selected a title, completely opposite to what you have probably read in your publications. Organizing for Action and Success.

Organizing for action and success—the temptation to say organizing for action and survival was almost overwhelming, but that is a negative type of thing. When we start an Annual Meeting, we ought to be positive, and I think we have a great deal to be positive about.

We are now five days away from a national election in this country; what they call a quadrennial silly season! One of the things that you have heard a lot about in the media is voter apathy. They have been running polls all over the country and they have come up with the conclusion that most of the people just don't care.

They took one poll on the south side of Chicago, and interviewed a great many people, the comments were something in the order of, "What difference does it make who gets elected? Nobody is going to listen to me anyway." "Oh, this is just the same old stuff that I have heard before." "Well, why don't you register?" I don't really care who gets in. It is not going to make any difference."

The term that is applied to that is "apathy." but this is an apathy that does not reflect an uncaring. Rather, this is an apathy that reflects something deeper and more important; it is a matter of having been disappointed before, of having been frustrated.

We constantly hear the word involvement. Everybody should get involved. The important question is, "involved" on whose terms?

I am always interested when I hear the political ads on TV, the ones in which the candidate says in very sober terms that we've got to do something about the special interest groups. Well, when the National Education Association endorses a candidate, that is not a special interest group. When the AFL-CIO endorses a candidate, that is not a special interest group. But if the Federation or the Association of Pickle Packers goes down and says, "Damn it all, we don't like what you are doing," *that* is a special interest group!

Recently, I had a call from a candidate's man in Washington who asked me, "Are there any messages that you would like me to carry back?" I said, "Yes. I have one that you ought to listen to very strongly. Every time you say 'special interest group,' you are cutting out half of the population in the United States, because that is how we organize ourselves to talk to politicians. Just because you like one group over another shouldn't give a connotation to the group you don't like—special interest group."

The first amendment belongs to all of us. It is only when you don't know how to get involved, or it is difficult to get involved, or you have seen too many unkept political promises that you get turned off, frustrated and say, "I don't care." That is apathy.

If we allow politicians to frustrate us, it's our fault. The worst way to respond to this frustration is to do nothing. That is precisely what they would like you to do. Then they can work their will without any outside interference whatsoever.

Looking at it from the positive standpoint, we know that involvement does work, if you can find the right vehicle. The Youngstown steel case in April is a good illustration. Youngstown is Big Steel, so they have got to be the bad guys from the start. There is no way you can be a steel company and be a nice guy. All of a sudden, we read in the *New York Times, Washington Post* and other national publications that the people in Youngstown, Ohio were out in the streets marching. They weren't marching against Youngstown Steel; they were marching for Youngstown Steel. Their signs said, "Jobs, not fish."

The EPA had leveled an environmental restriction on the water quality in Youngstown which could not be met by the Youngstown Steel Co. This was a river where, literally, if you

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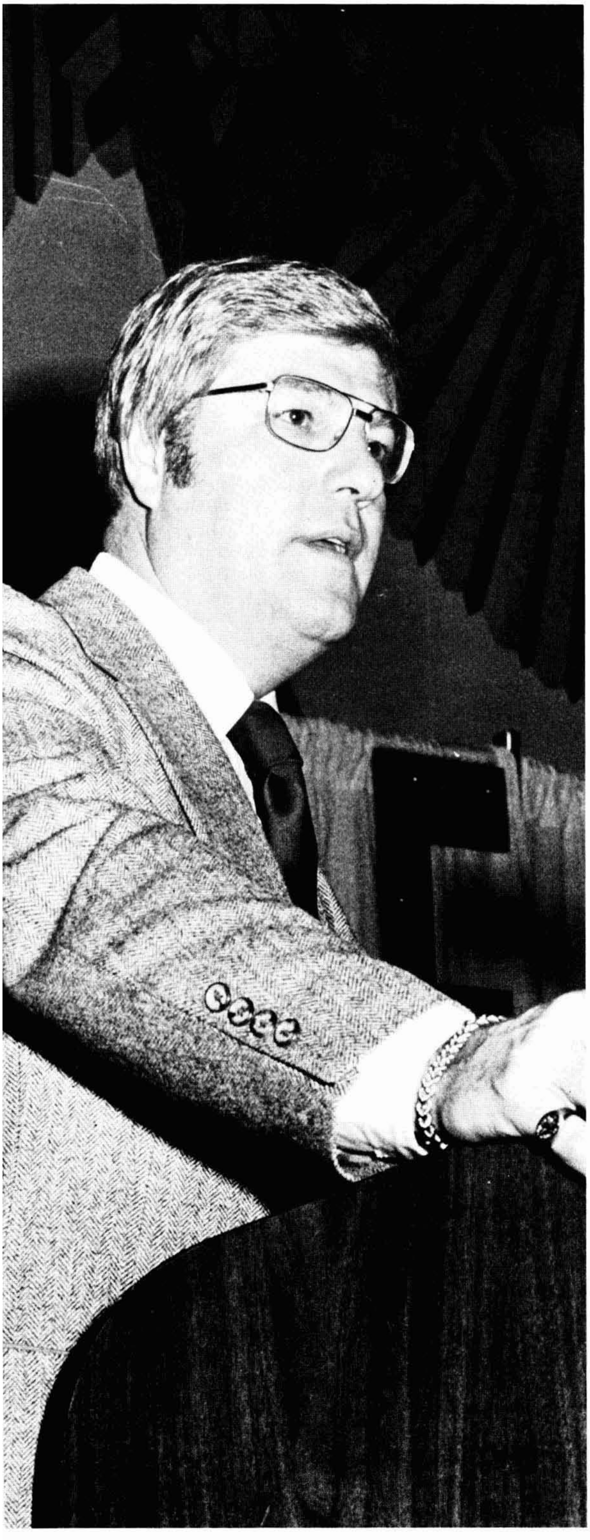
Presented at the 54th Annual Meeting of the Federation of Societies for Coatings Technology in Washington, D.C., October 27, 1976.

*1500 Rhode Island Ave., N.W., Washington, D.C. 20005.



wanted to impress people, you could walk on water; it was not very viscous.

When the people found out that their jobs were in jeopardy because of the EPA's regulation, they went to the barriers. They said, "Listen, we don't want to fish. We don't care about the fish. We can't feed our families on dead fish, and can't feed our families at all without jobs."

So the private sectors, the ministers, the business community, the retailers, everybody got together and produced some data. They put up some money, analyzed the time tables, and then went to Russell Train (EPA's Administrator) and said, "We can't live with this."

Mr. Train knows the alternatives when he sees them, and this was an alternative that even he could see. And so, the people in Youngstown got their reprieve, and their new compliance time table.

We went through the same thing in the coatings industry with the air quality standards which were going to be implemented in the State of New Jersey for stationary sources. We got our allies together. We testified, our members testified, the Federation testified, we presented the data.

Our staff involved the right people in the New Jersey proceedings—our customers. The result was that New Jersey decided not to move the plan forward. Involvement does work.

Take the mercury case. It is easy for people in political positions to say that a substance is bad. Mercury is mercury, what the heck, if it killed people over in Minamata Bay, Japan, it has to be bad over here. But there are different kinds of mercury and different circumstances. Our job was to gather the data and present that information in a meaningful way. We had to involve the right people. We did just that. In this case, again, the EPA Administrator found against us, reversing the administrative law judge who found that phenyl mercuric acetate was not harming either the environment or individuals.

So once again we went back to EPA and pointed out that we were on our way to the Supreme Court of the United States. Since the Administrator had not reviewed the record, we suggested that he do so.

How did we know that he hadn't reviewed the record? One of the interesting things in this case was that in the middle of the testimony, the star witness for EPA was called and gave his whole presentation. We then cross-examined him. After we were finished, EPA said, we would like to withdraw the testimony and cross-examination of the chief prosecution witness. That is how good the EPA case was!

Involvement does work, and I could go on and cite a litany of illustrations. There are some examples apparent in every environmental area where people recognize that the name of the game for economic security and progress is jobs.

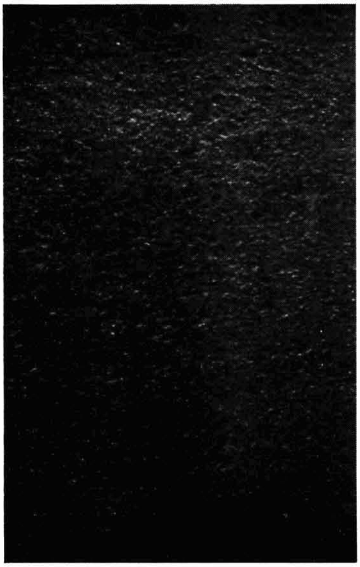
The question becomes, how do you get involved, when do you get involved, why do you get involved, and with whom do you get involved?

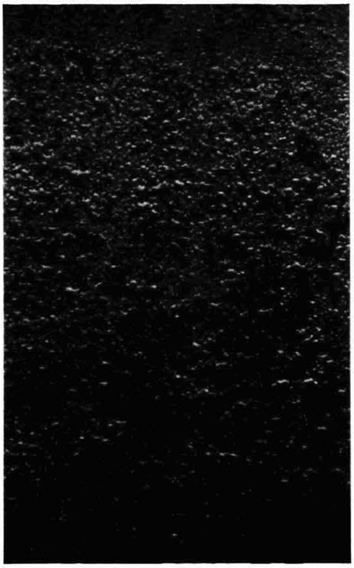
In this respect, the need we face is one of organizing for action, hence the title, "Organizing for Action and Success." How can we meet the problems we face with an informed and involved resource?

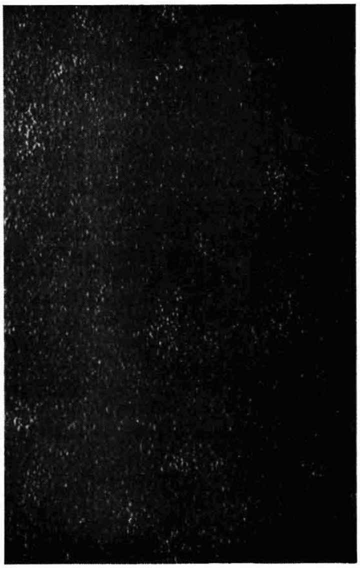
PROBLEM SOLVING— AN ORGANIZATION'S PURPOSE

Organizing for problem solving is the definition of an association or a society. Your organization, my organization, are vehicles for problem-solving. It is that simple.

When you break down the problem-solving technique, you end up with three basic components. First, understand the problem; second, develop a solution with a sound data base;







and third, communicate the solution with credibility and forcefulness to the right people.

Understanding the Problem

These are the three things that we are trying to do. Let's take a look at them. What is needed to understand problems? It might surprise some people, but I believe that good organizations are willing to, and capable of, looking at more than one side of an issue. Being a special interest group doesn't mean that our minds are channeled in only one direction. It is our responsibility to point out both sides of the issue and understand what the quid for the quo may be. We learned a long time ago in business that there are some equities on our side just as there are some on the government's side. What we need are professional resource people, people who have the ability to understand our industry.

For example, if we believe that the imposition of regulations in an unfair, heavy-handed manner is our biggest problem, then we should also believe that we know more about our industry then the government. Therefore, we should analyze the problem and come up with a constructive solution. This is complex because the regulatory problems that we face are complex. We need professional resource people. They have got to be knowledgeable people and they have got to be available whenever we need them and in every size, shape and form. It takes lawyers, technical people, communicators, and production people. It takes every aspect of our industry to understand what the nature of the problem may be. It takes organization of these talents through committees, task forces, and ad hoc groups—whatever they may be, and whatever is needed to get the information to understand the problem. It takes outside information because we don't operate in a vacuum.

One of our big mistakes is that we have talked to ourselves so often that we can't understand why others don't understand us and our problems. We haven't had a lot of practice talking with outside people. Consumers have organized themselves into a movement called "Consumerism" because we didn't do it. If we had, the consumers would be in our operation, not in some other places. We build these little dichotomies as we go along because we don't appreciate the other guy's position.

We have got to develop sound date bases. We have got to know what we are talking about. I am fond of the expression that bull does not beat brains and it hasn't for a long time, if it ever did. What happens today is that the Federal government takes our tax dollars, goes out and does $10 million worth of research and promulgates, not a study, but a rule-making procedure. Or they propose a law which can be dropped in the Congressional hopper. You then have a certain period of time in which to respond to an action that already has started with a complete data base behind it. Try to respond to it in 90, 60, or 30 days. You can't do it.

We have got to have our own data organized.

Developing Solutions

We are talking about both technical and economic data. In our industry we have lived far too long without this kind of good information. It is not cheap, is not easy to come by, but is absolutely necessary. When we had wage and price controls some time ago, we found out that we didn't know an awful lot about the coatings industry at all. In fact, the whole petrochemical industry knew very little about its economies. They are still trying to describe aspects of their industry to the Federal government.

But we were fortunate enough to have access to Stanford Research Institute. We have put together a program called the Data Bank, an input/output matrix. We have studied all of the generic raw materials and their precursors that go into the coatings industry. We have studied all of the products that come out of the other end and where they are used. We have done it in the areas of resins, solvents, pigments, and additives.

The SRI Data Bank report is very useful, because the government might get an idea that one of these raw materials which we consider essential is a hazard which should be banned. That determination may be easy for the government, but what does it do to the coatings industry? Our Data Bank gives us the opportunity to evaluate our need for that raw material and to tell the government its role in the total Gross National Product.

Take titanium dioxide, for example. The kind of logic that flows through the minds of activists is, "There is so much of it around. There must be something wrong with it, if they are using that much. We ought to investigate titanium dioxide."

You know what would happen to the coatings industry if we had to face up to a titanium dioxide ban. But to tell the government, "You can't do this. You will put us out of business," is simply not enough. What we can do now is say, "There are X million of dollars worth of this sold; that is converted into X billion dollars worth. Those X billion dollars of coatings go on XXX billion dollars worth of automobiles, furniture finishes, appliances, houses, capital construction, and X number of jobs are involved."

That is a data base which tells them what the total input of a decision is. It shapes the issue in a way they can understand.

One of our basic principles is that political decisions ought to be based upon good, sound data, not emotions.

In the technical area we have another interesting project which has just been finished. This is an $85,000 feasibility study on whether the coatings industry can undertake occupational health, epidemiological studies.

When I said problem solving today is complex I wasn't kidding. In the old days we would think we deserved a halo or the Nobel Prize if we spent $85,000 on a study. Now we spend $85,000 just to find out whether or not we can spend more money.

We found out through this study that the coatings industry *is* capable of doing the mortality, morbidity, and environmental studies which are necessary to position ourselves on the issue of occupational health. These worker's health studies will help us respond intelligently to any rule-making or legislation that will surely come. It will also help us determine if we have problems. The research is complex because we are operating in areas where protocols are still being discovered and developed. There is tremendous need for innovative technology in this area, and there is a tremendous need for managerial commitment to operate programs of this kind. When you are spending vast amounts of money to find out what your problems are, we need managers who understand where the money is going.

One of the things that we have noted is that industry can and must communicate with objectivity and forcefulness. Credibility is available to us, but credibility must be supported by this data base and by a complete understanding of our problems.

Our credibility has been demonstrated strongly in the air quality area. We went through a complex problem solving procedure 6 or 7 years ago in our Smog Chamber research. We bought the research from Battelle Memorial Institute which gave us the "credentials" for sitting down with the people in government. From that point on we were in, we were part of the club.

We worked hard. Our Air Quality managers and task force


NiPar S-30
NiPar S-30

members—all of the people in the coatings industry with expertise contributed to the development of solutions. We developed a dynamic data base.

Today, we don't have to spend vast sums of money to acquire air quality information. We don't have to go to Battelle. We don't have to go to Stanford Research Institute or anybody else. We developed a system to bring the data from the companies in the industry to the task force, and then to the government. This is the way it ought to be—first-hand intercourse between government and industry with the good data being pushed right up front. It is the most economical, the most effective way, but you can only evolve to that position by doing your homework. A dynamic data base is essential to us.

When we talk about data base, one of the concepts that has been discussed recently is that of a resource center. There are both advantages and disadvantages to this concept. I think the concept of a resource center is the right kind of thinking for this time. Our informational needs and the timing for these needs are so great, that we ought to consider this type of methodolgy. What do I mean by a resource center? When we first asked SRI to create our economic data bank and the occupational health research programs, we were very interested in their ability to do multi-disciplinary research. This means that they have the ability to look at all sides of the issue. Whether it is economic, energy, manpower, petrochemical or raw material inputs, SRI has the capacity to weigh the facts and put all of them into the solution. The need for an industry like ours to have that kind of resource is great.

One of the problems in creating it in one place, perhaps with one research organization, may well be the political overtones. We live in a very pragmatic world, and the fact is that there are research organizations that have developed a special expertise in a given area. There are research organizations that are holding open end contracts with the Consumer Product Safety Commission, EPA, or FDA. Research organizations which hold these contracts develop a degree of specificity and objectivity that is helpful when doing business with government agencies. Some may be unwilling to give their efforts to a resource center such as I have suggested. I think we ought to weigh this concept very carefully.

Communication is the Key

The final part of the problem-solving technique is communicating with the right people in a credible and forceful manner. This is not an easy thing to do. It is probably the most frustrating part of all. On the lead-in-paint problem, we have testified no fewer than ten times before the Congress of the United States, the Consumer Product Safety Commission and the Department of Housing and Urban Development. It is almost unbelievable how frustrating this process can become. Yet, over a month ago one more hearing before the Consumer Product Safety Commission was scheduled which appeared to be almost routine. The NPCA staff gave strong consideration to not testifying. "Why bother?" we said. The law says if CPSC doesn't do anything, the lead level is going to go to 0.06%.

Well, you don't win battles that way; you don't make friends; and you don't educate people. A big part of this job is education. So we built up our courage one more time and spent about 100 extra hours trying to look at the situation, position ourselves, analyze the data and find out what was happening. We testified.

My heart dropped when I walked into the hearing room. Of the four commissioners who are now sitting, there was one commissioner who was favorable to us in the past, and three who were unfavorable. Guess which three commissioners were there! Right.

We testified for two-and-a-half hours; we presented a position apparently which they had never listened to or heard before. It was all brand new to them. And for the first time they realized that maybe the coatings industry had a point; maybe there was something here that they had overlooked. (Our hopes were premature, because the CPSC decided in December 1976 to let the lead level go to 0.06% in household paints after June 22, 1977).

You have to be prepared to fight these battles, if only to gain time. We gained six years on the lead issue. You have to understand press relations. You have to have internal and external communications, not only to disseminate your policies, but to help people understand them. You have to have experts.

One of the great defections in the business community is the defection of the technical community from the needs of the industrial community on problems like air and water quality, consumer product safety, etc. You cannot divorce yourself from us. You cannot live in a vacuum. You are in an industry. You are in an economy, and you have a job to do. I suggest that your jobs, all of our jobs, are being threatened right now, and I suggest that the economy is being threatened. Nobody has a greater credibility, a greater understanding than the technical community. But no part of the business community has shown less courage than the technicians who do not want to commit themselves, or position themselves.

The luxury of laying back is the luxury of the 60's when the kids tuned in, turned on and dropped out. It is not the time for anybody to drop out. We have got to put it all up front. In the coatings industry which is based on technology, you should be in the forefront of that job.

More and more, our need is for effective intelligence gathering and analysis. In NPCA we are spending literally millions of dollars developing intelligence,—information that is correctly guiding our decision-making. And much of that information is technical, and you must have a bigger role in the acquisition and analysis of technical intelligence.

LOBBYING—INPUT FOR PROGRESS

There is one other aspect of communications that I think is equally important. It is political action. Political action is primarily communication. It requires action from both the top and from the bottom, at the top you need effective lobbyists.

Does anybody think that lobbying is dirty? It is not. Does it embarrass you to be called a special interest—a lobbyist? It doesn't embarrass me one bit.

When I testified before the CPSC on the lead issue, I called the people who testified from Consumer's Union just what they were — lobbyists, the same as we are. So are the medical people and the research lobbyists. Incidentally they are looking for more and more money to do more and more research. They would like us to believe their motives are much higher and grander than ours, but I haven't found anybody in our industry who wants to kill anybody, to hurt somebody, to put a rotten product on the line. Quite the contrary, I think we are very proud of our history and the effectiveness of our products.

Getting back to lobbying, you must lobby and work with the committees. You must work with the Senators, the Congressmen and all of their staffs. You must have grass roots involvement. This means you. You know where the tax base is—back in the county. You know where the votes come from—home. You know who has a vote—you do.

Do you consider yourself a lobbyist? You ought to. Your involvement in the Federation and your company gives you insights into the problems of the industry. Those insights should be translated into political action.

Have you ever talked to your Congressman or your Senator about the problems of the coatings industry? You should, because your job depends on it. Have you ever talked to management about inviting Congressmen to your plant, to show them how hard you have worked to make the products of the industry as good as they are? Or about how difficult it is to make the changes which seem simple in Washington, but aren't when you put them in a production line where you are producing thousands of gallons a week, where the tolerances for mistakes are quite small, where the demands of the end-user are quite high? I don't think that Congress understands that.

That is political action. That is communications. That is your job.

I am pleased that there are other structures that are available today—local societies, local associations, corporation political action committees. These are ways in which you could easily get involved. In addition, NPCA has developed task forces which are geared to single objectives such as air and water quality, metrics, products and occupational safety, and so forth. The task forces have a concentration of talent, dollars, and staff support to solve problems. It is easy to get involved in a task force. It takes time, but it is highly rewarding.

Our committee work is very productive and very hard nose.

On the political side is PAC PAC the Paint And Coatings Political Action Committee. PAC PAC was created in the NPCA as a funnel for individual money contributions for political action in Washington and in the states.

Moreover, local associations are given specific assignments to work in state capitals on legislative and regulatory issues. Local associations are brought into our grass roots action concept with specific training on how they can get the resources they need and how they can accomplish solutions. Yes, we have made it easy to get involved. We have provided many avenues of entry.

When to get involved, or timing, is an important part of the overall strategy. We have staff and committees spending a great deal of time finding out exactly what the involvement timing should be, how the strategy should be put into place. A lot of it is thrust upon us with specific response deadlines but the involvement deadline must be thought out.

Why get involved? We try to explain to all members of our Association and in fact, to the whole industry, what the impact of an issue is in terms of economy, jobs, products, sales, and profit. We try to explain what it is going to do to you if a regulation or law goes into effect. We try to help you understand why you should get involved. In a word, it is survival.

We sometimes lose sight of the impact of what government does. We get that same kind of apathy that I talked about earlier, that apathy of frustration, because we have been turned off. We ought to pick up a history book and read it, to get our perspectives one more time. We think that we are so put upon, that it has never been worse than it is now. I saw a file the other day with a notice on toxic substances legislation; special notices went to the NPCA Board of Directors and Executive Committee. The notice was written in 1938 by Ernest Trigg. Last month the Toxic Substances Control Act was passed into law. It is nothing very knew, but sometimes we lose our perspective.

One of our founding fathers, Thomas Jefferson had this to say, "If we could prevent the government from wasting the labors of the people under the pretense of caring for them, they will be happy."

I can buy that. Consider the following: the single largest item in the family budget in the United States for the fiscal year 1977 will be taxes, Federal taxes. The average family will pay $5,328—an increase of almost 99 percent in the last decade. Federal government doesn't make money; it spends money—your money.

There are 12,000 statutes currently on the books of the United States of America that contain the word "report"; 12,000 laws require a report. That does not include the Internal Revenue Service.

There are in Washington right now 100,000 people working in regulatory agencies. There are 10 billion sheets of paper that go into the Federal agencies every year. The General Accounting Office found that it took 2.8 billion pieces costing $440 million to generate those 10 billion sheets that came back in. The annual cost of paperwork processing in the Federal government is a minimum of $40 billion a year. You could take $120 billion, which is the largest figure that was found in one government study, and if you capitalized that, you wouldn't have a capital formation problem in the United States in the next decade. You can translate that directly into jobs. That is the impact of government; that is the impact of regulations.

With whom should we be involved? Certainly, we should be involved with people who have like interests. You and I could probably sit together and come to the right conclusions for the coatings industry. Who else is involved? The managers, the production and sales people, the manufacturers, the dealers and applicators; the unions—all the people who derive their living from the coatings industry ought to be actively involved in the problems and their solutions.

The other thing that an Association does is provide an ethical forum for the discussion and resolution of problems. This is very important. Sometimes we close our minds to our allies. We have had very rewarding experience with the Painting and Decorating Contractors of America, and the International Brotherhood of Painters and Allied Trades. We are working on a joint safety and health committee with them right now. There was a time not long ago when we weren't working together. We work together now, and that is the way it has to be because our survival depends on the health of our industry.

When we compare the organizations of the industry, we find that we do have problem-solving vehicles which permit easy and rewarding involvement. We have organizational structures which are germane to the problems that face the industry.

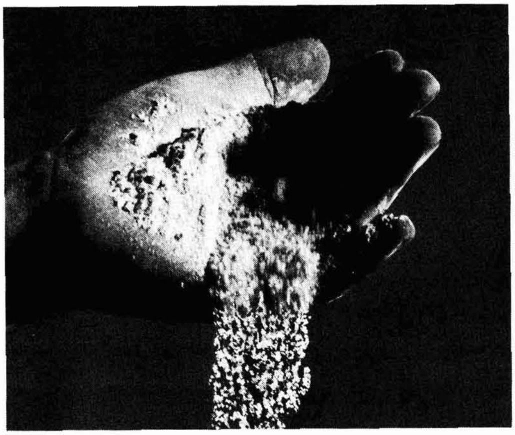
THE FEDERATION—AN ORGANIZATION FOR ACTION AND SUCCESS

Now, as your keynote speaker, I know that uppermost in your mind as my audience is: what should you do, where do you fit into this picture, what is the challenge for the Federation? Where does or where can the Federation fit into this formula? I have been looking at the Federation and working with it for 19 years. Many of the things that I have just talked about apply to the Federation.

For example, the dynamic information or data source. Certainly, the Federation can provide that kind of input. You can organize within your own company, you can assess and correlate within your local Societies pertinent data dealing with every major issue that faces the industry today. You can be a dynamic data source for political action.

I don't think you want to drop out. I don't think you don't give a damn. I think you care very much. I just think that nobody really made it easy enough for you to understand the issues. You have tremendous political action potential. You have informed men and women working in those Societies. This is a mechanism that ought to be employed as a structure for political action.

Communications. One of the most difficult things to achieve in the communications area is to testify effectively



before the Congress or an agency as an expert witness. Now that doesn't mean that you are all qualified to do it. I submit that most of you aren't. But you have something else. You have the brains; you have the understanding of the issues; you have the raw materials that can be developed into that kind of expert testimony. You have great credibility. And we have used that credibility time and time again but you haven't organized it yet. That is surely something that the Federation can do. Most of the managers of the industry are technical by background. Most of you are involved in all aspects of the industry. Most of the problems that we face are environmental, whether they be occupational environmental, or physical environmental. That is your ballgame. You know what the products are, what goes into them. You know what is good and bad about them. That is your training. It seems to me there is a very logical place in this "Organizing for Action and Success" for the Federation of Societies for Coatings Technology.

Right now the Federation is not quite sure what its mission should be. The problem is whether you will be simply a professional society in a world of changing industrial needs, or whether there is a broader role that can be filled by the Federation.

But we don't need any duplication. There is enough of that going on in the business community right now. An industry as cohesive as ours should be able to organize itself effectively.

You have the opportunity to use this Federation resource and manage it. That is the challenge that faces the leadership of the Society right now. My only comment is that I have a very sanguine feeling that the coatings industry, you, me, and all of the organizations in it, know the problems, are aware of the urgency of solving these problems, and intend to do something about it.

If that intention is frustrated, it will lead to apathy. If that intention is translated by easy access into important inputs, then it will bring success. You need to carefully study these issues. I would suggest that you don't take too long about it.

The mills of the paint industry "grind slowly, but they grind exceedingly fine." I think we have an enormous opportunity before us to relate the dynamic resources of the Federation to the established resources of NPCA. We have an opportunity for working for the first time with all segments of the industry—the decorators, the dealers, the Brotherhood. We can pull together a resource that will enable us to chart our own destiny and not simply make us victims of bigger and bigger government. ☐

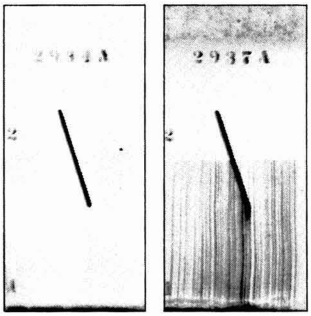
HOUSTON ASTROHALL

OCTOBER 26-28, 1977

Tests prove it...

NALZIN™ SC-1...The non-lead that equals or betters

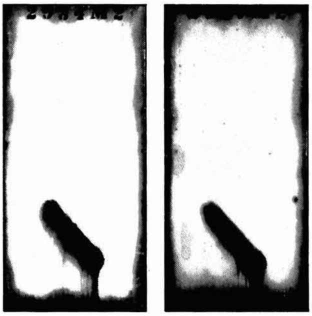
40 PVC OIL ALKYD 1:1 PRIMER



NALZIN™ SC-1 **Calcium boro-silicate**

2 YRS. ATMOSPHERIC EXPOSURE
(45° South, Hightstown, N.J.)

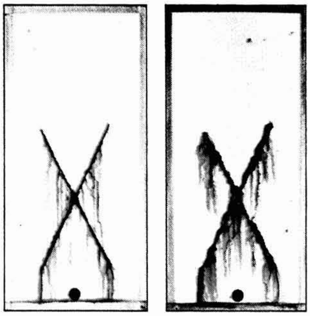
Corrosion-Inhibitive Pigments:
Equal weight (0.85 lbs./gal.)
Substrate: Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 1 coat primer overall
2nd coat over upper half
Total Film Thickness:
Upper half—3.0 mils (dry)
Lower half—1.5 mils (dry)



NALZIN™ SC-1 **Calcium boro-silicate**

2 YEARS MARINE EXPOSURE
(45° South, Ocean City, N.J.)

Corrosion-Inhibitive Pigments:
Equal weight (0.85 lbs./gal.)
Substrate:
Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 2 self-primed
Total Film Thickness: 4 mils (dry)

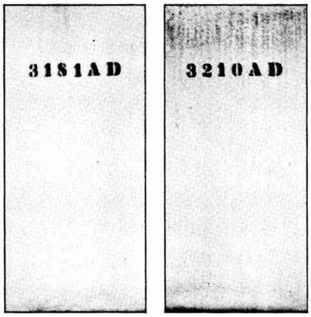


NALZIN™ SC-1 **Calcium boro-silicate**

340 HOURS SALT FOG
(ASTM Test B117-64)

Corrosion-Inhibitive Pigments:
Equal cost (formulated
to constant PVC)
Substrate: Phosphated steel
Application: Brush
No. of Coats: 1
Total Film Thickness: 2 mils (dry)

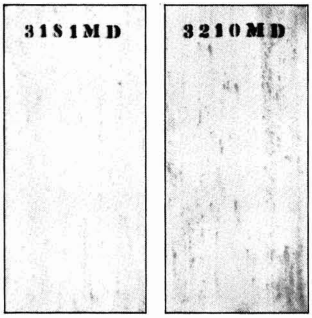
30 PVC STYRENE ACRYLIC LATEX PRIMER



NALZIN™ SC-1 **Zinc-calcium molybdate**

9 MOS. ATMOSPHERIC EXPOSURE
(45° South, Hightstown, N.J.)

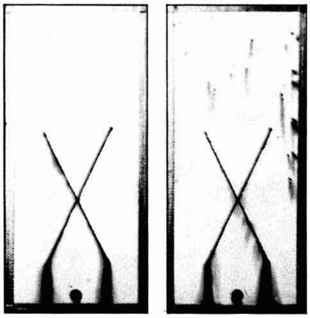
Corrosion-Inhibitive Pigments:
Equal weight (1.0 lbs./gal.)
Substrate:
Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 2 self-primed
Total Film Thickness: 3.0 mils (dry)



NALZIN™ SC-1 **Zinc-calcium molybdate**

44 DAYS MARINE EXPOSURE
(45° South, Ocean City, N.J.)

Corrosion-Inhibitive Pigments:
Equal weight (1.0 lbs./gal.)
Substrate:
Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 2 self-primed
Total Film Thickness: 3.0 mils (dry)



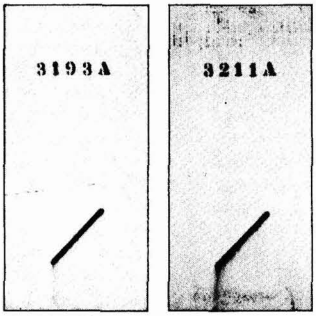
NALZIN™ SC-1 **Zinc-calcium molybdate**

350 HOURS SALT FOG
(ASTM Test B117-64)

Corrosion-Inhibitive Pigments:
Equal cost (formulated
to constant PVC)
Substrate: Phosphated steel
Application: Brush
No. of Coats: 2
Total Film Thickness: 2 mils (dry)

corrosion-inhibitive pigment anything you are now using.

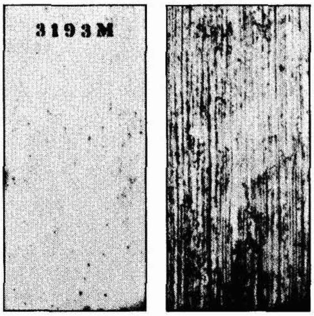
30 PVC ACRYLIC LATEX PRIMER



NALZIN™ SC-1 **Zinc-calcium molybdate**

9 MOS. ATMOSPHERIC EXPOSURE
(45° South, Hightstown, N.J.)

Corrosion-Inhibitive Pigments:
Equal weight (1.0 lbs./gal.)
Substrate:
Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 2 self-primed
Total Film Thickness: 3.0 mils (dry)



NALZIN™ SC-1 **Zinc-calcium molybdate**

44 DAYS MARINE EXPOSURE
(45° South, Ocean City, N.J.)

Corrosion-Inhibitive Pigments:
Equal weight (1.0 lbs./gal.)
Substrate:
Hot rolled steel, sandblasted
Application: Brush
No. of Coats: 2 self-primed
Total Film Thickness: 3.0 mils (dry)

NALZIN™ SC-1 is a remarkably versatile, lead-free corrosion inhibiting pigment. A zinc phospho oxide complex, it works equally well in both aqueous and solvent-based coating systems—oil/alkyds, acrylic latexes, styrene acrylic latexes.

The exposure tests shown here speak for themselves. What they show and what you can count on is:

- NALZIN SC-1 Pigment performs as well or better than standards of the industry at all levels tested.
- It exhibits mildew resistance lacking in other anti-corrosive pigments.
- It consistently equals or tops competitive pigments both at equal weight and at equal cost levels.
- Low levels perform as well as high loadings, *so it takes less to achieve good results.*

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- Stable in a wide variety of binder systems.
- White color and low tinting strength allow formulation of virtually any color coating.
- Minimizes tendency for flash rusting in aqueous coatings.
- Excellent throwing power and can stability in electrodeposition systems.

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Industrial Chemicals Division, NL Industries, Inc., Box 700, Hightstown, N.J. 08520. Telephone: (609) 448-3200.

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NL Industrial Chemicals

California Air Resources Board Holds Two Meetings On Regulating Use of Organic Solvents in Coatings

By John A. Gordon, Jr.
Chairman, Environmental Committee
Los Angeles Society for Coatings Technology

On March 7, at San Francisco, and March 9, 1977, at Los Angeles, there were meetings called by the California Air Resources Board to consider a new regulation on the use of organic solvents in coatings. The regulation stated that after January 1, 1979, "it shall be unlawful to sell or use architectural coatings which contain more than 350 g of volatile organic matter per liter of dried solids in the coatings." Architectural coatings were defined as coatings applied to stationary structures or their appurtenances, mobile homes, pavings, and curbs.

In the terminology of the coatings industry, this particular classification of architectural coatings covers those coatings which we normally look upon as being trade sales coatings, industrial maintenance finishes, and traffic paints. There were between 80 and 100 representatives of various sections of industry at both meetings and the conclusions reached were relatively similar at both meetings. Generally, the statements and observations fell into four classes:

(1) The meetings had been called in a hurry and there was insufficient time for the various participants to prepare meaningful accurate statements for presentation.

(2) The data upon which the ARB is basing their statement that the coatings industry is one of the largest contributors to the hydrocarbon content of the air in California, are not accurate. Representatives from NPCA stated that they were unable to come up with any figures which would corroborate the statement of ARB that there are 225 tons of hydrocarbon solvents per day going into the air in California. In fact, NPCA stated that their data indicated that it can't be over 85 tons per day. We have never seen the data base that CARB has used for these determinations so we cannot tell whether our assumptions are similar or not.

(3) The coatings industry has done an excellent job in the past of converting from solvent based coatings to water-borne coatings. In 1945, there were practically zero water-borne coatings being sold in the United States. Since the introduction of styrene butadiene paints in 1945, the industry has changed so that as of 1976, the average around the country is about 65 to 70% water-borne coatings and 30 to 35% solvent based coatings. This change has been accomplished by the free enterprise system in which the customers demanded water-borne coatings for whatever reason and it was necessary to produce them if companies were to remain in the marketplace in a competitive position. There have been no government regulations necessary to bring about this particular change in the actual manufacture of coatings. The net result has been a very great reduction of the contribution of coatings to the hydrocarbon solvent load in the air in California.

(4) Technology is not now available to convert the remaining 30 to 35% of coatings from solvent based to water-borne. These coatings represent those which are made for high performance uses, such as, sealing stain producing woods like redwood and cedar, sealing and acting as primers for woods which have previously not been coated, priming and sealing areas which have had water stains, priming sand blasted ferrous metals, traffic paints, and other types of coatings which must perform in difficult exposure areas. If the technology were available today, it would take a minimum of five years and possibly as much as 10 years to prove the adequacy of these coatings.

It was frequently pointed out that the 350 g of volatile organic matter per liter of dry coatings solids would rule out the use of semi-gloss interior and exterior coatings in which it is necessary to use relatively large quantities of glycols and coalescing aids to get good flow and leveling, adhesion to difficult surfaces, hardness and resistance to corrosion, and other manifestations of moisture permeability.

Another fault of the emulsion coatings to date is the fact that they are thermoplastic and, therefore, remain relatively soft and distortable under load. This doesn't mean much to the average person but the housewife who puts her dishes on a freshly painted shelf and then finds when she lifts the dishes up, that it takes the coating with them is certainly aware of the problem of blocking in these thermoplastic polymers.

The problem of application at temperatures of less than 50°F was mentioned frequently. It seems that in some parts of California, there is a tendency to coat objects at temperatures lower than 50°F and, under these conditions, emulsion type coatings fail to form an adequate film. The films that are formed look all right at the beginning but they deteriorate rapidly and do not survive well on exterior exposure.

For these and many others, as stated by some 33 people who testified in San Francisco, and 31 who testified in Los Angeles, the emulsion type coatings are not yet at the point where they can take over completely. It was stated again and again that if the technology were available, the paint companies would embrace it immediately because it would give them an economic and competitive advantage. There is no real need for regulations as strict and limiting as the one that ARB is proposing. Many small companies manufacturing specialty coatings based on solvents alone would find that their very existence would be eliminated by the regulation as it is proposed.

To the credit of the staff of the ARB, it must be stated that they mentioned several times that their purpose in holding these consultative meetings was to obtain information so they could go back to their offices and make whatever changes in the regulation were necessary before it is submitted for approval at the next CARB meeting. It was stated that the next meeting of CARB would be in April and notice of this meeting will be sent to all interested parties.

Statements for the industry were made by Larry Thomas, Assistant Chief Counsel; and Ray Connors, Technical Director of the National Paint and Coatings Association; and by Neil Estrada, President of the Federation of Societies for Coatings Technology.

(Please see facing page for Mr. Estrada's statement before CARB—Ed.)

President Estrada Makes Statement Before C.A.R.B.; Urges Further Studies Prior to Rules Approval

By Neil S. Estrada
President, Federation of Societies for Coatings Technology

The Federation of Societies for Coatings Technology (FSCT) is a 55-year old, non-profit organization representing some 6300 technical workers in the Coatings Industry. It is internationally recognized as the organization representing the professional and scientific interests of the industry. In California there are two member societies, Los Angeles and Golden Gate, with a total membership of just over 500, representing some 235 concerns whose memberships vary from 1 to 27. Its position was early recognized by the ORGSOL Committee, who contacted it for information. Its local members have consistently attended the various workshop meetings of the ORGSOL Committee and have provided professional technical advice. It is in the interests of the California members of the FSCT that the following comments are being made. However, it is also felt that the subject matter of this hearing is of concern to our industry on a national basis.

Our industry is very well aware of the position of volatile solvents with respect to air pollution. It successfully adjusted to the requirements of Rule 66 (and Regulation 3) by substitution of solvents, using techniques and materials commercially available. It should be realized, however, that Rule 66 did not require development or adoption of new resin technology to meet its requirements with concomitant long range testing. It required only substitution of solvents with little effect on application properties and essentially no change in performance properties.

The proposed ruling, on the other hand, calls for a very significant change in the basic types of resins normally used in architectural coatings that are now based on solvents. The dominant position of water-based coatings in present architectural coatings (approximately 70%) is not a result of regulations but rather represents the normal progress of coatings technology. The architectural coatings that are still solvent-based must, therefore, be at least presumed to require the use of solvents if they are to properly preserve and decorate the surfaces to which they are applied. The point to be made is that technology does not presently exist nor may it ever exist that will permit all architectural coatings to conform to the proposed ruling without serious sacrifice of performance.

There is at present, and has been for a considerable period, a great deal of activity in our industry to develop coatings that are reduced in solvent content, even to their entire elimination. Techniques using 100% reactive systems or powder coating do not apply to architectural coatings. The major thrust for architectural coatings has been in terms of low-solvent coatings or water-based coatings. Both of these have limitations of a fundamental character. Low-solvent coatings depend on very low viscosity of the resin used, implying low molecular weight, which limits performance and available materials. Water-based systems are either thermoplastic (emulsions) or require resin types (soaps) that have built-in disadvantages. It should be clearly understood that the term "architectural" is synonymous with "air-drying." The numerous successful industrial applications of water-based coatings require heat or catalysis or both to insure suitable performance.

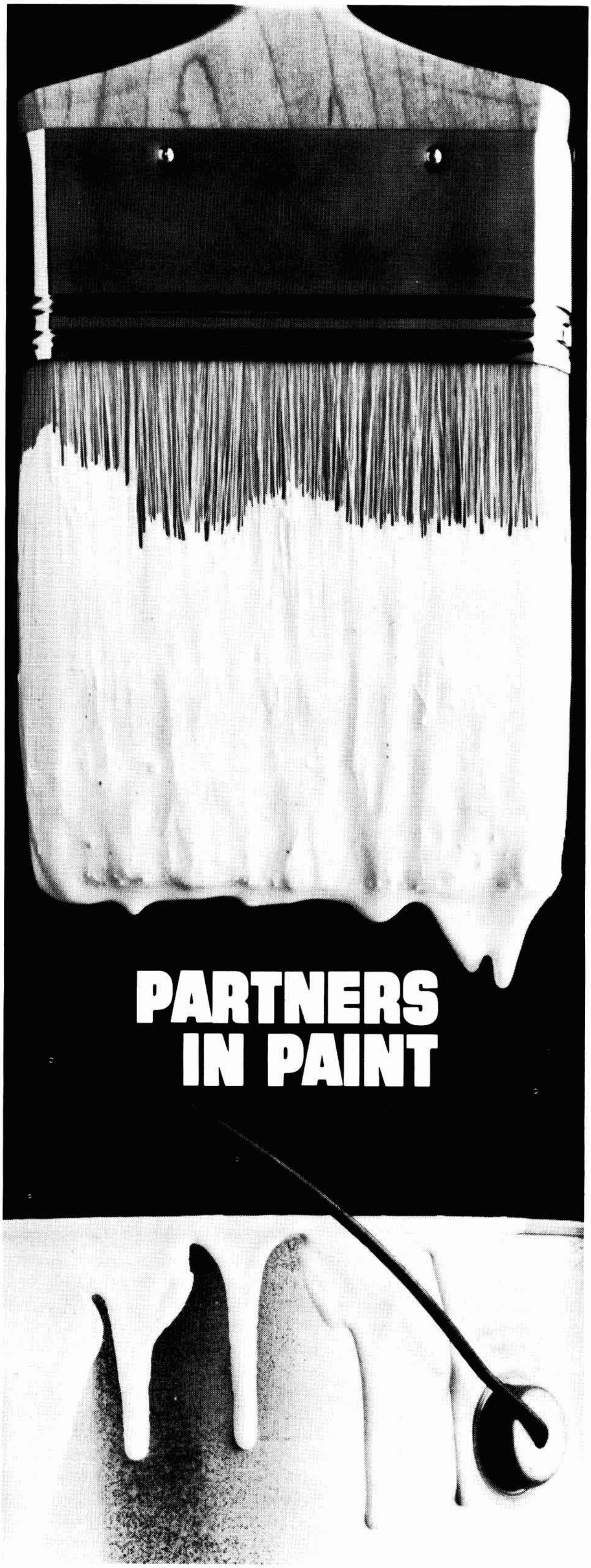
The subject of water-based coatings is a very popular one at technical meetings, such as the recent University of Southern Mississippi Symposium in New Orleans and the Western Coatings Societies' Symposium just completed here in Los Angeles last week. They generally cover materials that are new to the market and that are extensions of current known technology. As will be readily understood, time on such programs is typically devoted to new products and techniques and the interest of the industry in them. To the experienced technologist the very number of such efforts indicates the experimental nature of them and the lack of general commercial acceptance. Review of this activity for the last ten years shows little in new fundamental technology that would be of service in providing coatings that could conform to the requirements of the proposed ruling.

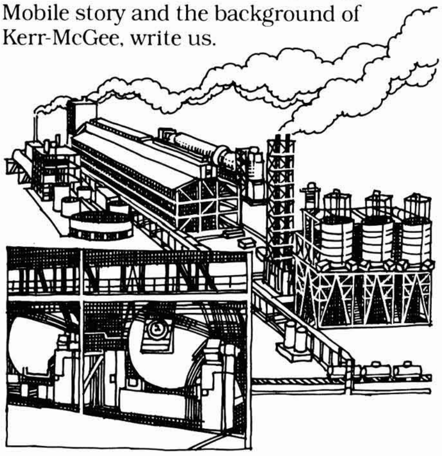
It is also evident that there will be honest diversity of opinion in the coatings industry as to the merits of various solutions to coatings applications. Testimony given or to be given will undoubtedly allow the conclusion that some companies have products that seemingly conform to the requirements of the proposed ruling. Care must be exercised to avoid concluding that all companies can do likewise or extending a very special solution to a particular problem to a general area of the technology involved. As was expressed by a wide cross-section of companies attending the earlier ORGSOL meetings, proven technology to meet all the requirements of the proposed ruling does not exist.

The proposed ruling is at once too simplistic and too demanding. It does not define methods to be used in determining solvent content. If this is left up to the various local air pollution control districts, it can give rise to confusing requirements. It neglects the important area of state and federal specifications, both based on long-time commercial and governmental experience. Enforcement is left to the local APCD's with no assurance of uniform requirements. Organic solvents are not defined nor is it evident that there may not be restrictions on types of solvents permitted. It completely neglects the requirements of special surfaces for which special coatings have been developed, such as bridges and road surfaces.

If the ruling is adopted as proposed, it would presumably then require adoption by local APCD's who would necessarily have to provide detailed regulations. This would not be instantaneous and in the event, would require approval by the Air Resources Board. The hazard of trying to conform to a local APCD regulation (Actually to the most restrictive APCD regulation since companies cannot afford to supply a variety of similar coatings, each designed to meet special regulations) before approval by the ARB of the local regulation is a very real one. It would delay effort toward conformance, especially since the rule is so restrictive that every possible material available and permissible would have to be considered. In view of this, the time available before January 1, 1979 for formulation is severely reduced. In all exterior coatings, adequate time for testing must be provided and a period of 5-7 years is not unduly long, when necessary development time is considered. "Forcing technology", in a well-developed technology and in an area where most of the potential desired reductions in solvent emissions have already been realized, can prove to be an effort of greater cost than possible benefits derived.

As indicated above, approximately 70% of all architectural coatings, using


PARTNERS
IN PAINT



the conventional definition, are water-based, primarily with emulsions as the resin. In recent years. gloss and semi-gloss enamels have been introduced on the market for interior and exterior service and are being accepted as generally successful. In order to have suitable application properties, they require use of considerable amounts of volatile organic compounds. Coatings of this type currently on the market would be excluded by the proposed ruling because of their content of such volatile organic compounds. Further, so-called water-soluble resin systems require use of solvents that fall in Class III with respect to reactivity and these may well be the subject of further restriction. These systems also do not provide the air-dry qualities and water- and weather-resistant qualities needed to replace the present solvent-based systems. Their adoption can only result in inferior performance and, because of lack of time to evaluate thoroughly, give rise to serious future failures.

Companies in our industry vary widely in size. The majority are small with limited technical capabilities. They lack the capability to readily translate their present systems to conform to the proposed ruling, if this indeed can be done, and will be at a serious disadvantage in the future. In some cases, where they use only solvent-based coatings and no suitable alternate systems exist, they may well be forced out of business. While this is the exception, there is no question that very expensive efforts will be required for the coatings industry to conform to the proposed ruling. In the present state of the technology there will be a general reduction in the quality of coatings, especially in the protective sense. The ultimate cost of such reduction cannot be assessed at this time but it will be substantial. If nothing else, it will cause more frequent painting and the emission of more reactive solvents, if indeed these are permitted.

Finally, the manner in which this entire program of attempting to control further the organic emissions from architectural coatings has been handled, is considered highly unsatisfactory. Not only has the time table, too short as proposed, been accelerated, but the development of the proposed rule prior to any possible analysis of the data provided by the requested survey suggests that due process is not being followed. This is further confirmed by the lack of consideration given to the many pertinent comments and recommendations made during the preliminary consultation at San Diego in January. In spite of well-documented need for obvious exceptions to the proposed ruling discussed at that meeting the present proposed rule does not make any exceptions.

In a letter dated February 24, 1977, the coatings industry is requested to supply literature on water-borne or high solids coatings technology. This, along with data from the coatings survey and the documents and testimony supplied at the hearings on March 9 and 11, will all be considered prior to adoption of a possibly modified rule by the ARB at its April meeting. It is scarcely to be wondered that the credibility of the ORGSOL Committee is questioned by our industry in view of all the above. At best, it can only be said that this whole action is moving much too precipitously and can only result in a bad regulation.

It is urged that further time be taken for analysis of the data and information provided and that further hearings be scheduled to allow definition of a practical rule that will provide the maximum possible reduction of solvent emissions consonant with retention of necessary protective and decorative characteristics of architectural coatings. It is further requested that justification of such a rule be provided in terms of air quality improvement as compared to the cost of reduced performance of coatings, extra costs in materials and energy and the costs of regulation.

Much of the necessary testimony, both past and present, concerning the possibility for regulation of solvent emissions from architectural coatings and the capabilities of the coatings industry to supply satisfactory, economic coatings must necessarily come from members of the FSCT. It and its members stand ready to cooperate in any process of reasonable character with respect to time, valid data bases and evaluation of cost-benefit data that may be developed.

Radiation Cured Coatings Subcommittee Formed

The National Paint and Coatings Association's Ad Hoc Subcommittee of the Product Safety Task Force held its organizational meeting recently. The Subcommittee's objective is to establish guidelines and procedures for the proper application of radiation cured coatings. The Subcommittee intends to publish a booklet within a year.

At its initial meeting, The Subcommittee developed a list of tentative chapters for the booklet: toxicology, product assurance, emissions, and education. Each of these chapters will be assigned to a subgroup to develop the complete text.

DOT Postpones Comment Filing Deadline On Shipping Controls Until June 13

The U.S. Department of Transportation's Materials Transportation Bureau has extended the deadline for filing comments on Docket HM-145 to June 13, 1977. The original deadline for HM-145, *Environmental Health Effects Materials,* as reported in the March 10, 1977 *Federal Register,* was set for March 14.

The original notice stated that DOT wanted to receive comments on the practicality and need for controls on materials, which if released during shipping, may cause an unreasonable risk to property, the environment or human health and safety.

HM-145 is only an advanced notice of proposed rulemaking and as such, is merely seeking preliminary information upon which to base a proposal. At the request of National Paint and Coatings Association's Transportation and Distribution Committee, the Association will submit comments on this advanced notice. NPCA will also have an opportunity to submit comments when the proposed rulemaking is published.

Currently, NPCA feels that the fact that a material is a health or environmental hazard does not necessarily warrant DOT regulation, unless that material presents an unreasonable risk to health, safety and property in transportation. While there may be a need for further identification of the material when transported, NPCA believes that this must be authorized by the government agency evaluating the specific hazard.

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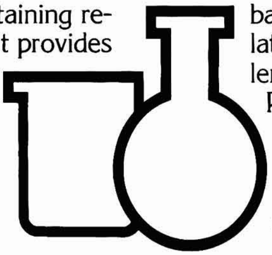
POLYWET KX-3 is recommended with hydrophobic monomers (SBR) and POLYWET KX-4 with hydrophilic monomers (acrylics).



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UNIROYAL

Amorphous Precipitated Silica Flatting Agents For Coatings

H. S. Ritter and H. J. Golden
PPG Industries, Incorporated*

The properties and performance of precipitated amorphous hydrated silica flatting agents show that this type of silica is ideal for flatting various types of coatings and is at least as effective as other types of silica, either synthetic or natural. The ability of the micro-porous structure in individual agglomerates to cause concentration near the surface of films increases flatting efficiency beyond that attainable from even distribution throughout the film. Easy stir-in dispersion combined with high flatting efficiency provide economies with precipitated hydrated silica that are not achieved with other types of synthetic silicas.

KEY WORDS: Refractive index; Pyrogenic silica; Precipitated silica; Particle size distribution; Flatting agent; Pigment volume concentration (PVC).

INTRODUCTION

The general concept of flatting a surface or giving it a matte appearance is well known and has been studied and reported extensively.[1] Flatting simply involves introducing irregularities or interruptions in a plane surface so that incident light rays are diffused rather than reflected at the same angle as the angle of incidence. In considering variations in flatting due to different sizes, shapes, and arrangements of surface irregularities, the process is no longer simple and involves degrees of flatting, geometrical factors, and optical responses that are dependent on how the flatting is accomplished, as well as type and concentration of flatting agent used, and interactions between flatting agents and the media in which they are dispersed.

In the coatings industry, flatting is usually achieved by dispersing a particulate material in a liquid coating composition which induces deviation of a film surface from a planar state as the film is formed. This process requires that the particles used must be of greater diameter than the unflatted film thickness would be or that particles form a structure in the film by agglomeration, flocculation, or by nonuniform distribution (buoyancy) which causes surface irregularities. In flatting opaque films, any sort of pigmentary or other particulate matter can be used as a flatting agent, including extenders such as clay, talc, silica, mica, etc., as well as hiding pigments or organic polymer particles. For transparent films, particles with refractive indexes equal or close to that of the film material are required to maintain transparency. *Table 1* shows the refractive indexes of common pigmentary materials compared with film forming substances. Film formers are seen to have refractive indexes in the 1.48-1.55 range. Pigments with high indexes always appear opaque in common film formers since the difference in refractive index causes incident light refraction. The few materials with indexes close to the film formers are those that can be used in clear as well as opaque films. Precipitated silicas fall in this group and occupy a unique position as flatting agents because their inherent lower cost offers economies over other types of synthetic silicas. These silicas are the main subject of this discussion.

SILICA FORMATION

While there are many silica and silicate materials available to the coatings industry, flatting of clear finishes is limited to those which have refractive indexes below approximately 1.5 (similar to the film former to assure transparency) and which are wetted completely so that no air pockets or microvoids larger than a small fraction of a micron persist to cause haze or opacity. Synthetic silicas therefore are most generally used since they produce the clearest films with maximum flatting efficiency. These silicas may be pyrogenic in origin, may be aerogels or hydrogels precipitated from aqueous systems, or may be the direct product of precipitation.

Pyrogenic Silicas

The pyrogenic silicas[2,3] are produced at very high temperatures which yield nonporous ultimate particles. Fumed silicas are made by burning silicon tetrachloride in an oxygen-hydrogen flame with SiO_2, water vapor and HCl resulting. Another type of pyrogenic silica is arc silica which is high purity silicon dioxide reduced in an electric arc furnace at 3000° C to SiO which is then oxidized to SiO_2 product.

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*Chemical Div., P.O. Box 31, Barberton, Ohio 44203.

Table 1—Refractive Indexes of Some Pigments and Film Formers

Pigments	
TiO_2, rutile	2.71
Zinc oxide	2.00
Barytes	1.64
Pptd. $CaCO_3$	1.63
Calcite	1.60
Mica	1.59
Talc	1.59
Clay	1.56
Gypsum	1.53
Silica, quartz	1.55
Silica, diatomaceous and pyrogenic	1.45
Silica, pptd. hydrated	1.45
Film Formers	
Alkyd resins	1.51-1.55
Acrylic resins	1.51-1.55
Cellulose	1.53
Cellulose nitrate	1.51
Linseed oil	1.48
Other Materials	
Air	1.00
Water	1.33

Precipitated Silicas

Precipitated silicas[4,5] are produced by neutralization of sodium silicate solutions to form hydrated silica and the sodium salt of the acid used. The precipitate may be dried by heat directly or in the case of gels may be dried from alcohol or under vacuum to minimize shrinkage. The latter products are known as aerogels. Direct dried gels are known as hydrogels.

Hydrated, precipiated silicas are characterized by surfaces covered with silanol (Si-OH) groups of two types, isolated Si-OH and pairs of Si-OH groups.[6] Water can adsorb on the pairs of silanols by hydrogen bonding and provide sites for further adsorption. Thus, these surfaces are enveloped in a layer of H-bonded adsorbed water that provides a formidable barrier to many other substances. Heating to around 750° C or higher removes adsorbed water and causes condensation of Si-OH groups into Si-O-Si so the surface becomes very sparsely covered with isolated Si-OH groups typical of pyrogenic silicas.[7] The concentration of silanol groups on silica surfaces is the primary difference between hydrated and pyrogenic silica flatting agents and is responsible for differences found in dispersion, wetting, flocculation, and therefore, flatting variations between them. The surface hydration of precipitated silica obviously renders it predominantly hydrophilic but at the same time does not diminish its wettability in organic media, so that universal dispersibility is maintained.[8]

Most silica products go through a milling operation to obtain a desirable particle size distribution. The most generally used process is fluid energy milling (or micronizing) which can disintegrate agglomerates to more desirable sizes with some classification to obtain narrow size distributions.[9]

The chemical inertness of silica, either pyrogenic or hydrated, favors its use in coatings. The absence of reactivity with most film forming materials and film modifiers or additives makes silica an ideal flatting agent since its use avoids problems associated with vehicle gelation, film durability or effects on other properties.

PROPERTIES

Table 2 lists the range of physical properties and composition of typical silica flatting agents of the various types mentioned. The most consistent property seen is the silica content which indicates these materials are all essentially pure silica, with the exception of some aerogels and hydrogels which may contain up to several percent of surface treatment.[10] The use of surface treatments is intended to improve dispersion and suspension stability in coatings and mar resistance of films.

The most critical property of a flatting agent is its particle size distribution and the effect it has on film surface irregularities that diffuse incident light. Obviously this involves the texture desired on the film surface, which can range from a very smooth to a highly textured surface. The practical particle size distribution is limited to particles large enough to affect a film surface, usually around 2 microns (μ) or larger, but not larger than the size required to produce the desired texture. The particle size referred to is effective particle size (or frequently agglomerate size) since most silica flatting agents are composed of agglomerates of very small ultimate particles. *Figure* 1(a-d) shows electron microscope pictures of typical silica flatting agents illustrating their agglomerate structures. *Figure* 1(a) indicates the detail of the ultimate particles making up the agglomerate structure of a 4μ precipitated silica compared with an aerogel while *Figure* 1(b) shows a similar comparison of a 7μ precipitated silica with a hydrogel. *Figures* 1(c) and 1(d) show the same comparisons at lower magnification to show the agglomerates which are the effective "particles." In observing the nature of these structures, it is apparent that the effective particle

Table 2—Properties of Silica Flatting Agents

Type	Surface Area (m^2/g)	Avg. Particle Size (microns)		Oil Abs. (g/100 g)	Ignition Loss (%)	SiO_2 (%) (anhyd. basis)
		Ultimate	Agglomerate			
Pyrogenic	50-380	0.005-.06	—	200-300	3	99.7-99.9
Arc	170	0.015	5-10	75	2	99.6
Aerogel	200-400	0.01	3-10	250-300	4-6.5	96.5-99.5
Hydrogel	220-380	0.01	3-11	140-250	2-15	96.5-99.7
Precipitated	150	0.021	4-10	150	10	97.5

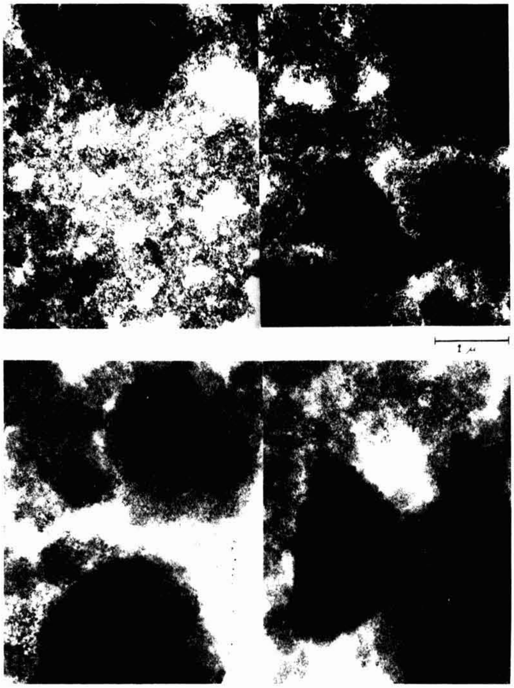

Figure 1(a)—Top—Precipitated silica, 4μ average. Bottom—Aerogel, 5μ average

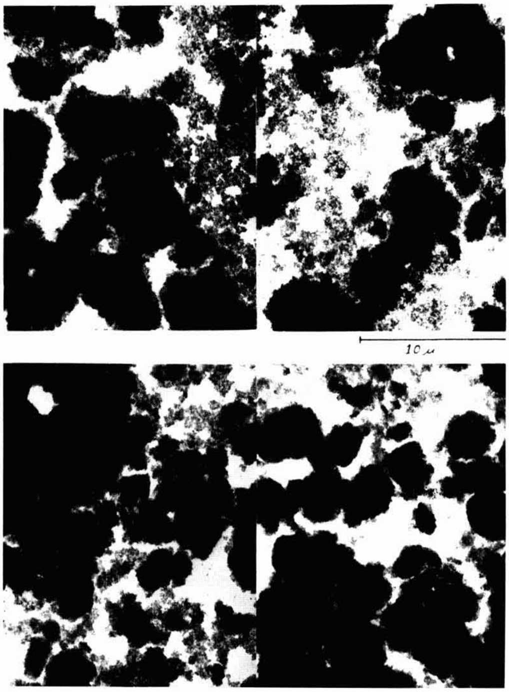

Figure 1(c)—Top—Precipitated silica, 4μ average. Bottom—Aerogel, 5μ average

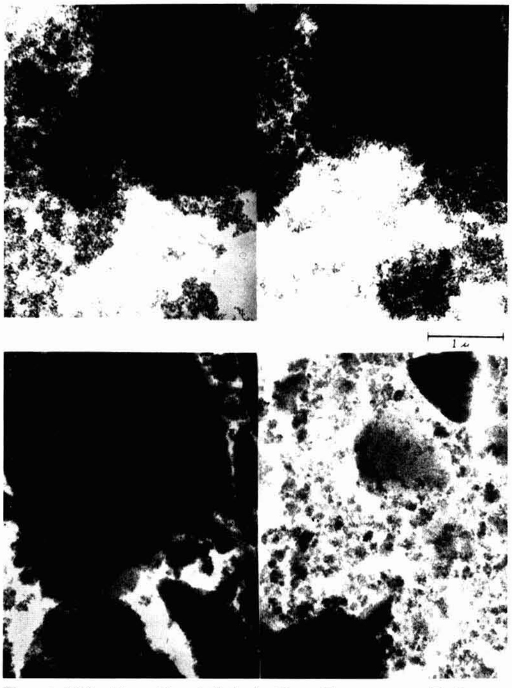

Figure 1(b)—Top—Precipitated silica, 7μ average. Bottom—Hydrogel, 7μ average

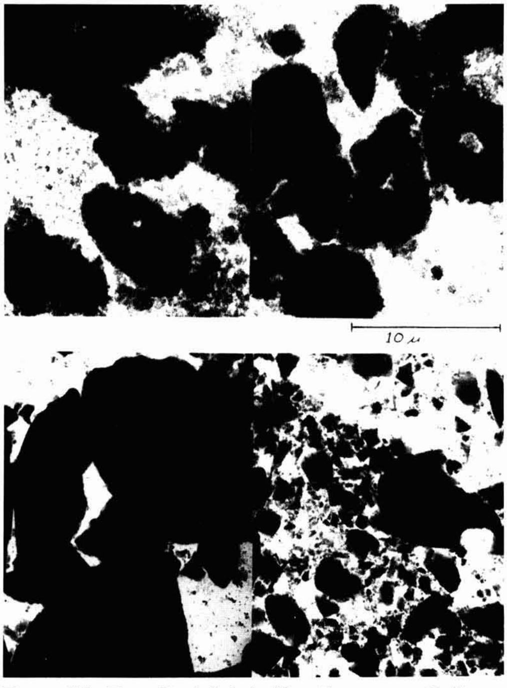

Figure 1(d)—Top—Precipitated silica, 7μ average. Bottom—Hydrogel, 7μ average

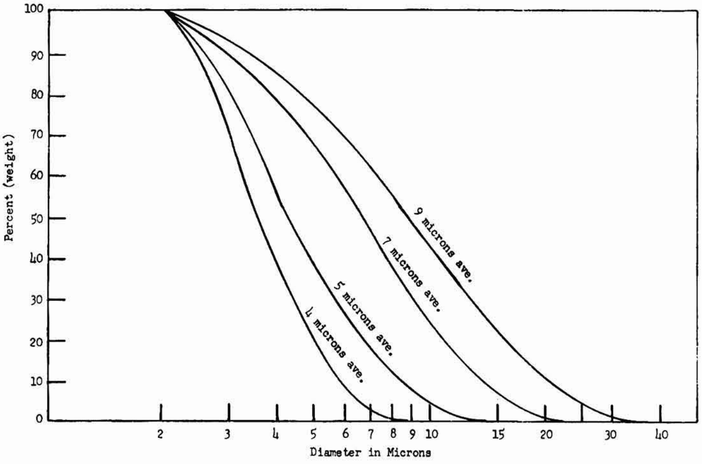

Figure 2—Particle size distribution of silica flatting agents (+2μ range, Coulter Counter)

sizes depend on the extent of agglomeration resulting from the manufacturing process as well as particle size reduction by milling or grinding into a vehicle when used. Thus, effective particle size distribution is meaningful only if determined under conditions similar to those in a coatings system where flatting is obtained.

One method of determining particle size distribution which is convenient, and at least related to actual use conditions, involves the Coulter Counter.[11] This method uses an aqueous electrolyte solution as suspending medium and determines particle size by variations in dielectric properties as the suspension flows through an orifice. *Figure* 2 shows Coulter Counter curves for four typical silica flatting agents, representing the range of most commonly used products. These curves do not show particles smaller than 2μ since they are ineffective for flatting and are usually present only in minor quantities. A narrow size distribution is required to avoid dilution of product by undersized particles that do not contribute to flatting and to avoid oversized particles that produce undesirable roughness in films. The type of size distribution curves shown in *Figure* 2 represents only those particles larger than the arbitrary minimum, 2μ, and frequently does not show small numbers of oversize particles that may be sufficient to cause objectionable film roughness. These curves represent agglomerate sizes obtained with minimum dispersion energy applied; more vigorous dispersion or milling tends to break down agglomerates and shift the distribution curve to smaller sizes.

FLATTING EFFICIENCY

The formulation of flatted finishes essentially involves selecting the amount of flatting agent to be added to obtain the desired level of flatness. However, the nature of the vehicle system, the resin or polymer, and the solvent type all affect flatting efficiency. Thus, the details of formulating become important to developing optimum efficiency and performance from a flatting agent. In addition, the severity of milling in the vehicle used is a large factor since the degree of subdivision of flatting agent directly affects flatting. Since various silica flatting agents are different in degree of agglomeration, strength of agglomerates and ease of subdivision, efficiency may vary widely with dispersion technique and severity.

The effect of the nature of the vehicle system is illustrated in *Table* 3 which indicates the amount of precipitated silica required in a stir-in dispersion to reach a 60° gloss of 10 in a dry film.

The coatings shown in *Table* 3 cover a wide variety of types, from a simple resin solution in mineral spirits (alkyd varnish) to more complicated solvent and plasticizer systems in the lacquers to pigmented (TiO_2) systems in the enamels. The much greater efficiency of flatting agent in fast drying lacquers than in enamels or varnishes is primarily due to the rapid reduction in pigment particle mobility caused by fast drying. In films which dry slowly and remain fluid for some time, flatting agent particles that are concentrated near the surface by buoyancy and convection currents of evaporating solvent have an opportunity to migrate back into the film or even settle out. It is pertinent to note that the silica level necessary for a 60° gloss of 10 when TiO_2 is present is similar to the varnish which is unpigmented. This is probably due to the TiO_2 being essentially all dispersed to effective particles of less than about 2μ which are ineffective for flatting.

As noted earlier, the amount of milling applied in dispersing a flatting agent affects flatting efficiency

Table 3—Effect of the Nature of Various Vehicle Systems

Vehicle System	% Flatting Agent (Based on Resin Solids)
Nitrocellulose lacquer	6.5
Vinyl lacquer	8.0
Acrylic enamel	15.0
Alkyd-melamine enamel	16.5
Silicone-polyester-melamine enamel	17.0
Alkyd varnish	17.5

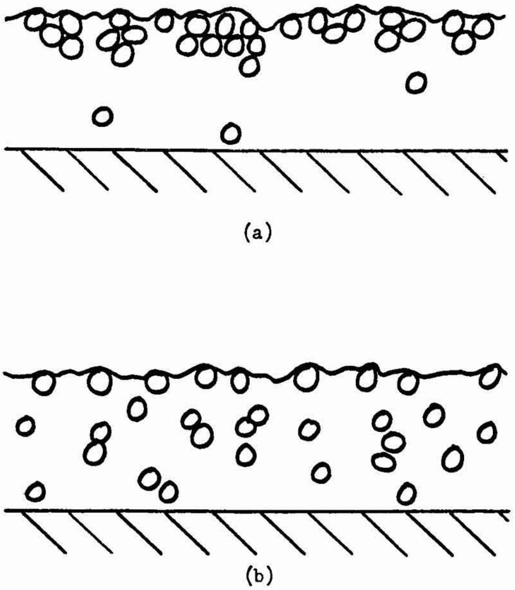

Figure 3—Schematic representation of flatting agent dispersion in a film: (a) surface concentration (b) uniform distribution through film

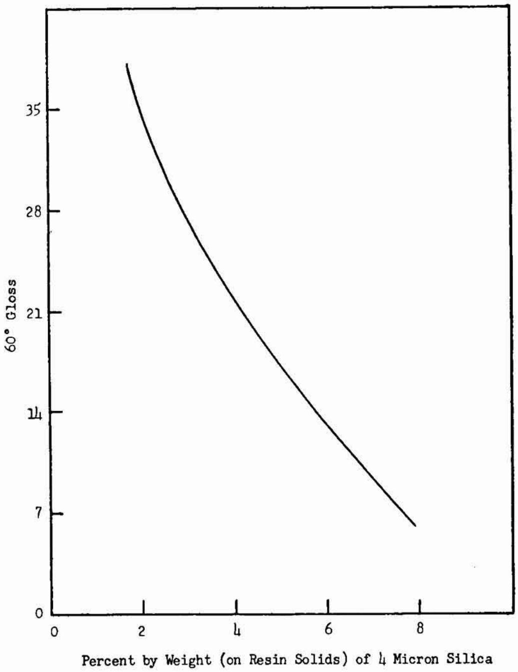

Figure 4—Flatting efficiency of 4μ silica in a nitrocellulose lacquer

since silica agglomerates may be reduced in size with increased milling. As an example, in the vinyl lacquer shown in *Table* 3, high energy dispersion increases the silica loading required from 8.0 to 9.0% for a 60° gloss of 10.

Although flatting agent loading is usually expressed as a percent of resin solids in a film, the structure that is established in the film can be considered for purposes of discussion in terms of "pigment" volume concentration (PVC). With a density of 2.1, a solid cubic foot of silica would weigh 131 lb. Since air flocculated silica flatting agent has a bulk density of about 4 lb/ft^3, it must be 4/131 or about three percent silica and 97% air. If the silica maintained this degree of flocculation in a lacquer, a maximum loading of three percent could be achieved assuming uniform distribution and air space completely filled with vehicle. Probably, silicas arrive at a less flocculated structure in lacquers and varnishes than in air since much higher loadings are easily attained.

Using a nitrocellulose lacquer modified with alkyd resin and dioctyl phthalate as an example, six percent silica based on resin solids is equivalent to a PVC of 3.5% in a dry film. If evenly distributed, this small volume of silica is hardly sufficient to induce film surface disruption for flatting even by normal packing, therefore, it must be present in a matrix structure that spaces pigment into the equivalent of a much higher PVC, even allowing for some or all of the silica to be concentrated at the film surface. The silica agglomerates or particles involve some porosity in their structure as seen in the EM pictures. If this porosity is in the range of 26% of their volume (hexagonal close-packed spheres produce this porosity), a PVC of 4.8% results without any further flocculation or structure. Therefore, some flocculate structure involving the silica agglomerates is necessary to account for the degree of film surface unevenness obtained. *Figure* 3 illustrates two concepts of silica flatting agent distrubition in films, idealized in that only 4μ particles are shown. (a) illustrates concentration or floating of silica particles at the film surface, while (b)

Table 4—Nitrocellulose Lacquer

	Lbs	Gal
Toluene	135	18.67
½ sec R.S. nitrocellulose[a]	85	8.09
Stir 10′ and add:		
Ethyl alcohol (95%)	25	3.67
Methyl isobutyl ketone	70	10.48
Butyl acetate	85	11.68
Mix until dissolved and add:		
Duraplex® ND-77B[b]	125	14.37
Dioctyl phthalate	15	1.83
Lacquer thinner[c]	220	31.16
	760	99.95

Silica flatting agent (Lo-Vel®) added as seen in *Figure* 4.[d]
%Non-vol.: 19.7
Viscosity No. 4 F.C.: 24″

(a) Hercules, Incorporated
(b) Rohm and Haas Co.
(c)

Ethyl alcohol (95%)	15% by weight
Methyl isobutyl ketone	20
Butyl acetate	25
Toluene	40

(d) PPG Industries, Inc.

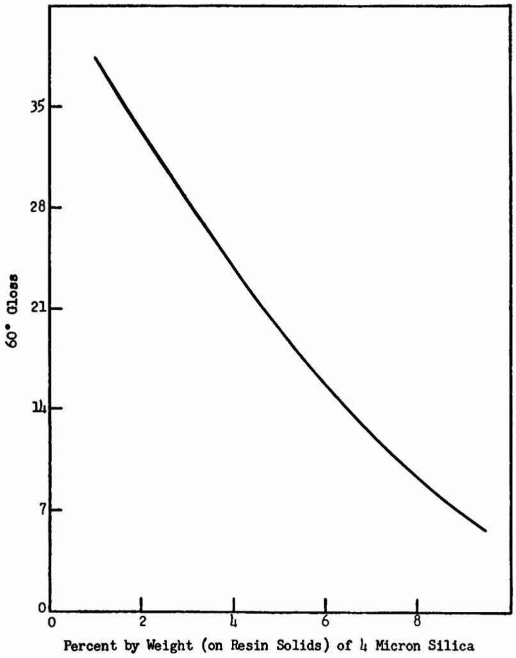

Figure 5—Flatting efficiency of 4μ silica in a vinyl lacquer

indicates a flocculate structure through the film. While actual particle arrangement probably involves both of these mechanisms, the effect of various solvents in carrying silica particles to the surface of acrylic lacquer films reported by Golden[12] indicates a strong effect related to particle mobility and concentration at or near the film surface.

Golden's work suggests that prewetting the porous silica agglomerates with low boiling solvents promotes transporting the silica particles to a lacquer film surface by convection currents set up by the evaporating solvent. For this to occur the film must "set" to immobilize the flatting agent early in the drying cycle. If the film remains sufficiently fluid for the particles to settle back or diffuse from near the surface, as in an alkyd varnish for instance, flatting efficiency is reduced and a higher loading of flatting agent is required to build up a structure in the film to induce flatting.[13] This is well illustrated in *Table* 3 in that an alkyd varnish requires double the flatting agent loading for lacquers to be effectively flatted.

The selection of solvents for flatted finishes is a complex process since interactions between solvent and binder, between solvent and flatting agents, and among different solvents are involved.[12] Polar solvents tend to increase flatting over nonpolar solvents such as mineral spirits. The greater the solvency for a resin in a vehicle, the better the pigment dispersion in that vehicle. Mixtures of solvents must be compatible or poor dispersion can result.

Actual performance of amorphous precipitated silica flatting agents has been determined in a number of typical flatted finish applications, including both solvent and water base types. *Figure* 4 shows the flatting efficiency of a 4μ silica in the nitrocellulose lacquer described in *Table* 4.

To achieve a 60° gloss of 10, about 6.5% silica flatting agent on resin solids is required, lesser amounts giving gloss levels in the semigloss range. The silica is stirred into the lacquer directly or a paste dispersion can be used with subsequent let-down. The 4μ grade is preferred to produce smooth lacquer films with minimum texture. Major uses of flatted lacquer of this type are in furniture and wood or plastic paneling and trim.

Figure 5 illustrates the flatting efficiency of the 4μ silica in a vinyl lacquer (*Table* 5) similar to that seen in nitrocellulose lacquer. About eight percent silica is required for a 60° gloss of 10. A smooth textured film for application at minimum film thicknesses is obtained

Table 5—Vinyl Lacquer

	Lbs	Gal
Methyl ethyl ketone	617.0	91.95
Elvacite® 2041[a]	22.1	2.11
Bakelite® VYNS-3[b]	67.2	5.93
	706.3	99.99

Silica flatting agent added as seen in *Figure* 5.[c]
Resins solids: 12.6%
Viscosity No. 4 F.C. 15 sec.

(a) E.I. du Pont de Nemours & Co., Inc.
(b) Union Carbide Corp.
(c) PPG Industries, Inc.

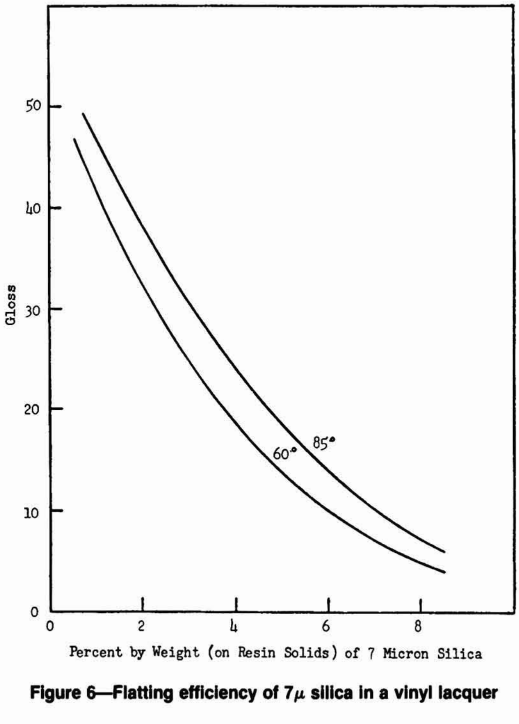

Figure 6—Flatting efficiency of 7μ silica in a vinyl lacquer

Table 6—Alkyd Varnish

	Lbs	Gal
Tall oil alkyd resin[a]	658.0	82.3
18% Zr drier[b]	6.5	0.72
12% Co drier[b]	3.5	0.41
Antiskinning agent[c]	1.4	0.18
Mineral spirits	106.5	16.4
	775.9	100.01

Silica flatting agent added as shown in *Figure* 7.

Resins solids: 50.9%
Viscosity No. 4 F.C. - 90 sec
Dry to touch - 6 hr

(a) Aroplaz 1240-M60, Ashland Chemical Co.
(b) Nu-X-tra® driers, Tenneco Chemical Co.
(c) Skinno® #1, Mooney Chemical Co.

with this system. Dispersion can be achieved by either a paste or by stirring directly into the lacquer. Pastes can be easily made in methyl ethyl ketone but, as with any flatting agent, care must be taken to avoid drying which allows a crust to form that does not easily redisperse and may produce white specks in a film.

Figure 6 shows the flatting efficiency of a 7μ silica in the vinyl lacquer in *Table* 5. Efficiency is seen to be higher than for the 4μ silica, about six percent loading required for a 60° gloss of 10. The 85° sheen is approximately parallel to 60° gloss and only moderately higher. This type of finish shows more texture than that containing the 4μ flatting agent.

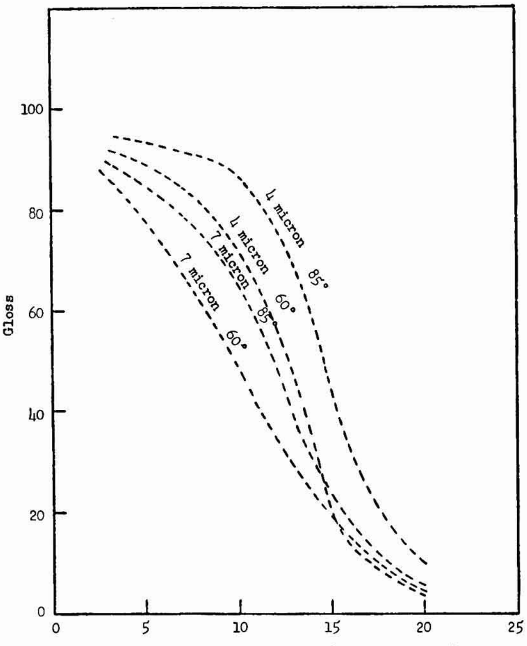

Figure 7—Flatting efficiency of 4 and 7μ silicas in an alkyd varnish

Table 7—Acrylic Coil Coating

	Lbs	Gal
Coroc® A-69-M[a]	55.6	6.74
Hi Sol® 15[b]	23.7	3.19
TiO_2, rutile	218	6.56
Disperse		
Coroc A-69-M	14.9	1.80
Hi Sol 15	6.3	0.85
Paste		
Coroc A-69-M	382	46.3
Hi Sol 15	166	22.3
Isophorone	31.2	4.07
Ethylene glycol monobutyl ether[c]	16.7	1.92
Cymel® 303[d]	40.8	4.08
Cyzac 1010[d]	1.1	0.16
Epon® 1001 (50% in toluene)[e]	2.0	0.24
Modaflow® (25% in xylene)[f]	14.0	1.70
Cal Ink MM6614 Blue[g]		
	972.3	99.91

Silica flatting agent added as shown in *Figures* 8 and 9.

Solids - 50.0%
Viscosity No. 4 F.C. - 90 sec.
Pigment: Binder - 0.8:1.0

(a) Cook Paint & Varnish Co.
(b) Ashland Chemical Co.
(c) Houston Chemical Co.
(d) American Cyanamid Co.
(e) Shell Chemical Co.
(f) Monsanto Chemical Co.
(g) Tenneco Chemicals, Inc.

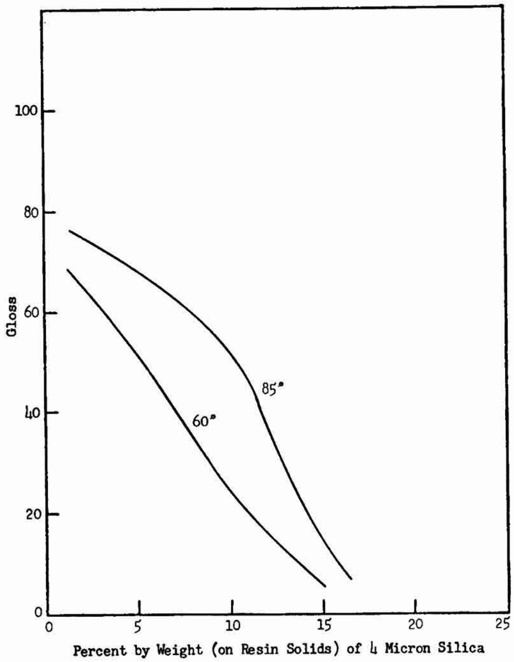

Figure 8—Flatting efficiency of 4μ silica in an acrylic coil coating

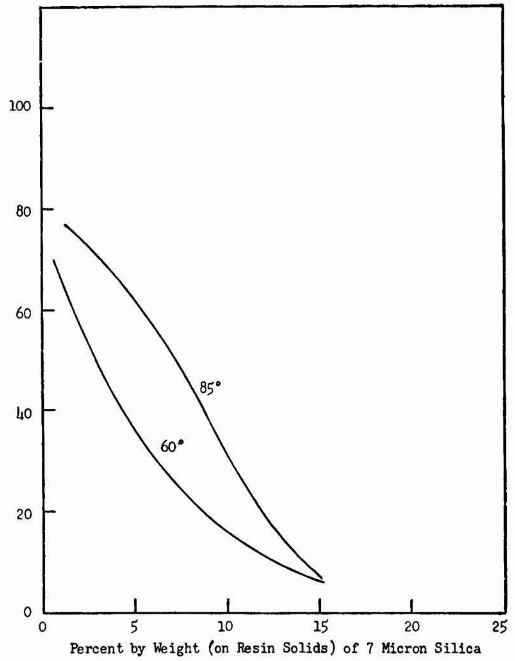

Figure 9—Flatting efficiency of 7μ silica in an acrylic coil coating

The performance of both the 4 and 7μ silicas in an alkyd varnish (*Table* 6) is shown in *Figure* 7. The greater efficiency of the 7μ flatting agent is apparent (larger disruptions of the film surface) until a 15% loading is reached where the 4μ particles are equally efficient in reducing 60° gloss. A higher 85° sheen persists with the smaller particles, due to more shallow "valleys" in the film surface diffusing incident light at 85°

Table 8—Water Based Acrylic Coil Coating

	Lbs	Gal
Rhoplex® AC658[a]	290	32.6
Tamol® 731[a]	18	2.0
Triton® CF10[a]	3.5	0.4
Nopco® NXZ[b]	0.6	0.1
Dimethyl aminoethanol	4.7	0.6
Water	9.4	1.1
Rutile TiO₂	235	7.1
Silica flatting agent (15% of resin solids)	52	3.0
Disperse 20' at 4000 rpm in high speed disperser		
Rhoplex AC658	450	50.6
Water	25	3.0
Butyl Cellosolve® (60% in H_2O)[c]	6	0.8
	1094	101.3

Note: Silica flatting agent can be added in let-down as "stir-in" material—transfer part of AC658 from paste to let-down.

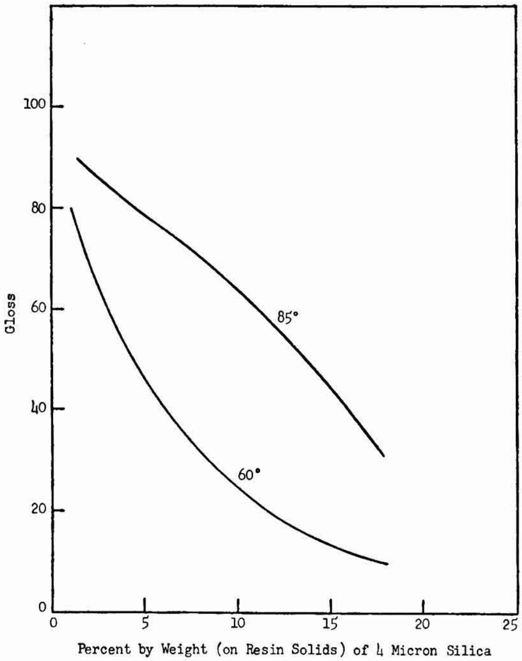

Figure 10—Flatting efficiency of 4μ silica in an acrylic emulsion coil coating

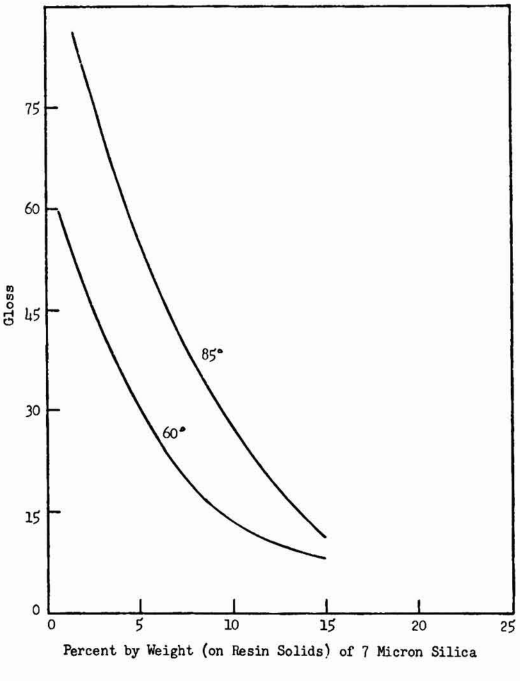

Figure 11—Flatting efficiency of 7μ silica in an acrylic emulsion coil coating.

(a) Rohm and Haas Co.
(b) Diamond-Shamrock Corp.
(c) Union Carbide Corp.

less efficiently.[1] As pointed out previously, more flatting agent is required for reducing gloss in a varnish than in a fast drying lacquer since the mobility of flatting agent particles persists longer in the slower drying varnish and they have an opportunity to migrate away from the surface.

The mechanism of flatting pigmented finishes containing extenders is somewhat different from clear lacquers and varnishes in that flatting agent particles are combined with other particles at or near the film surface. The flatting efficiency of a 4μ silica in a pigmented acrylic coil coating (*Table* 7) is seen in *Figure* 8 and that of a 7μ silica is seen in *Figure* 9.

The amorphous precipitated silica flatting agents described here are particularly interesting in water based finishes, due to the very hydrophilic nature of these silica surfaces which favor easy wetting and dispersion. The water based acrylic emulsion type coil coating shown in *Table* 8 produces gloss reduction as seen in *Figure* 10 for the 4μ silica and *Figure* 11 for the 7μ product. The greater efficiency of the 7μ material is obvious, as well as its ability to approach a 1:1 ratio for 60:85° gloss as the dead flat area is reached.

The properties and performance of precipitated amorphous hydrated silica flatting agents presented here are intended to show that this type of silica is ideal for flatting various types of coatings and can be used as effectively as other types of silicas such as pyrogenic silicas, aerogels, hydrogels, and ground natural products. The chemical inertness of this silica permits a range of products varying only in effective particle size (agglomerate size) which permits use for varying gloss reduction requirements, compatibility with different vehicle systems, and easy dispersibility. The ease of wetting of hydrated amorphous silica particles by both aqueous and nonaqueous media produces a "stir-in" type of flatting agent which minimizes dispersion energy and cost. The ability of the micro-porous structure in individual agglomerates to cause concentration near the surface of films increases flatting efficiency beyond that attainable from even distribution throughout the film.

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Inhibition of Yellowing In Linseed Oil Paint

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Ozonized commercial monoolein and acetoacetic ester were evaluated, in several concentrations, as potential yellowing inhibitors for a linseed oil paint. Contrary to expectations, the acetoacetic ester, in which the methylene hydrogens are alpha to two carbonyl groups, was less effective than the ozonized monoolein in which methylene hydrogens are alpha to only one carbonyl group.

KEY WORDS: Color measurement; Reflectance; Yellowing; Linseed oil paints; Inhibition of yellowing; Ozonized monoolein; Acetoacetic ester.

INTRODUCTION

The yellowing of linseed oil paints is an age-old problem. Although, over the years, many people have studied the problem, the nature of the materials showing the yellow color is still unknown. It is known[1] that yellowing increases with increasing unsaturation in the vehicle, with increase in temperature, with increase in humidity, with the nature of the drier, and with the wavelength of the light to which the film is exposed. Since it has been shown[1] that a linseed oil film will yellow when stored in a vacuum or in a hydrogen or nitrogen atmosphere as well as in ozonized air, Privett, et al.[2] suggested that "yellowing precursors" are formed during the oxidative drying process and that these materials then undergo some condensation reaction to yield a yellow-colored product. Privett, et al. found that low-molecular-weight aldehydes containing alpha hydrogens inhibit the yellowing of linseed oil films. Unfortunately, the low-molecular-weight aldehydes which inhibited yellowing, such as butyraldehyde, were too volatile to be tested satisfactorily by simply adding them to films, so special techniques had to be devised. Privett, et al. measured yellowing by an accelerated yellowing test[3] in which the film, prepared on filter paper, was kept at 50°C in a forced draft oven. The yellowing was measured as the difference in absorbance measurements at 520 and 650 nm.

We have studied the effect of two potential inhibitors of yellowing, ozonized commercial monoolein and acetoacetic ester (ethyl 3-oxobutanoate), on a paint known to yellow. The compounds chosen have hydrogens alpha to a carbonyl group and have relatively high boiling points. Acetoacetic ester is noted for the reactivity of its methylene hydrogens. The other inhibitor was made by ozonolysis of commercial monoolein. The fatty acid composition of this product is detailed in *Table* 1. Ozonolysis of pure monoolein yields 2,3-dihydroxypropyl azelaaldehydate, $OHC(CH_2)_7COOCH_2CHOHCH_2OH$ and nonanal. Ozonlysis of palmitoleate, linoleate, and linolenate contained in the commercial monoolein would yield the same dihydroxypropyl azelaaldehydate and shorter chain aldehydes which would be lost during removal of the solvents *in vacuo*. Infrared analysis of the ozonized mixture showed the presence of hydroxy, carbonyl, and aldehydic hydrogen absorption. Commercial monoolein was used rather than the pure monoolein because a possible inhibitor must be available at a reasonable price.

EXPERIMENTAL

Materials

PAINT: The paint used was supplied by Spencer-Kellogg Div., Textron, Inc. It had the composition indicated in *Table* 2.

OZONIZED MONOOLEIN: Ozone was bubbled through commercial monoolein (Matheson, Coleman, and Bell) (45 g) in methanol (150 ml) solution at −10°C for 1 hr until excess ozone was detected leaving the reaction flask. A Welsbach Ozone Meter was used to monitor the reaction. The pot was allowed to warm to room temperature under a nitrogen atmosphere. Glacial acetic acid (46 ml) was then added and followed by a slow addition of zinc dust (18 g), so that the temperature remained below 35°C. The mixture was filtered with Celite® diatomaceous silica and washed with methylene chloride. The methylene chloride-methanol solution was washed several times with saturated sodium chloride solution and the combined aqueous extracts were extracted several times with methylene chloride. The combined methylene chloride extracts

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†Mention of firms names or trade products does not imply that they are endorsed or recommended by the U.S. Dept. of Agriculture over other firms or similar products not mentioned.

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Table 1—Fatty Acid Composition Of Commercial Monoolein Before Ozonization

Fatty Ester	%
Palmitate	6.4
Palmitoleate	7.5
Stearate	1.6
Oleate	68.4
Linoleate	7.6
Linolenate	0.8
Total of four unidentified peaks	7.3

were dried over anhydrous sodium sulfate, and the solvents were removed *in vacuo* to leave a viscous yellow oil (36.4 g) which was used without further purification.

METHODS

Acetoacetic ester was incorporated into the paint in 1% and 5% concentrations by stirring. The ozonized monoolein was dissolved in ethyl ether (30 mg/ml) and quantities of the ether solution to give 0.1, 0.5, 1, and 5% concentrations (based on the whole paint) of the ozonized monoolein were stirred into the paint.

Masonite® panels (2 in. × 2 in. × ⅛ in., 50 mm × 50 mm × 3 mm) were primed on both faces and all edges with Sherwin-Williams Co's. "Exterior Wood Undercoater." Two coats of the experimental paint were applied one day apart to the smooth face of each panel. The samples were stored in a dark cupboard in a room controlled at 73°F (23°C) and 50% relative humidity.

Color was determined as previously described[4] by a weighted ordinate method after taking 17 readings 20 nm apart from 700 to 380 nm on a Beckman Model DB spectrophotometer with a reflectance accessory. Color was measured initially and at 2, 5, 9, 12, 17, 20, and 25 weeks. The colors stabilized by 12-17 weeks.

Table 2—Composition of Paint

Components	Pounds
Rutile TiO_2 (R-900®)	100
Anatase TiO_2 (Ti-Pure® FF)	100
Zinc oxide (XX-601®)	300
Talc (Nytal® 300)	350
K.V.O. linseed varnish oil	304
T1215 Z2 heat bodied linseed oil	132
Mineral spirits	116
Fungicide (Metasol® TK-100)	1
6% Cobalt naphthenate (0.05%)	3.5
24% Lead naphthenate (0.5%)	9.0
	1415.5

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XX-601 is a registered trademark of New Jersey Zinc Co.
Nytal is a registered trademark of R.T. Vanderbilt Co., Inc.
Metasol is a registered trademark of Merck & Co., Inc.

DISCUSSION

The results obtained are presented graphically in *Figure* 1.

Ozonized commercial monoolein showed little inhibiting effect at 0.1% concentration. It showed significant inhibiting effect at 0.5% concentration, but no greater effect at 1% or 5% concentration. Thus, 0.5% ozonized monoolein appeared to be optimal for this system.

Acetoacetic ester showed an inhibiting effect at the 5% but not at the 1% level. However, even at the 5% level it is not as good as ozonized monoolein at the 0.5% level. According to Privett, et al.[2] aldehydes with alpha hydrogens (e.g., butanal, hexanal) showed an inhibiting effect, whereas those without alpha hydrogens (e.g., chloral, benzaldehyde) did not. Contrary to expectations, acetoacetic ester, in which the alpha hydrogens are activated by two carbonyl groups, was not as effective as the ozonized monoolein where the alpha hydrogens are activated by only one carbonyl group.

All of the prepared linseed paint films exhibited visi-

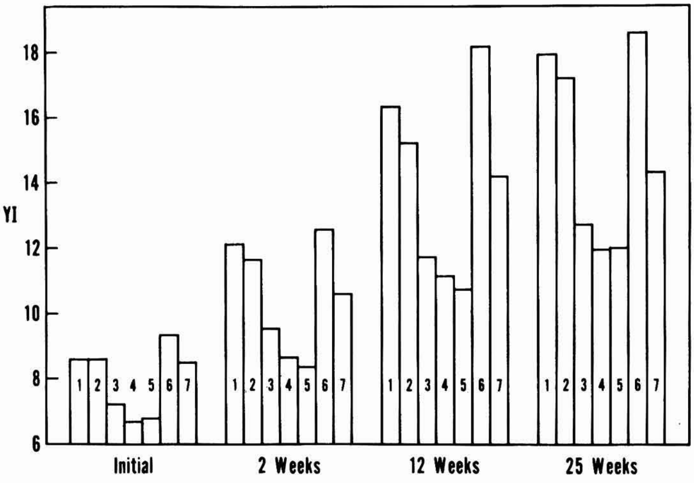

Figure 1—Yellowness index vs. time for linseed oil films containing different amounts of potential yellowing inhibiting agents. 1 = no inhibitor; 2 = 0.1% OMO; 3 = 0.5% OMO; 4 = 1% OMO; 5 = 5% OMO; 6 = 1% AAE; 7 = 5% AAE. OMO is ozonized commercial monoolein; AAE is acetoacetic ester.

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ble yellowing. The formulations containing optimal amounts of the two inhibitors were noticeably less yellow than the uninhibited films.

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Review of Underwater Cleaning Methods And Their Interaction on Navy Anti-Fouling Paint Systems

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Periodic underwater cleaning of Naval shipbottom anti-fouling paint systems can maintain high level ship performance with attendant reduction in fuel consumption, for extended periods between drydockings. Power brush cleaning at present offers the most effective method of removing fouling from shipbottoms and restoring the AF surface to toxic levels. Removal of slimes, grasses and early calcareous forms can be routinely accomplished without paint damage. Semi-automatic multibrush vehicles are operational on a commercial basis and are used for cleaning large ships where diver held brushes would be excessively labor intensive. More work is required to address frequency of cleaning, cleaning of sea chests and techniques for underwater repair.

KEY WORDS: Anti-fouling system (AF); Anti-corrosive paint (AC); Cuprous oxide toxic; Underwater cleaning.

INTRODUCTION

Navy vinyl anti-fouling (AF) systems have been in use for many years to protect ships against fouling. Ships have remained free of fouling for as little as 15 months in temperate and colder waters and for as little as six months in tropical and warmer waters.

Operating and maintenance costs and the performance efficiency of Navy ships have become matters of increasing concern because of rising prices and budget limitations, particularly the large increase in the cost of fuel.

Until such time that improved AF paints can be developed with environmentally accepted toxicants having long-term effective resistance to a wide spectrum of fouling organisms, other techniques are needed to resolve the problem. Heretofore, the concept of application and renewal of AF paint systems on ships was restricted to drydock operations. Little thought, until recently, was given to periodic maintenance and repair of hull AF paint systems while the ship remained waterborne.

This paper summarizes the use of underwater cleaning methods in combination with present Navy AF paint systems to improve anti-fouling performance and extend service life. The paper will examine in logical sequence: hull fouling from the viewpoint of the underwater observer to determine when intervention for its removal is required; underwater cleaning methods currently in use; problems and benefits of periodic mechanical cleaning on the painted surface from a laboratory and field approach; some examples of full scale cleaning by diver-held rotary power brushes and by semi-automatic diver guided multibrush vehicles; and will conclude with some unexpected gains to be derived from the combination process as well as some unsolved problems for future study.

FOULING REMOVAL AND AF PAINT RESTORATION

Drydock vs. Underwater Techniques

Ship bottoms are painted for the obvious reasons of protecting the steel hull from corrosion by seawater and preventing or reducing the accumulation of marine fouling organisms. Pitting corrosion, if unabated, can ultimately lead to the loss of structural and water tight integrity of the hull. The accretion of fouling results in marked hull roughness and additional dead weight.

It is taken for granted that all interior and exterior coating systems above the water line are periodically inspected, maintained, and repaired while the ship is afloat. For exterior coating systems below the water line, it has been customary in the past to drydock the ship after two to four years of service, remove the old fouling coating systems to the bare steel and apply a new coating. Such a procedure which tolerates the progressive buildup of fouling results in a continuous degradation of ship performance and a consequent increasingly higher fuel consumption. By permitting the hull paint system to deteriorate far beyond the point of restoration during intervals between drydockings, higher costs of labor and material are incurred to replace the entire ship bottom coating system. Moreover, grit blasting of the hull to remove the AF/AC coating systems gradually reduces the effective thickness of the

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*Annapolis Laboratory, Annapolis, Md. 21402.

Table 1—Navy AF/AC Paint Systems

Location	AF	AC				Total Thickness
Hull	Paint Color	Type	1st Coat Paint Color	2nd Coat Paint Color	3rd Coat Paint Color	Mils
Bottom and appendages	Vinyl 121^a Red	Epoxy	150^c Green	152^d Grey	154^e Black	10-15 (0.25-0.38mm)
		Vinyl	117^f Blue	119^g Orange	119 Orange	9-13 (0.23-0.33mm)
Boot topping	Vinyl 129^b Black	Epoxy	150 Green	152 Grey	154 Black	10-15 (0.25-0.38mm)
		Vinyl	117 Blue	119 Orange	119 Orange	9-13 (0.23-0.33mm)

(a) Formula 121/63 anti-fouling, red (vinyl) MIL-P-15931 based on Cu_20.
(b) Formula 129 anti-fouling, black (vinyl) MIL-P-16189 based on Cu_20.
(c) Formula 150 epoxy-polyamide green primer MIL-P-24441/1.
(d) Formula 152 epoxy-polyamide haze grey exterior topcoat MIL-P-24441/2.
(e) Formula 154 epoxy-polyamide black exterior topcoat MIL-P-24441/5.
(f) Formula 117 vinyl wash primer MIL-P-15328.
(g) Formula 119 vinyl red lead AC MIL-P-15931.

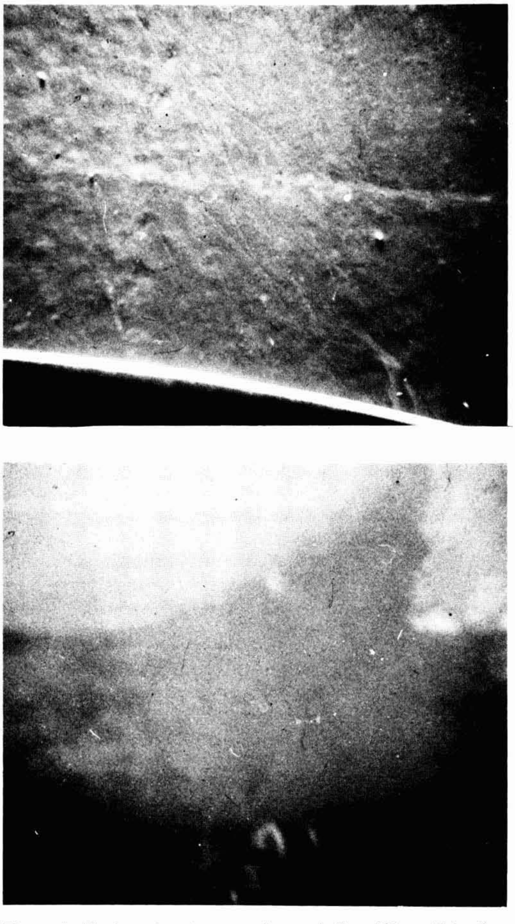

Figure 1—Underwater close-up views of slime (Stage 1) fouling (top), and partially cleaned surface (bottom)

hull plating and thereby may limit the ship's service life expectancy.

In the past decade, significant progress has been made in underwater technology as evidenced by improved diver life support systems, diver mobility and communications, development of power tools, and video and photographic documentation. The impetus to apply this technology for the removal and control of fouling on hulls of Navy ships has been spurred by the looming world-wide energy crisis. Demands are being made that stringent fuel conservation measures be taken to insure that ships operate more efficiently and economically than in the past.[1,2] Former levels of fouling and intervals of drydocking are no longer acceptable. One viable alternative is to periodically remove fouling growths and restore the function of the AF hull paint system while the ship is afloat and to institute a policy of drydocking ships only for extensive overhaul and repair.

NAVY ANTI-FOULING/ANTI-CORROSION (AF/AC) PAINT SYSTEMS

Cuprous oxide based Navy anti-fouling (AF) paints have been undergoing continuous refinement over the past several decades culminating in the present vinyl anti-fouling system widely used in the fleet. These AF paints are applied over multi layers of vinyl or epoxy anti-corrosion (AC) coatings to form suitable AF/AC systems as shown in *Table* 1.

The use of AC coatings, aside from corrosion protection, per se, is necessary in order to electrically isolate the AF paint from the hull so that the cuprous oxide toxic can perform its function without undesirable galvanic interference with the hull.[3]

Although cuprous oxide toxics have been quite effective in preventing barnacle and tunicate fouling, these

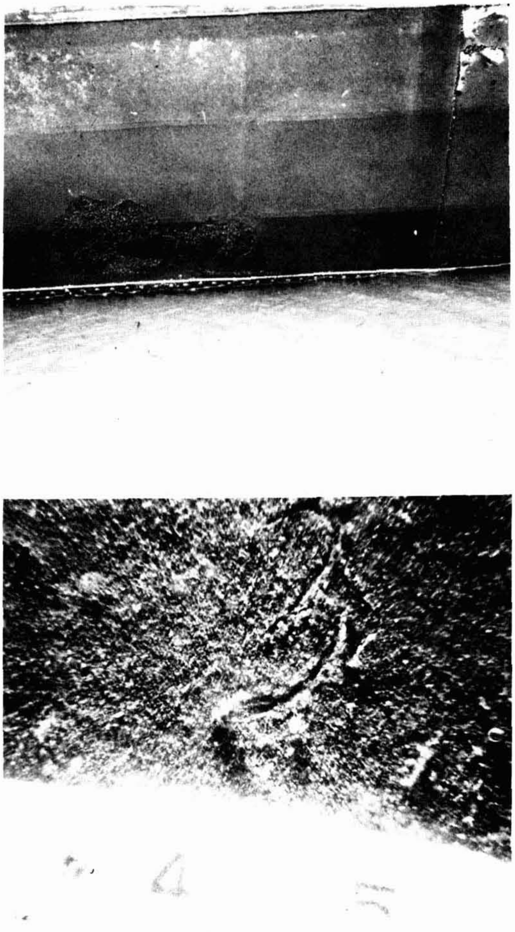

Figure 2—Appearance of incipient grass (Stage 2) on exposed portion of hull, USS Blakely (FF1072) going into drydock (top), and underwater close-up view of same growth (bottom)

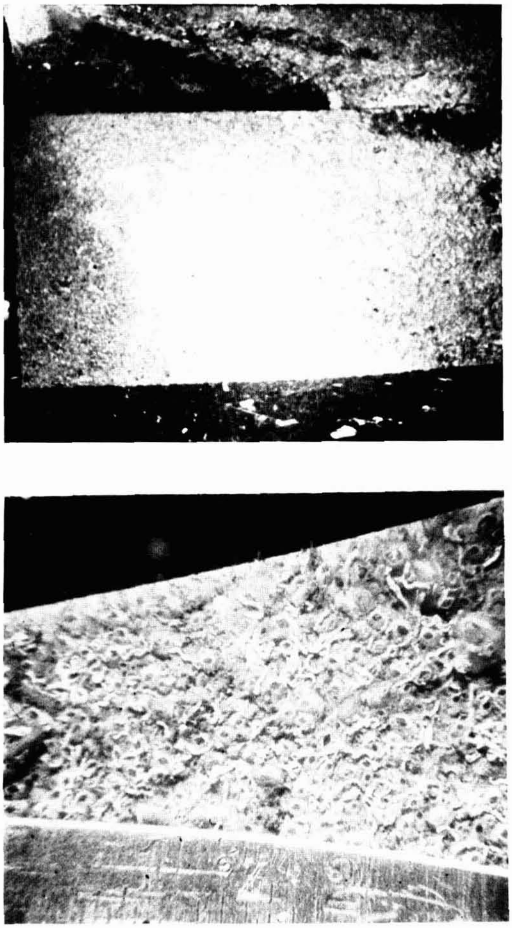

Figure 3—Calcareous (Stage 3) fouling on partially exposed rudder of USS John King (DDG-3) going into drydock (top), and underwater close-up of same growth (bottom)

paints have not demonstrated good resistance to slime and algal accretion, to be discussed further.

New paint formulations containing organometallic compounds and other biocides are under development to respond to a larger spectrum of fouling organisms.[4] Much work needs to be done before these newer paints can be released for general use, including minimization of environmental pollution side effects and personnel hazards associated with their manufacture, application, and removal.

HULL FOULING — UNDERWATER OBSERVATION AND DOCUMENTATION

Most of the field studies on ship fouling and AF paint development have been based on observations made when the ship was out of the water, in drydock, usually after some extended period of service. In most instances, significant intermediate events that may have contributed to or led to the final appearance of the hull remained unknown or uncontrolled. The use of reliable underwater techniques for assessing the conditions of the hull without reliance on drydock inspections is a necessary adjunct to periodic underwater cleaning. Through the use of battery-powered lighting equipment, light weight, mobile TV cameras, and waterproof still and movie cameras controlled by skilled divers, it is feasible to systematically survey the underwater hull and record the nature and extent of fouling and the degree of deterioration of the hull bottom AF/AC paint system before and after underwater cleaning. It is anticipated that the close study and observation of the ship fouling, as it interfaces with underwater cleaning, will accelerate the overall development of optimized techniques for more effective controls.[5]

Hull Fouling Community

It is common knowledge that fouling comprises a community of organisms ranging from the microscopic

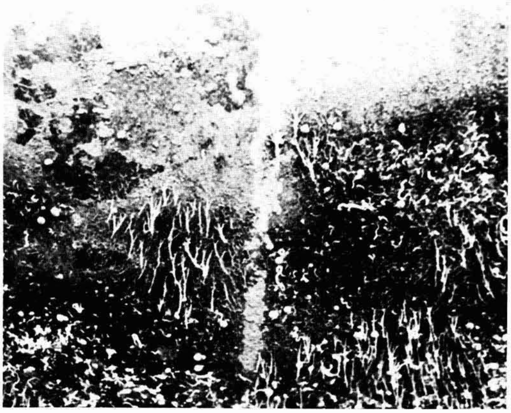

Figure 4—Fouling on a nontoxic surface, (Stage 4)

one-celled forms to the more complex sedentary animals such as the barnacles, tubeworms, and tunicates. The aspects of fouling that are pertinent to underwater cleaning are:

- Identification of various forms of fouling.
- Interpretation of the presence of fouling with respect to condition of the AF/AC paint surface.
- Distribution and density of fouling as it affects the selection of the proper tool for its removal.

As it degrades, the weakening toxic action of the cuprous oxide allows the most resistant organisms to attach first, followed in time by the accrètion of those fouling species of decreasing immunity to the toxic. Although this is a sequential process reflecting diminishing toxicity of an AF paint system, it can for convenience, be visually identified in four stages by an experienced underwater observer:

STAGE 1—A slime layer comprising unicellular organisms that appear as a level and smooth surface or intimately following the contours of the hull surface, shown in *Figure* 1. The presence of a slime film is readily discerned by passing the hand over the surface thus generating a cloud of organic debris in the adjacent water and a visible change in the color of the painted surface marking the pass. The presence of only the slime layer indicates that the AF/AC system is functioning as a toxic deterrent to the attachment of calcareous fouling. The presence of the slime also indicates that there are various microorganisms in the biosphere that have a natural resistance to the cuprous oxide toxic. Slime layers are the easiest to remove by underwater cleaning.

STAGE 2—The growth of incipient grass as small vertical projections and/or a flat network of connecting threads. These are multicellular organisms that may increase 3-4 in. in length. This stage has a green appearance along the waterline changing to a yellow-brown color in the lower areas of the hull where there is less light. Surfaces below the waterline flaring away from the hull such as the top AF painted portion of a bow mounted sonar dome may also have green fouling organisms. The presence of only grasses and slimes on a surface indicates that the AF/AC system is still functioning to prevent attachment of the advanced stages of fouling, shown in *Figure* 2. These organisms are slightly more difficult to remove underwater when compared with slimes, but offer no mechanical problem other than a slight decrease in rate of removal.

STAGE 3—Cumulative attachment of barnacles and tubeworms with the slime (Stage 1) and grass (Stage 2) signifies an AF paint of diminishing toxicity, as shown in *Figure* 3. At this stage, the AF paint system is not performing fully due to surface barriers interfering with proper toxic release or due to partial mechanical damage to the paint film itself. The underwater removal of calcareous growths from intact paint surfaces is more difficult, is labor intensive, and in the advanced stage, may cause damage to the AF paint surface when using a hand held tool.

STAGE 4—A fouling community comprising all forms but identified by the presence of soft bodied animals such as tunicates that are most sensitive to the cuprous oxide toxic. Such a surface is considered to be nontoxic, as shown in *Figure* 4. In this case, complete loss of toxicity can be attributed either to the formation of impermeable barriers on the AF paint surface or the complete loss of the AF paint film. These growths are the most difficult to remove.

FOULING/PAINT INTERACTION

Diminishing toxicity observed on intact Navy cuprous oxide AF paints, as determined by the accretion of stages 3 and 4 fouling, can be explained by the formation of surface barriers which interfere with toxic leach rate, as illustrated in *Figure* 5. These surface barriers arise as result of complex interactions of a physical, chemical, and biological nature taking place in concert.

Physical Interactions

As the toxic leaches from discrete sites on the surface layers of the AF paint, a porous matrix gradually develops which physically impedes the rate of solution of toxic from within the deeper layers of the paint film.

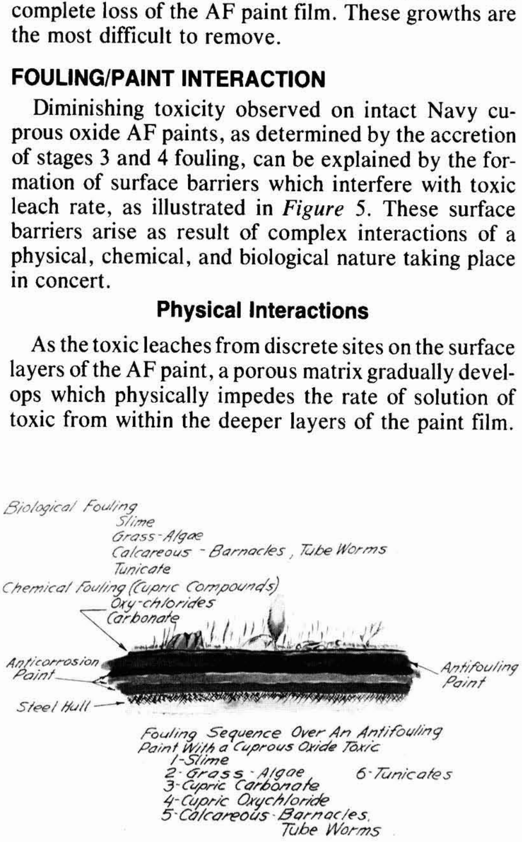

Figure 5—Fouling interaction with AF paint

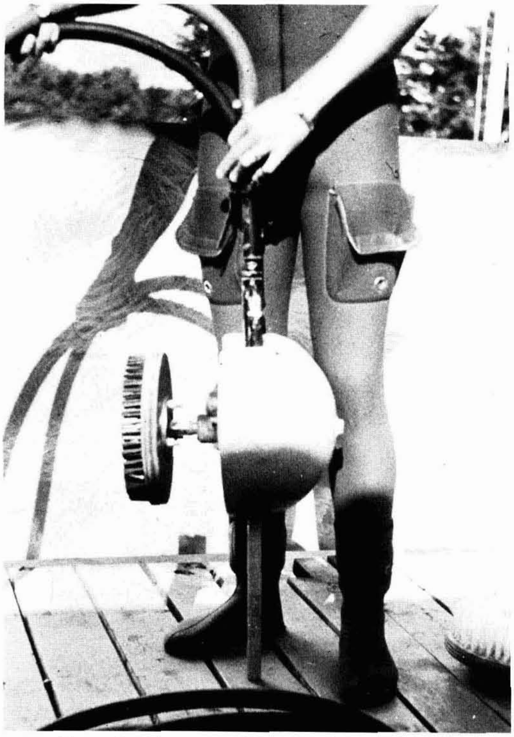

Figure 6—Diver controlled rotary brush assembly

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The porous vinyl matrix structure also provides a suitable haven for attachment of microorganisms whose presence causes a further obstruction to the free passage of the toxic in solution.[6]

Chemical Interactions

The cuprous ion in seawater in the presence of oxygen forms cupric carbonate which deposits as a green layer over the AF paint.[7] Cupric carbonate has a lower solubility than cuprous oxide but is sufficiently toxic to prevent attachment of calcareous fouling (barnacles and tubeworms). However, the cupric carbonate in time, when exposed to seawater in the presence of oxygen, converts to cupric oxy-chloride compounds which are a greenish-blue color and deposit as an insoluble layer over the cupric carbonate. This reaction renders the surface nontoxic and tends to seal off the unused toxic that may still be present in the AF paint film.

Biological Interactions

This type of fouling, particularly the microorganisms, have a marked effect on the chemical barrier formation affecting leaching rate.[8] If the slime is composed of organisms that release oxygen (algae), then the formation of cupric compounds is accelerated, thereby reducing the long term effectiveness of the AF paint. On the other hand, if the slime consumes oxygen (aerobic bacteria), then the rate of cupric compound formation is reduced, leaving the surface of the AF paint less impeded for passage of the toxic.

NEED FOR PERIODIC CLEANING

Although the use of toxics in anti-fouling paints to control fouling on ship hulls was a major discovery, none of the current Navy AF paints can provide long term, unattended foul-free service. Navy ship hulls have sometimes fouled measurably in as little as 15 months in temperate waters and in as little as six months in tropical waters. No current technology anti-fouling paint systems are known that are effective over the entire range of fouling organisms for five years of unattended service. However, certain types of organometallic compositions currently under development at the Naval R&D Center, are expected to provide long term unattended AF service. Hull cleaning may even further enhance the service life of these paints.

The concept of periodic underwater cleaning complements the currently used Navy AF paint systems in the quest for effective fouling control over an extended term by performing the following functions:

(1) Removes slime and grass which have a natural resistance to the Cu_2O toxic. These organisms are soft, less adherent and can be easily removed mechanically without damage to AF paint.

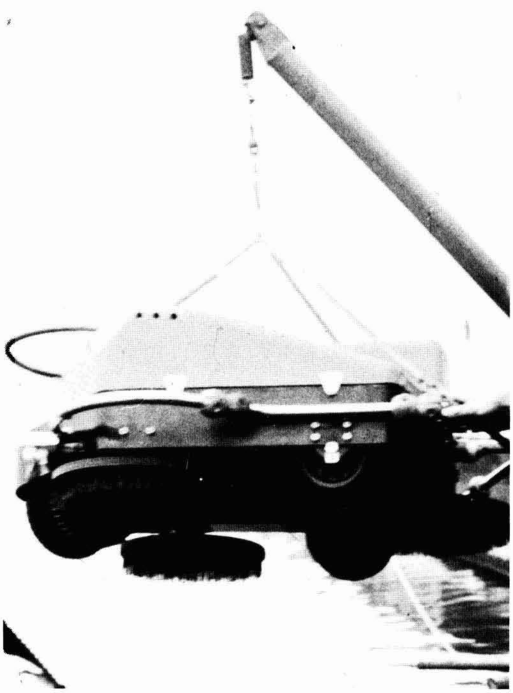

Figure 7—Brush Kart cleaning unit

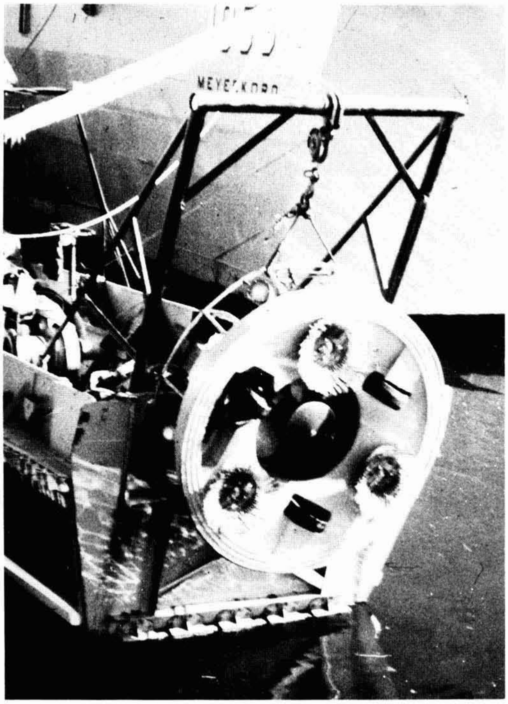

Figure 8—Underside of "SCAMP" cleaning unit

(2) Removes the cupric compounds that form over the AF paint progressively preventing the leaching of the toxic.

(3) Removes the outer layers of the spent AF paint to expose a fresh AF paint surface. This action maintains effective toxicity levels to prevent attachment of gross forms of calcareous fouling which are difficult to remove and may cause damage to the AF paint system.

UNDERWATER CLEANING METHODS

Of the various underwater cleaning methods available, three methods merited serious consideration:[1]

- Rotary powered brushes
- Jets
- Explosive detonation

Various designs employing the rotary brush are in current use commercially. The underwater use of jet cleaning is still in a developmental stage.[9,10] The "Sea Mesh" system which uses a network of explosive cords positioned near the hull was found to be unsuitable for Naval use after some preliminary evaluation tests.[11]

The brush cleaning system uses either a rotary disc with bristles attached to one face, in a single and multiple arrangement, or a cylinder rotating axially with bristles mounted on the surface and projecting radially. The single rotary disc brush hand held by the diver, varies from 8 in. to 14 in. in diameter (shown in *Figure* 6). Diver-operated multibrush vehicles like the Brush Kart®, *Figure* 7, and SCAMP®, *Figure* 8, have brushes of 18 and 24 in. in diameter, respectively. These brushes are so configured as to remove a swath of fouling of 4 ft for the former and 6 ft for the latter. The cylindrical brush is usually 3 ft in diameter and up to 20 ft in length mounted on the bow of a special workboat, as shown in *Figure* 9, and is used for removal of fouling at the waterline and boot top areas.

The rotary disc power brush is the design most commonly used and has the desirable feature that the rotary action itself maintains the brush in intimate contact with the surface being cleaned. By slightly tilting the brush on edge, sufficient traction is obtained to permit the diver to guide the tool in the desired direction to traverse the surface that is being cleaned. Another feature of the power brush is its flexibility in satisfying a variety of cleaning requirements through the selection of optimum brush design, bristle characteristics, and rotational speeds. The hand held scrubber equipped with a stiff bristle polypropylene brush can remove light to moderate fouling (barnacles less than 0.25 in. in diameter) without damage to the AF paint.

On more advanced fouling and on ships of the destroyer class and larger, where the labor intensive nature of the work becomes critical, a multibrush vehicle such as SCAMP emerges as a preferred method for cleaning. In all underwater fouling removal involving

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Brush Kart is a registered trademark of Phos Marin, Inc.

SCAMP is an acronym for Submerged Cleaning And Maintenance Platform. It is also a registered trademark of Butterworth Systems, Inc.

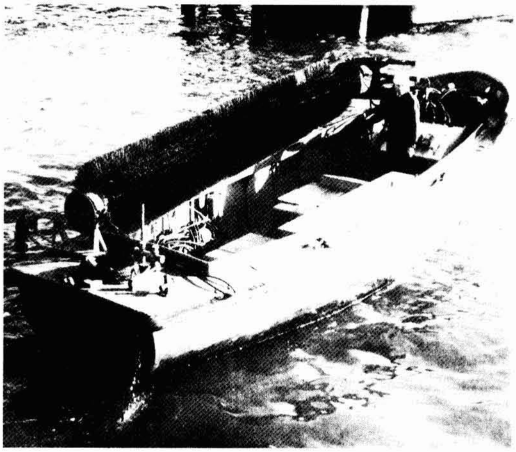


Figure 9—Brushboat system

the multibrush vehicles, the hand held rotary brush is a necessary adjunct to enable cleaning of areas inaccessible to the multibrush vehicle.

Although the basic cleaning tool is the brush, there are locations on the hull where specialized tools are still to be developed to efficiently clean surfaces with a small radius of curvature such as propellers, drive shafts or fairwater caps and other confined or inaccessible spaces such as sea chests.

Benefits

As mentioned before, periodic underwater cleaning, if performed properly, can safely remove slimes, grasses, and incipient calcareous forms of fouling without damage to the intact anti-fouling paint on the hull. The cleaning action of the brushes can also cause removal of the insoluble cupric compounds and the outer layers of spent AF paint, thus restoring the remaining AF paint film to its full function once again. A change in color from the green cupric compounds to the red AF paint during brushing alerts the diver when restoration of the surface is being achieved. Such controlled removal of the unwanted outer surface materials enables the retention of still useful paint layers, particularly the epoxy anti-corrosion components of the AF/AC paint system. Periodic underwater cleaning also provides a reliable means for on-the-spot assessment of the overall condition of the hull.

Problems

The primary questions of how and when to clean a fouled navy ship in the most practical cost-effective manner is the focus of the DTNSDC program. However, some problems relating to the paint/cleaning interface are under active study in the laboratory and the field in order to develop and optimize the "how" aspect of cleaning:

(1) Develop criteria for brush selection and operation in removing various stages of fouling from painted and unpainted surfaces.

(2) Determine degree of paint wear and/or damage associated with repetitive brushing on newly applied and aged paint systems.

(3) How much of the chemical green layer must be removed from AF paints during brushing for restoration of anti-fouling action? Can sufficient removal of the green layer be visually determined by the diver?

(4) Does periodic cleaning alter the refouling rate on an AF paint under similar exposure conditions?

(5) Can localized damage of the AF/AC paint system be repaired underwater? If so, are the repaired coatings scrubbable in the same manner as the original paint system?

(6) What can be done to improve brush control and orientation by the diver in waters of poor visibility?

To study various aspects of fouling and aging of AF paint systems, 15 × 18 × ⅛ in. panels coated with the AF/AC paint system are exposed in four panel sets for scheduled periods at Miami, Fla., Pearl Harbor, Hawaii, and Solomons Island, Md. At the termination of the exposure period each set of four panels is packed in the wet condition in a water tight box and shipped by air freight to a test pond located at the Center. When the panels are received, they are photographed and then mounted on a special cleaning rack at the test pond which permits simulation of diver cleaning of an underwater surface with a hand held rotary brush. A sketch of the test pond arrangement is shown in *Figure* 10.

Underwater cleaning of the panels is done by divers using actual full scale power tools, both pneumatic and hydraulic, and an assortment of brushes. After cleaning, the panels are re-examined, photographed, and paint thickness measurements are taken. They are then returned to the exposure sites for refouling and further aging. In an initial study using a stiff bristle propylene brush to remove slimes and incipient grass from freshly painted panels exposed three months, the cumulative paint wear after 18 repetitive passes with the brush was less than 2 mils (0.05mm). These data indicated that

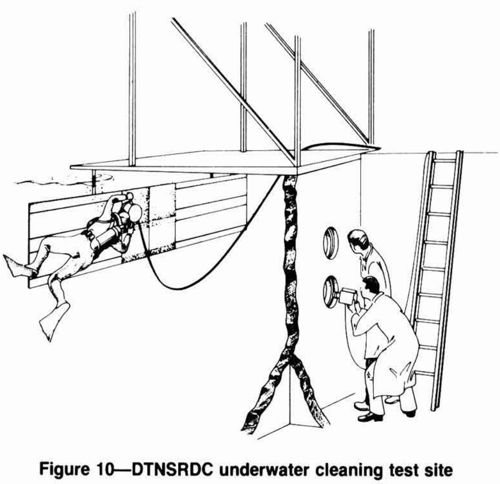


Figure 10—DTNSRDC underwater cleaning test site

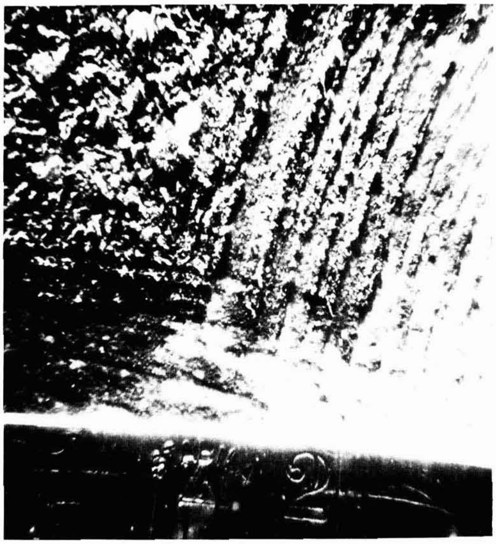
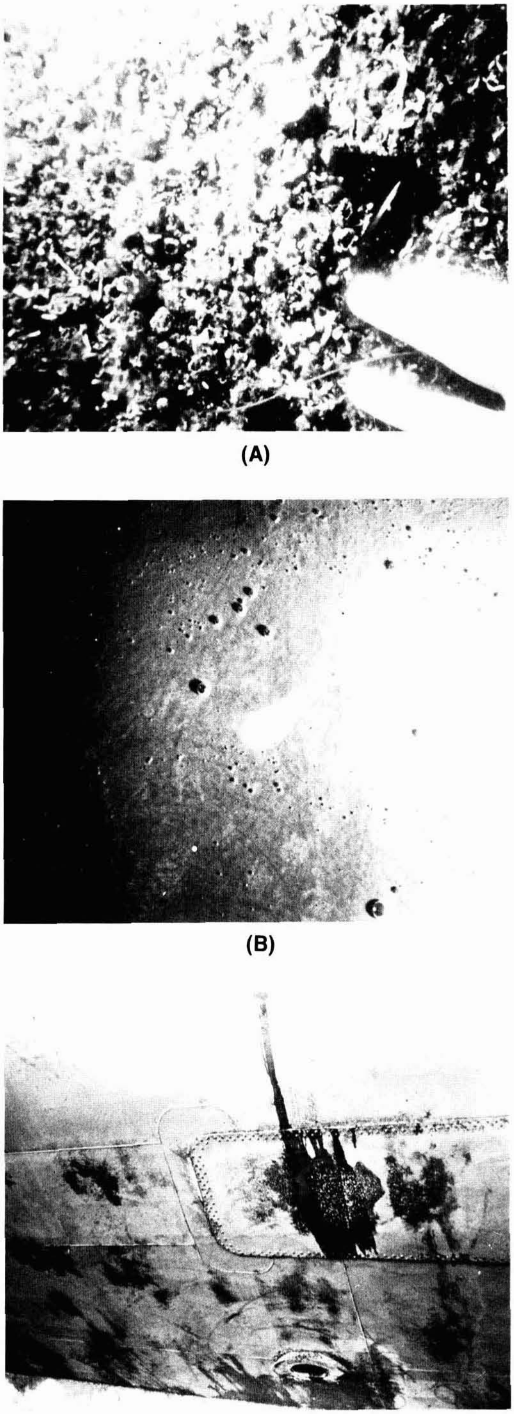


Figure 11—Underwater close-up of fouled and rotary brush cleaned area on hull of the USS Blakely (FF1072) (21 months service)

present Navy AF paints can be scrubbed without damage by polypropylene brushes. These experiments are being repeated on aged panels exposed for longer periods. Data obtained during cleaning of fouling on two destroyers USS Blakely (FF1072) and USS John King (DDG-3) 21 months and 52 months out of drydock, respectively, further indicated that hard polypropylene brushes were able to remove fouling up to incipient stage 3 without damage to the paint, as shown in *Figure* 11. When more severe fouling, advanced stages 3 and 4, were encountered, the SCAMP was used to remove the fouling with no damage to the paint surface, as shown in *Figure* 12.

The handling and control characteristics of pneumatic and hydraulic powered hand-held rotary brushes is currently being evaluated at the test pond. Operational parameters of brush geometry and bristle characteristics are under study. The rotational speed of the brush is an important parameter because it directly relates to the ability of the tool to remove fouling in one pass without damaging the AF paint surface. The brushes included in the current investigation are characterized in *Table* 2.

Handling of the tool under a variety of underwater conditions is also under study. Two aspects of operation are being evaluated: position of surface from the overhead position (ship bottom) to the vertical (ship sides); and degree of visibility, which is a pervasive problem in underwater cleaning. Changing conditions of visibility affect the manner in which the tool is held, how well the diver can follow the edge of the previous cleaned swath, and how quickly he can traverse the surface at a selected rpm and still clean in one pass without damaging the AF paint.



(A)

(B)

(C)

Figure 12—Views showing (A) underwater close-up of fouling (Stage 4), (B) underwater close-up of cleaned surface by SCAMP and, (C) overall view in drydock

Table 2—Brush Characteristics Data

	Plywood Base							
Brush	No. of Plies	Dia. of Brush (in)	Dia. of Bristle (mil)	No. of Bristles in Bundle	Angle of Bristle with Base, (deg)[a]	Length of Bristle (in.)	Material of Bristle	Spacing Between Bristle Bundles (in.)
A[b]	9	12(30.5 cm)	120-125(3.05-3.17 mm)	4-5	90	2.25(5.71 cm)	polypropylene	0.5 (1.27 cm)
B	9	10(25.4 cm)	20-25 (0.51-.64 mm)	23-30	60	2.5 (6.35 cm)	soft steel	0.75 (1.91 cm)
C	9	10(25.4 cm)	30-35 (0.76-.88 mm)	60-65	60	2.0 (5.08 cm)	polypropylene	0.875(2.24 cm)
D	11	14(35.5 cm)	60-65 (1.53-1.65 mm)	12-15	70	2.0 (5.08 cm)	polypropylene	0.5 (1.27 cm)

(a) The exterior acute angle formed by the base and the bundle of bristles that slant away from the center.
(b) Stiff bristle polypropylene brush.

FIELD STUDIES—FULL SCALE CLEANING

Field studies have been initiated to develop information on "when" to clean ships and to evaluate multibrush vehicles for cleaning ships larger than destroyers.

When to Clean

Information to determine when to clean is based on cost of cleaning, optimum ship performance, fuel consumption, and longevity of AF paint. For this work speed/power measurements are made under standardized trial conditions[1,5] using an appropriate speed sensor and a torsionmeter. The speed sensors are calibrated over a measured mile course. The torsionmeter mounted on the drive shaft can measure changes in horsepower (arising from frictional drag) resulting from cumulative fouling or its removal by cleaning. Four ships, two on each coast, have been instrumented and their speed/power characteristics will be monitored over a period of two years. The test ship on each coast will be periodically cleaned and compared to its corresponding control ship (not cleaned over the entire test period). The data developed from these tests will define a cost-effective frequency of cleaning consistent with optimum fuel savings and extended paint life. Until such data are forthcoming, it is recommended practice to inspect ship hulls quarterly and make the decision to clean when divers fully observe developed stage 2 fouling (grasses), and incipient stage 3 (barnacles less than 0.25 in. diameter). It is anticipated that twice per year cleanings will be required in temperate waters and perhaps three cleanings per year for tropical waters.

Multibrush Vehicles

Underwater cleaning with hand-held brushes is labor intensive, and likely to cause damage to AF/AC paint when performed by inexperienced persons removing heavy calcareous fouling. A multibrush vehicle, such as the SCAMP, is more suited to removing heavy calcareous fouling from Navy ships of the destroyer class and larger. Over 30 Navy ships have been cleaned in the past two years using the SCAMP. These ships were heavily fouled after three to four years of service. The cleaning was performed to restore the loss in the ship's operating speed so that it could accomplish its missions. The SCAMP has effectively removed calcareous fouling with minimal damage to the AF/AC paint system. A typically fouled surface before and after cleaning by SCAMP in shown in *Figure* 12. SCAMP demonstrated an ability to remove material in layers and expose the interface of the layer of green copper compounds and the red AF paint surface. This mottled surface of green and red assures that the AF paint is exposed, together with retention of green copper compounds, which are also toxic to calcareous fouling, and that minimal AF paint was removed during the cleaning operation.

ADVANTAGES OF UNDERWATER CLEANING

Underwater cleaning, as it is envisioned over the long term, is a hull maintenance procedure performed while a ship is afloat. The gains to be realized by underwater cleaning are:

(1) Maintain designed maximum speed capability of ship.

(2) Extend longevity of AF/AC paint systems.

(3) Delay drydocking for several months if desired.

(4) Provide opportunity for pre-drydock inspection as basis for setting up priority schedules for limited drydock facilities.

(5) Expedite hull inspection and survey in drydock.

(6) Reduce environmental impact by increasing dispersal and decreasing the bulk of fouling removed from hulls on a fleet wide basis (Stage 1 and 2, slime and grass, more readily assimilated by environment than advanced stage 3 and 4, calcareous fouling accretions).

(7) Reduce volume of refuse removal in drydock.

(8) Maintain high level of sonar operation by frequent grooming of sonar dome.

FUTURE STUDY

This paper has attempted to put into perspective the viability of underwater cleaning as a powerful technique for achieving fuel conservation and extended drydocking intervals of Naval ships without compromising ship performance. Obviously, the technology has come of age and is being applied rapidly in naval and merchant fleets, worldwide. There still remain areas which require further investigation in order to optimize the system for universal acceptance. Work planned for the future include:

- Develop jet system for removing fouling from sea chests and other areas inaccessible to brushes.
- Develop methods for underwater application, repair and removal of AF/AC hull paint systems.
- Study refouling rate of cleaned painted surfaces.[12]
- Continue improvement of scrubbable AF/AC paint systems.[13]
- Improve advanced work boats and platforms.
- Develop fully automated ship grooming system.

ACKNOWLEDGMENTS

This work has been sponsored by NAVSEA (0331G) under the Navy Energy R&D Program. The work has been accomplished in the Nonmetallics Div. of the Materials Dept. of the David W. Taylor Naval Ship R&D Center. The underwater photography, inspection, and cleaning with hand held rotary brushes, was performed by the Center's diving team, Messrs. F.A. Sampson, M.F. Oakes, A.P. Partlow, Jr., and E.L. Whitmore. The opinions expressed in this paper are solely those of the authors and do not necessarily reflect the official views of the Naval Establishment. ☐

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Water Dilutable, Dispersible, And Emulsifiable Epoxy Resins

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Three procedures have been developed for introducing epoxy resins into water-borne ecologically acceptable systems: (1) Epoxy resins modified with hydrophilic moieties that make the polymer water dilutable; (2) Resin/surfactant combinations that can be dispersed in water; and (3) Resin/surfactant/solvent mixtures that can subsequently be emulsified. Each procedure results in systems that have specific advantages and disadvantages. Recently, formulations containing a water dilutable epoxy resin in the aqueous phase and either an emulsified or dispersed resin in the particulate phase were prepared.

Preliminary data indicate that these systems possess the processing and handling properties of standard solvent systems and the performance of epoxy resins.

KEY WORDS: Water-borne epoxies; Emulsions; Dispersions; Can coatings; Coil primer coatings.

INTRODUCTION

Recently, a number of modified epoxy resins have been developed to fulfill the needs of the coatings industry for high performance, environmentally acceptable coating resins. When formulated, certain of these resins result in emulsions or dispersions particulate in nature (particle sizes of 0.1 - 1.0 μ as measured by a calibrated optical microscope), while other, more hydrophilic resins will result in colloidal dispersions (particulate sizes < 0.1 μ). Actually, a spectrum of resin solutions is possible ranging from very hydrophilic epoxy type resins exhibiting great ease of water dilutability and extremely small particle size, to hydrophobic, high molecular weight epoxy resins requiring a surfactant to become water-borne and exhibiting large particle sizes of from 0.1 - 1.0 μ.

The hydrophilic epoxy resins are bisphenol-A based, with hydrophilic moieties built into their backbone. The extent of hydrophilic moiety incorporation can be varied along with the molecular weight of these resins.

Resin A, the most hydrophilic, has an epoxy value of 0.013 eq/100 g and an hydroxyl value of 0.3 eq/100 g. Resin B, which is less hydrophilic, more hydrophobic than Resin A, has an epoxy value of 0.065 eq/100 g and an hydroxyl value of 0.36 eq/100 g. Resin C, the most hydrophobic of these modified epoxy resins, has an epoxy value of 0.06 eq/100 g, and an hydroxyl value of 0.27 eq/100 g.

These polymers do not depend upon amine neutralization to achieve water dilutability, but rather can be directly diluted with water. While the resins of high hydrophilic character can easily become water-borne with moderate stirring from a drill press to form very fine colloidal dispersions, those resins low in hydrophilic character and very high in epoxy character need the same type of moderate stirring to self-emulsify and form particulate systems.

High molecular weight epoxy resins, of course, are even more hydrophobic than this last resin described, and need an external surfactant to be dispersed or emulsified. Usually, moderate stirring from a drill press is not sufficient to effect a stable dispersion or emulsion of these resins, but instead a high shear mixer, such as a colloid mill, is necessary. These dispersions or emulsions may have particles as large as 4 μ, yet they show no tendency to agglomerate even over long periods (six months - one year).

In general, coating solutions containing the more hydrophilic resins, termed "water dilutable", have excellent handling properties (freeze-thaw stability, redispersibility of dried solids), but produce films which do not have the high degree of chemical resistance for which epoxies are known. In contrast, the self-emulsifiable epoxy resin (small hydrophilic moieties built into backbone), and to a greater extent the high molecular weight epoxy resins needing external surfactants, possess this exceptional chemical resistance. The application properties of these latter particulate systems, however, are not as good as the water dilutable types. Dispersions and emulsions tend to be non-Newtonian, and need the addition of ethylene glycol for freeze-thaw stability. They are also sensitive to certain solvents, and are not able to be re-dispersed or re-emulsified.

EXPERIMENTAL METHODS

All formulations were prepared using standard, low shear propeller agitation. Coatings were made on

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Table 1—Formulation Data

Composition	Formulation I %	 II %	 III %
Epoxy resin A	33.90	—	—
Epoxy resin B	—	42.17	—
Epoxy resin C (85% in butyl carbitol)	—	—	47.60
Melamine hardener[a]	5.90	7.50	7.10
Water	60.00	50.00	44.97
Flow additive[b]	0.12	0.13	0.13
Catalyst[c]	0.08	0.20	0.20
	100.00	100.00	100.00
Physical Properties			
Viscosity, #4 Ford Cup @ 77° F, sec.	46	60	28
Solids, %	39.80	50.00	47.40
Resin/Crosslinker ratio (solids)	85/15	85/15	85/15

(a) Cymel® 303, American Cyanamid Co.
(b) Byk® 301, Byk-Mallinckrodt
(c) Curing agent "C" (morpholine salt of p-TsOH), American Biosynthetics

Alodine treated aluminum with a #7 RDS rod at a film thickness of 10-14 mg/4 in.^{2} (0.2 mil). After a flash off time of approximately 30 sec, these coatings were cured for 10 minutes at 400°F (205°C) in an electric forced hot air oven.

MEK resistance was determined by hand rubbing a coated panel with an MEK soaked cotton swab. Acid resistance of the coating was measured by immersing a fabricated 303 aluminum food can end in a 10% acidic (HCl) $CuSO_4$ solution (pH=1.8). The stretch involved in fabricating a 303 can end is approximately equal to a 2T-3T bend. A darkening of the can end indicates permeation of the coating by the $CuSO_4$ solution. Resistance to steam processing was measured by placing the coated panel in a pressure cooker at 250°F (120°C) and 15 psi for 90 min and then checking the panels for adhesion and blushing. Beer and water pasteurizations were performed in open half-filled bottles at 180°F (82°C) for 30 min. Again, adhesion and blushing of the coated panels were measured.

COATINGS FORMULATION

Water Dilutable Epoxy Resins

There are two ways of formulating these water dilutable epoxy resins into coating systems. One way is to add a water dilutable melamine or urea-formaldehyde hardener to the neat resin while stirring this mixture at 400 rpm. Once homogeneous, water can slowly be added to the system with continued stirring. Of course, resins with more hydrophilic character will require less mixing for water dilution while hydrophobic varieties will require more. Another method is to add water directly to the resin. Then water-borne curing agents can be incorporated into the diluted resin with light stirring. The principal advantage in the first method is that the curing agent-epoxy resin mixture is easier to dilute with water than just the resin alone. The second method, however, allows one to vary the curing agent type and ratio while optimizing a coating system.

CURING REACTIONS: The only reactive groups on these resins are pendant hydroxyls as those found in bisphenol-A based, high molecular weight epoxy resins. Thus, melamines, urea-formaldehyde, and resole phenolic curing agents can be used to crosslink these resins. When completely alkylated melamine monomers and resole phenolics are used, acid catalysis is necessary. Partially alkylated melamine polymers and urea-formaldehyde resins require no catalysis for cure.

COATINGS PERFORMANCE: Because the raw materials for these new resins are sanctioned under section 121.2514 of the *Federal Register* "Resinous and Polymeric Coatings," one of the primary uses for coatings derived from these materials is beer, beverage, and food container coatings. Other uses are in the coil and drum coatings industries. The data presented in Formulation I, *Table* 1, is for Resin A, one of the most hydrophilic, which has been formulated into a can coating enamel. The performance data for this formulation are listed in *Table* 2. It is worth noting that there is no organic co-solvent present in this system.

Data in *Table* 2 indicate that a flexible, MEK and pasteurization resistant coating can be formulated from this resin. One area of weakness is in this coating's acid resistance. It seems as though the hydrophilic portion of the resin is susceptible to acid attack.

Coatings formulated from a more hydrophobic, but still water dilutable resin as in Formulation II, *Table* 1, result in enamels with much better acid resistance. Aluminum can ends coated with this formulation pass a 30 sec acidic $CuSO_4$ solution immersion (*Table* 2), while analogous formulations with the more hydrophilic Resin A fail this test. In addition, the MEK resistance of these coatings is greater (500 single rubs without marring) than those produced from more hydrophilic Resin

Table 2—Application and Performance Data

Formulation No:		**I**	**II**	**III**
Cured Film Appearance - Color:			← Clear →	
Tack:			← Dry →	
Flow:		Some small, medium craters	← Excellent →	
Cross cut adhesion			← Excellent →	
MEK resistance (single rubs)		400	500	> 500
Fabrication of 303 can end (inside coated)			← Pass →	
303 Can end immersed in CuSO₄ solution (pH = 1.8)		Fail (complete film removal) (30 second immersion)	Pass (30 second immersion)	Pass (2 minute immersion)
Beer pasteurization 30′ @ 180° F (in open container)				
	Appearance:		← No change →	
	Adhesion:		← Excellent →	
Water pasteurization 30′ @ 180° F (in open container)				
	Appearance:		← No change →	
	Adhesion:		← Excellent →	
Steam processing 90′ @ 250° F				
Vapor Phase:				
	Appearance:		← No change →	
	Adhesion:		← Excellent →	
Water phase:				
	Appearance:		← No change →	
	Adhesion:		← Excellent →	

A, and substrate wetting on Alodine treated aluminum improved from marginal with Resin A to excellent with Resin B. The superior coatings properties of Formulation II in contrast to Formulation I stem from the more hydrophobic character of Resin B. As expected, however, it is more difficult to incorporate this more hydrophobic resin into water. Greater agitation at higher rpm's is required. Although more difficult to dissolve in water, this resin requires no co-solvent for solubilization.

When less hydrophilic character is incorporated into the resin, it usually requires an organic co-solvent to become water-borne. The solution, however, can still be described as colloidal in nature. Formulation III, *Table* 1, is typical of this type of resin. Typical co-solvents include butyl Cellosolve® and butyl Carbitol.® In general, the resin is produced as an 85% cut in one of these solvents. Water and crosslinker can be added to this solvent cut to yield a water-borne formulation. Coatings performance data from this formulation are given in *Table* 2.

It is important to notice the increase in $CuSO_4$-acid resistance of Formulation III over the previous two coatings formulations. This datum reinforces the idea that the large hydrophilic moiety in Resins A and B made coatings produced from them susceptible to acid attack. Also, coatings based on Resins A and B lacked the solvent resistance normally expected of epoxy

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Cellosolve and Carbitol are registered trademarks of Union Carbide Corp.

Table 3—Epoxy Resin Dispersion in Formulation IV

Composition	**%**
Epoxy resin dispersion (55% solids)	86.40
Melamine hardener[a]	2.50
Catalyst[b]	0.20
Flow additive[c]	0.13
H_2O	10.77
	100.00
Physical properties	
Viscosity, #4 Ford Cup @ 77° F (sec.)	44.0
Solids, %	50.0
Resin/Crosslinker ratio (solids)	95/5

(a) Cymel® 303, American Cyanamid Co.
(b) Curing Agent "C", American Biosynthetics.
(c) Byk® 301, Byk-Mallinckrodt.

Table 4—Epoxy Resin Dispersion Performance Data

Cured film appearance	Color:	Clear
	Tack:	Dry
	Flow:	Some small craters
Cross cut adhesion		Excellent
MEK resistance (single rubs)		> 500
Fabrication of 303 can end (inside coated)		Pass
303 Can end immersed 8 min. in CuSO₄ solution (pH = 1.8)		Pass
Beer pasteurization 30′ @ 180° F (in open container)		
	Appearance:	No change
	Adhesion:	Excellent
Water pasteurization 30′ @ 180° F (in open container)		
	Appearance:	No change
	Ahesion:	Excellent
Steam processing 90′ @ 250° F		
Vapor Phase:		
	Appearance:	No change
	Adhesion:	Excellent
Water phase:		
	Appearance:	No change
	Adhesion:	Excellent

Table 5—Epoxy Resin—Phenolic Hardener Coemulsion in Formulation V

Composition	%
Epoxy resin[a] / Surfactant	31.70
Phenolic hardener[b]	13.60
Organic solvent (MEK/MAK/Butanol)	10.55
Phosphoric acid	0.10
Flow additive[c]	0.05
H_2O	44.00
	100.00
Properties	
Viscosity, #4 Ford Cup @ 77° F (sec.)	35
Solids, %	45.3
Resin/Crosslinker ratio (solids)	70/30

(a) Araldite® 6097 epoxy resin, CIBA-GEIGY Corp.
(b) HZ 949U hardener, CIBA-GEIGY Corp.
(c) Byk® 301, Byk-Mallinckrodt.

Table 6—Resin B/Araldite® 6097 Dispersion

Composition	%
Epoxy resin dispersion (55% solids)	55.00
Resin B (50% solids)	30.00
Melamine hardener[a]	5.00
Water	6.70
Ammonium maleate catalyst (15.9% solids in water)	3.00
Flow additive[b]	0.30
	100.00
Physical Properties	
Viscosity, #4 Ford Cup @ 77° F, sec.	40
Solids, %	50.3
Resin/Crosslinker ratio	90/10
Resin B/Araldite 6097 dispersion	1:2

(a) Cymel® 303, American Cyanamid Co.
(b) Byk® 301, Byk-Mallinckrodt

based coatings, while Formulation III has typical epoxy-like solvent resistance.

Water Dispersible Epoxy Resins

There are a number of ways to disperse epoxy resins in water. One method involves melting the high molecular weight epoxy resin to be dispersed and adding an aqueous surfactant solution to the molten resin with high speed stirring. The resultant epoxy resin dispersion has a very fine particle size. Another procedure is to finely grind the solid resin and slowly add the particles to an aqueous surfactant solution with stirring to produce a thick slurry. This slurry can then be ground by ball milling to a fine dispersion.

Dispersions of high molecular weight epoxy resins are normally produced at about 50% solids, and water dilutable curing agents are generally added directly to the dispersion with only light stirring.

Epoxy resin dispersions cured with water dilutable melamine or urea-formaldehyde resins produce coatings with properties similar to solvent-borne standard "7" type epoxy resins.* The physical properties of a typical "7" type epoxy resin/melamine dispersion containing a nonionic surfactant are listed in Formulation IV, *Table* 3. Coatings properties from this formulation are described in *Table* 4. Note the high degree of acid resistance.

Although these dispersions have been successfully roller coated, some problems have been experienced in spraying. This situation, however, probably can be corrected. Certainly, there is great incentive to do this since epoxy dispersions provide a means of producing a solvent-free coating with all of the properties characteristic of an unmodified solvent-borne epoxy resin.

Water Emulsifiable Epoxy Resins

Epoxy resin emulsions are quite similar to epoxy resin dispersions except that each dispersed particle in an emulsion contains some organic solvent; dispersions are virtually solvent free. While the amount of organic solvent in epoxy emulsions can vary, the solvent content is these emulsions is no more than 20% by volume of the total volatiles.

The advantages of epoxy emulsions over dispersions are; (1) greater ease of preparation, and (2) superior substrate wetting and flow. The presence of organic solvent is responsible for these differences. However, should environmental legislation become more restrictive and ban the use of organic co-solvents in water-borne systems, epoxy resin dispersions would gain a distinct advantage over emulsions.

PREPARATION: Epoxy resin emulsions can be prepared by adding water to a solution of resin and nonionic surfactant in an appropriate organic solvent. The mixture is usually emulsified with the aid of a colloid mill or homogenizer to produce an oil in water emulsion. A properly prepared sample should have a particle size of 4 μ or below.

FORMULATION: There are a number of ways to introduce curing agents into an epoxy emulsion system. One method, for example, is to dissolve a water insoluble phenolic curing agent in the epoxy resin organic solvent cut. If the proper surfactant is used, both resin and curing agent can be emulsified. Emulsions prepared in this manner are quite stable even in the presence of acidic catalysts. One reason for this stability is that the catalyst is usually in the continuous water phase, but both epoxy and crosslinker are bound in the particulate state, surrounded by surfactant, and in a sense "protected" from any catalytic effects. Coatings made from epoxy resin/curing agent co-emulsions and containing acid catalysts reveal no loss in coatings properties even after one month's storage.

COATING PROPERTIES: In general, epoxy emulsion based coatings have properties very close or identical to analogous dispersions. Correctly formulated epoxy resin emulsions generally produce coatings with excellent solvent and acid resistance on treated aluminum, tin-free steel, and tinplate. These coatings can also

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*Such as Araldite® 6097, a registered trademark of CIBA-GEIGY Corp.

Table 7—Application and Performance Data of Resin B/Dispersion Combination

Substrates	A 272 aluminum, TFS
Application[a]	Direct roller coater
Leveling	Good
Wetting	Slight cratering
Drying out and powdering	None
MEK resistance (single rubs)	> 500
Acidified $CuSO_4$ resistance (pH = 1.8)	Pass (8 min.)
Wedge bend, mm	21
Pasteurization, beer and water, 30′ @ 180° F, (in an open container)	
Appearance:	No change
Ahesion:	Excellent

(a) A Rutherford Direct Roller Coater was used.

undergo both beer and water pasteurization without blushing or loss of adhesion, and have sufficient flexibility to meet most fabrication requirements. Since, as has been stated, the coating properties of these emulsions are very similar to those of epoxy resin dispersions, only the physical properties of a typical emulsion will be described. Formulation V, *Table* 5, lists these properties for an emulsion made with a "7" type epoxy resin and resole phenolic curing agent. This type of formulation has been repeatedly roller coated in the laboratory.

WATER DILUTABLE—DISPERSION OR EMULSION COMBINATIONS

Recently, a number of water-based formulations containing both a water dilutable epoxy resin in the aqueous phase and either an emulsified or dispersed epoxy resin in the particulate phase have been produced. Although water-borne acrylics have long been formulated with high molecular weight polymers in the dispersed particulate state and low molecular weight resins in the continuous aqueous phase, this analogous epoxy system appears to be novel. Results to date indicate that these combinations do not adversely affect the good coating properties ordinarily expected from epoxy dispersion or emulsion systems. Instead, handling and processing properties have been greatly improved over noncombined dispersions or emulsions of high molecular weight epoxy resins. Since the water dilutable epoxy resin is acting as a true reactive protective colloid, properties such as flow, leveling, and wetting of epoxy dispersions or emulsions are greatly improved. Drying out during roller coating is greatly reduced along with any shear instability during extended time on the roller coater. Because a high molecular weight resin is present in the aqueous phase, the steep water dilution-viscosity curve, typical for dispersion and emulsions, is not nearly as steep.

Initial experiments based on a combination of epoxy resin B with an epoxy resin dispersion appear to have quite promising results. The formulation in *Table* 6 based on a 2:1 ratio of dispersion to Resin B was recently roller coated and found to have greatly superior flow and leveling over the unmodified epoxy dispersion system in Formulation IV. In addition, the film properties of this new combination system seem to be still comparable to those of the epoxy dispersion alone. As the data in *Table* 7 suggests, combining one part of Resin B with two parts of epoxy dispersion resin appears to result in coatings with just enough of the good wetting and flow properties of Resin B without sacrificing any of the superior film properties of the epoxy resin dispersion. Other ratios of Resin B to epoxy dispersion were found not to have this delicate balance between application and film properties.

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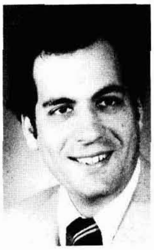

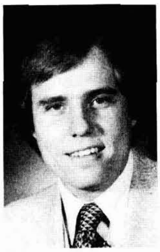

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SUMMARY

Water dilutable epoxy resins which require little or no co-solvent and possess very good handling and processing properties have been developed. In general, coatings properties are good but only approach those of solvent-borne epoxy resins. Coatings based on epoxy resin dispersions or emulsions, however, strongly exhibit typical epoxy-like properties, but are more difficult to work with than standard solvent systems. Preliminary data indicate that a combination of water dilutable epoxy resins and water dispersible or emulsifiable resins results in a system possessing the processing and handling properties of standard solvent systems and the performance properties of epoxy resins.

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Coatings in Transition

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This paper reviews some significant developments which have occurred in the coating industry. These include the evolution of water borne coatings, electrodeposition, radiation curing and engineered polymers.

The impact of a number of constraints are discussed which include government, materials and energy.

An attempt is made to forecast some significant changes in the coatings field specifically for appliances.

Finally, there are discussions of alternatives to porcelain and the profile methodology for improving the transition from laboratory to production of new finishes.

KEY WORDS: Transition; Coatings; Porcelain; Systems; Government.

Introduction

The ubiquity of coatings since the beginning of recorded history is well documented.[1] The cyclic evolution of coatings development has been cited in a previous paper.[2] This paper reviews the impact of several significant developments in the recent past, and looks at an 'Era of Transition' in which many significant factors are playing an extraordinary role in coatings developments. This is followed by a look at a specific situation involving the search for alternatives to porcelain and a methodology for achieving a set goal involving commitment and, finally, project some future happenings.

Background

As in the development of geological time or human development a number of distinct eras can be identified. Coatings developments may be divided into eras as shown in *Table* 1. A plot of these data yields what is similar to the familiar S or maturity curve for a product (See *Figure* 1). We can see that there is a leveling off, or even a drop, as we enter the era of transition. This era may see a retardation in the growth rate of the coating industry as it becomes more stifled by several important constraints. These constraints include:

- Energy
- Government
- Materials
- Capital

in that order but with energy acting as a common denominator which influences all aspects of the business future.

Energy

Our continued dependence upon foreign oil will be reflected in higher prices for process energy and for materials. There is a trend now to using petroleum in a conversion mode rather than burning it. This will keep the pressure on natural gas, cost, supplies, and other materials used for the manufacture of coatings.

Government

The second major constraint is that of government. Continued influence by government in costly regulations can stifle the industry and send the curve plunging downward. In defense of government, there has been some benefit in that, due to pending government action, certain technologies have been employed to solve problems. Whether this stimulus will continue to be positive remains to be seen—This is doubtful!

One need not be reminded of the impact of the aerosol spray, solvent, mercury, lead, and chromium problem on our industry. What will be next?

Materials

We are fast reaching a point where the availability of large quantities of low cost material will be in doubt. The enormous capital costs for recovering and transporting materials (oils, minerals) will increase. An examination of the cost of some typical coating materials since 1972, reveals the significant changes which have occurred (See *Figure* 2, *Table* 2).

Capital

With more and more dollars being spent to satisfy government regulations, capital will be in short supply or too expensive to acquire. This could have serious consequences on the growth in R&D, Technical Service, and expansion.

Era of Transition

These four constraints will have major influences on the coating industry during this era of transition. Coatings people will have to expand their horizons to cope with present and future problems.

In attempting to live with the constraints mentioned above, manpower and resources must be carefully utilized.

An examination of some problems in this Era of Transition would indicate how we might respond by considering the introduction of new finishes, cooperation, and the porcelain replacement problem.

Introduction of a New Finish

Traditionally, the introduction of a new finish is accomplished in a number of ways, many of which are haphazard at best. In an effort to achieve a successful product, a supplier or user may overlook a number of important elements in the total system. These are:

(a) Commitment
(b) Preparation: Substrate and Finish
(c) Cooperation and Program Coordination

Presented at the University of Southern Mississippi High-Solids Symposium in New Orleans, La., February 14, 1977.

*Elisha Gray II Research and Engineering Center, Benton Harbor, Mich. 49022.

Table 1—Coating Eras

Era	Impact
Ancient	Noah's Ark Egyptian art Cave drawings
Fossil	Gums, oils, resins
Synthetic	Alkyds, nitrocellulose melamines
Engineering (polymeric)	Thermosetting acrylic Epoxy resins latex
Scientific-Technical	Electrocoating (+) (−) Water soluble Radiation cure Automation
Transition	Combination of above Government Energy Materials

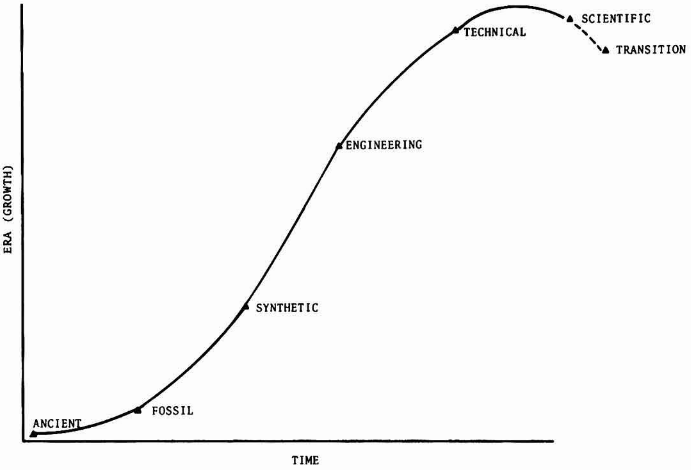

Figure 1—Coatings in transition

(d) Application (equipment)

(e) Cost

When test panels are submitted, the supplier should have done as complete a job on meeting the users needs as possible. This means that a systems approach is required in which all major parties can participate to bring about a success in a minimum of time. Such an approach is shown in *Figure* 3.

We must learn to cooperate more completely in order to take full advantage of the technology available within and outside a company. We can no longer afford the luxury of going it alone in meeting the coating needs of the future.

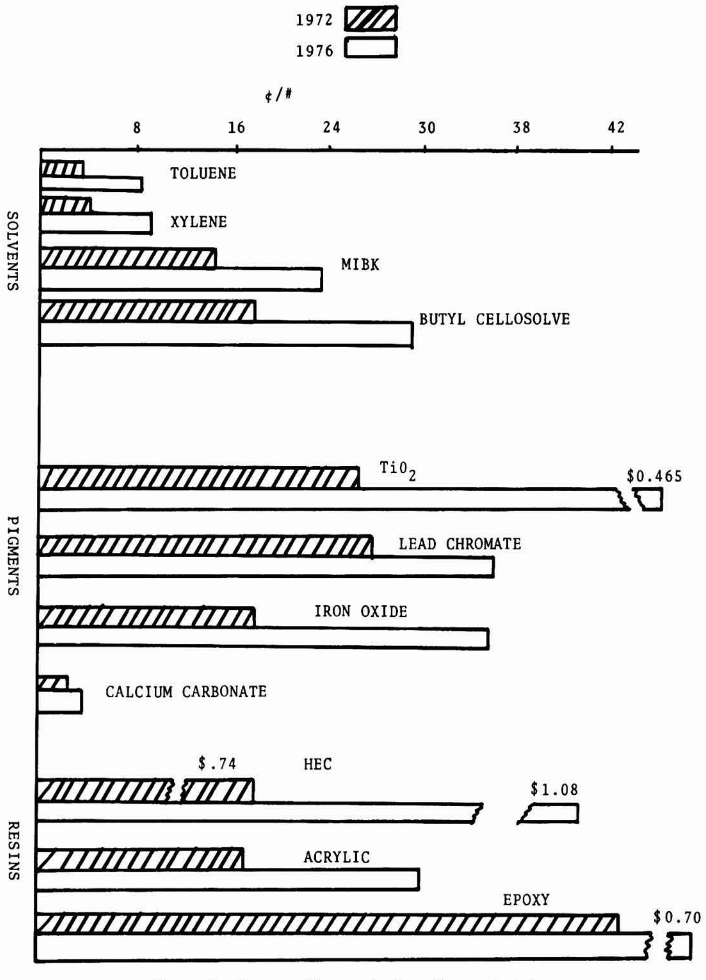

Figure 2—Comparative cost of coating materials

Table 2—Comparative Costs of Coatings Raw Materials

	$/lb	
Material	**1972**	**1976**
Solvent		
Toluene	$0.03	$0.08
Xylene	0.036	0.083
Methyl isobutyl ketone	0.14	0.23
Butyl cellosolve	0.17	0.29
Pigment		
Titanium dioxide (rutile)	0.255	0.465
Lead chromate	0.26	0.35
Iron oxide (synthetic)	0.1575	0.375
Calcium carbonate (whiting)	0.0195	0.0225
Resin		
Hydroxy ethyl cellulose	0.74	1.08
Acrylic latex (46%)	0.1475	0.28
Epoxy (liquid 100%)	0.41	0.70

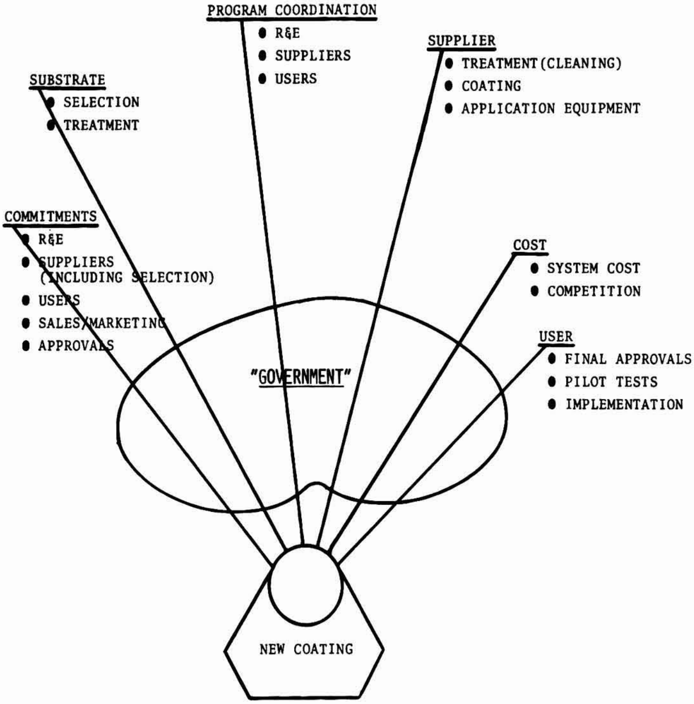

Figure 3—A systems approach to coatings

The Porcelain Situation

An example of a problem facing a user in this Era of Transition is the search for coatings as alternatives to porcelain. (A number of opportunities exist in the appliance field for coatings to replace porcelain, *Table* 3).

This effort is prompted by the high consumption of energy required to support a porcelain furnace. This is summarized in *Figure* 4.

In considering porcelain replacement, a number of options are available, as shown in *Figure* 4. Perhaps the most significant aspect of this chart is the last column which measures the potential for energy independence in the curing step. This is shown in *Table* 3.

Table 3—Replacement Possibilities

Application	Type Coating	Energy Independent
Freezer liner	Epoxy powder	No
Refrigerator liner	Epoxy powder	No
Tub/basket	Epoxy primer	No
	Urethane top	Yes
Top/lid	Thermoset acrylic	No
Range top	Polyester	No
Oven	?	No
Furnace	?	No
Ice maker	?	?

Results

Some progress has been made in this area. For example, we have been successful in replacing the oven door finish with an organic coating. The range top and oven interior still represent major challenges.

We have also investigated and proven the technological feasibility of replacing porcelain on washer baskets. This was carried out using a profile technique involving a systems approach. The cooperation between research centers, equipment, treatment, coating suppliers, and our engineering groups was paramount. One key to the success of the initial work was the ability to identify the chemical, physical, and processing parameters of the finish; an essential feature of the profile. The profile is basically an attempt to identify values such as salt spray, detergent resistance, etc.

Once the profile values were agreed upon by the parties involved, the profile was submitted to the coating supplier who worked to satisfy the requirements on panels. It should be noted here that panels were not submitted for our own testing until all the elements of the profile were satisfied.

Once this was achieved, a technology transfer step followed in which the information was released to the engineering groups for implementation. This was followed by preparing a number of baskets for field test and life cycle testing.

The feasibility of replacing porcelain on a laundry basket has been demonstrated. The challenge now is to gain field experience and seek out other porcelain replacement opportunities.

In a related development, powder coatings have been used to replace porcelain on freezer liners. The major benefit was the reduction in cure temperature from 1500°F to 400°F in an area where propane was used in heating the porcelain furnace. The only long term

MATERIAL OPTIONS

	PHYSICAL							CHEMICAL								ECOLOGY						ENERGY	
								DETERGENT		WATER STAIN(NEAT)						SOLVENT							
MATERIAL	HARDNESS	COLOR	GLOSS	ABRASION	IMPACT	FLEXIBILITY	SALT SPRAY	NORMAL	NEAT	SOAK	HUMIDITY	DET.	RINSE AID	BLEACH	GREASE	WATER	HIGH	LOW	H/C	POW.	LIQ.	D	I
THERMOSET ACRYLIC																						X	
EPOXY (SOLUTION)																						X	
POWDER																						X	
OLIGOMER: 1																						X	
2																							X
URETHANE TWO																							X
SINGLE COMPONENT																						X	
POLYESTER																						X	
VINYL																						X	
CATALYZED																							X
SILICONE																						X	
CATALYZED																							X
EMULSIONS																							X

Figure 4—Organic coatings as alternatives to porcelain

disadvantage of powder relative to energy is the inability to achieve room temperature curing.

Future

COOPERATION: For the coatings industry, its best interest in the future will be served through a concerted effort of intergroup cooperation. Deliberate efforts must be made to use the systems approach to solving problems.

ENERGY: Energy will be a major concern for the next 10 years. At the present time water-borne latices and high-solid urethanes provide routes to oven free curing. What the status of oil-modified vehicles for industrial application will be will depend upon obtaining rapid dry and nonyellowing. The advantage of oil-modified coating materials is their renewable resource base.

CHEMICALS: There is a need for alternatives to urethanes as fast curing low energy coatings. Multi-component nonurethanes are available. Raw material suppliers have an opportunity to look into the cost of aliphatic urethanes to determine methods for lowering the cost. The long term potential for urethane finishes is good. UV curable coatings may provide some unique opportunities.[4]

CLEANING: Another major area of energy consumption is in cleaning. It is estimated that 52% of the total energy in a plant is dedicated to the cleaning-pretreat operation while only 22% for curing coatings. Clearly, methods for bringing this consumption figure down are surely needed. Some possible routes would include mechanical cleaning, factory precoating such as Dacrometal®, Cool Phos®, or ultrasonic cleaning.

PETROLEUM ALTERNATIVES: The continued dependence on petroleum makes the coatings industry vulnerable to the whims of those who control the oil supplies. This should be a signal for coatings research centers to look at nonpetroleum derived coating materials, such as silicones, phosphazenes, and other inorganic coatings.

GOVERNMENT: Government will continue to play a strong role in all aspects of the coating business. It is imperative that the coatings industry become involved so that workable legislation can be produced. A good example is the area of high-solids coatings. We need a reasonable regulation which allows 75% weight solids - 60% volume solids to be used. As we approach the higher solids we are faced with manufacturing and application problems which force cost up.

One approach which may provide assistance to government compliance is the use of robots which can reduce exposure of workers to solvents and related chemicals.

RENEWABLE RESOURCES[3]: A reexamination of coatings raw materials which are renewable is needed. The vegetable oils are an excellent resource as well as the cellulose derived vehicles which have served the industry well. Silicates and other inorganics require a determined look by coating specialists.

WATER-BORNE FINISHES: Several years ago we evaluated a water-borne topcoat which was essentially pollution free. The biggest stumbling block to its successful implementation was the electrical isolation problem. The successful resolution of this problem is a must for the coatings industry.

Electrocoating will continue as a major priming method. Lower bake temperatures will be forthcoming. Cationic electrocoating will eventually overtake the anionic method. We should look for more single coating by electrocoating for topcoats.

CORROSION: Corrosion is still a major problem which is begging for innovative solutions. The current cloud over chromate pigments may make this problem more acute. There is definitely a need for alternatives to this important chemical and for improved methods of eliminating corrosion.

Conclusion

Coatings in transition was presented, citing a number of key concerns including energy, government, materials, and capital. Porcelain replacement problem and some of the future events which may occur in the coating industry were also discussed. ☐

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Future of Waste Disposal In the Paint and Coatings Industry

Earl E. Baumhart*
Kurfees Coatings, Incorporated

A brief presentation of recent legislation (The Resource, Conservation, and Recovery Act of 1976) and its immediate and future impact on the coatings industry concerning the disposal of waste and hazardous materials is presented. Also discussed are state and local regulations and the relatively new development of waste exchanges.

KEY WORDS: Environmental controls; Solid waste; Hazardous materials; Waste disposal.

Introduction

Down through the ages people have always littered the land with solid waste. Archaeologists in their excavations have uncovered many areas of waste—broken crockery, bone residues from meals, and ashes from their fires. American Indians would move from one camp to another because of the piles of waste would become too great.

Today, every highway, park, and stream show that the present day Americans still carry on the tradition of dropping their old waste anywhere that is convenient. Industry has done a little better, but not much. At least they contracted to have their solid waste hauled away to some dump, or municipal landfill. Years ago, with fewer people and lots of open country, dumping of solid waste was not a major problem. However, today it is a major problem. The average American disposes of more than five pounds of refuse daily. It is estimated[1] that the United States produces annually an estimated four billion tons of solid waste. Animal and agricultural waste account for the largest volume—2.6 billion tons. Mining and mineral extraction residues pile up more than one billion ton. Municipal waste at 300 million tons. The waste from manufacturing industries amount to 130 million tons, the smallest percentage of the total.

The chemical industry, in general, contributes about one-third of the total industrial solid waste. The coatings industry, in some localities, contributes about 10% of the waste of the chemical industry. Although the chemical waste from chemical industry and coatings industry represent only a small part of the national total, some of these wastes are potentially hazardous and must be handled with care. Coatings industry refuse is quite similar to household trash, e.g. empty boxes, paper bags, floor sweepings, etc. Some wastes, however, are slurries from pigment grinds and sludges from paint waste.

As other environmental controls on air and water have become effective, they have caused increased amounts of solid waste to be generated. Enormous amounts of sludge are generated through the scrubbing of stack gases to remove sulphur dioxide. The flocculation and settling of waste from water discharges again cause a tremendous amount of solid waste. Therefore, as the air and water are continuously cleaned and the environment improved in that area, the burden is being placed more and more on the handling of solid waste. In the next 10 years there will be an increasing awareness of the need for proper disposal of solid waste and an increasing need for the recycling and reuse of these materials, many of which are not replaceable or are in short supply.

Cost

The cost of waste disposal is very high. At the present time it is estimated[1] that the chemical industry spends around $125 million per year. By 1980 they expect this to increase to $350 million per year. The coatings industry will have to spend about $109 million over the next five years to meet the requirements for the solid waste disposal.

Current Legislation

FEDERAL — On October 21, 1976 Congress passed a bill, S-2150 The Resource, Conservation, and Recovery Act of 1976. This Act was supported by both industry and environmentalists. We discuss here some of the major parts of the Act and how they will affect the coatings industry.

STATES PROGRAM — The states will submit a summary report to the administrator of the Environmental Protection Agency and at the same time establish a time table and schedule for compliance. Under the grants to the state, 50% of the Federal aid will be based on the ratio of population of that state to all states, but none will receive less than one-half percent. The remaining 50% will be distributed to the states with the best progress in developing solid waste programs.

GUIDELINES — By April 21, 1978, the Administrator of the Environmental Protection Agency will develop and publish guidelines for solid waste management and provide technical and economical levels of performance expected. He will describe methods and levels of control to protect public health and welfare—also with the protection of ground water from leachates. The Administrator also will develop guidelines for waste management and cost of construction, operation, maintenance, and percentage of resources that can be recovered. He will submit to Congress a list of products and packages that inhibit or restrict the recycling or recovery of materials from solid waste.

PROHIBITION OF OPEN DUMPING — By October, 1978, all open dumping is prohibited, i.e., (all of the present type open private or municipal landfills and dumps).

HAZARDOUS WASTE DISPOSAL CONTROL — Six months after the designation of any waste as hazardous, the Act will prohibit the dumping of this waste except under a permit issued in compliance with the regulations. By April 21, 1978, the Administrator will develop regulations that designate that certain solid wastes are hazardous, and define

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Presented at the 54th Annual Meeting of the Federation of Societies for Coatings Technology in Washington, D.C., October 27, 1976.

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those quantities of the wastes that are hazardous. The Administrator shall also designate as hazardous any waste material that is included in the list of hazardous air pollutants under the Clean Air Act, and any toxic pollutants listed under the Federal Water Pollution Control Act.

PERMIT PROGRAM — By April 21, 1978, any person who stores, moves or disposes of hazardous waste must have a permit issued by the Administrator or by a state. The permit program will require an application to specify the composition, quantities and concentrations of the waste, and any mixtures of the hazardous wastes. It must specify the site at which the waste will be treated or disposed of and determine the type of containers used for storage at the site or for disposal. In addition, each permit will require a contingency plan for effective action to minimize danger from spills and contamination.

IMMINENT HAZARD— Not withstanding any other provision of the Act, the Administrator, upon receipt of evidence that the disposal of any solid waste is presenting an imminent and substantial danger to health or environment may bring suit on behalf of the United States in the appropriate District Court to immediately restrain any person from causing or contributing to the disposal.

ENFORCEMENT — Whenever the administrator finds a person is in violation of any permit, standard, or regulation, he shall bring civil action in the United States District Court. Any person who violates any permit or regulation shall be subject to a penalty not to exceed $10,000 per day of each violation. Any person who knowingly violates requirements of a permit shall be punished by a fine of not more than $25,000 per day of violation, or by imprisonment for not more than one year, or both, for the first offense. Upon conviction on a second offense, they shall be fined $50,000 per day or two years in jail, or both. Any person who knowingly makes any false statements, representation, or certification in the application or permit shall, upon conviction, be punished by a fine of not more than $10,000 or imprisonment for not more than six months.

There are many other sections of the Act, including loan guarantees for the building of the disposal sites, resource recovery sites, etc., to encourage local states, municipalities, and even private corporations to build resource recovery units with the assistance of the Federal Government. There also is a section on employee protection so that no employer may discharge or discriminate against an employee who has by means of report or testimony indicated that the employer is violating a regulation or permit in the disposal of hazardous waste.

EARL E. BAUMHART received the B.S. Degree in Chemical Engineering from Case Institute of Technology, and has done graduate work at both Case and the University of Alabama. A member of the Louisville Society, ASTM, and the National Safety Council, he has spent 30 years in the coatings industry in research, engineering, and production management. He is Vice-President, Director of Manufacturing at Cook Paint and Varnish Co., Kansas City, Mo.

All of these regulations in this new Act are geared toward the operator of the sanitary landfill or the waste disposal site; however, it is obvious that the operator of the landfill will certainly require the waste generator to supply him with the information as required for the permit, and in many areas will refuse to accept anything that is considered hazardous under the Act.

Therefore, it is significant that it will be necessary for the coatings industry to quickly develop methods to eliminate much of their waste and recycle other waste streams so that it will reduce the amount that will be required to be sent out to the sanitary landfill or incinerator.

A major concern to the coatings industry is the designation of some of the materials that are used in coatings industry as hazardous, although in the form that it is used in the industry, is not considered hazardous.

Local

Many local cities and counties have also developed solid waste ordinances and regulations, and many of them have had a direct bearing on our coatings industry, especially areas such as Atlanta and Louisville.

Basically, the regulations as enacted establish a permit system and regulation of the owner-operator of a landfill or other method of waste disposal. It also generally requires information from the generator as to the type of waste, the amount of waste, and the responsibility that goes along with it. They must notify the landfill operator and the controlling agency about the potential hazards of their waste materials. Recent studies by government agencies and the Wapora[2] study made for Environmental Protection Agency has shown that the paint and coatings industry has a fairly large amount of waste that is generated in comparison to the total volume of products produced. This has lead some local municipalities, like Atlanta, to put very stringent restrictions on the handling of paint waste.

Waste Exchanges

One of the methods that may help the coatings industry is the recent development of waste exchanges, that is, one company's waste may be another company's raw material. By publishing lists of available materials that are waste from one location, they can be sent to another location to be reused as a basic raw material. This is in operation in several locations around the country so far, and is being encouraged by the government and the states to expand this program as a good resource recovery system. It is one method that will help reduce the solid waste load that is generated by the coatings industry.

Summary

The coatings industry has continued to generate more and more waste over the past years. Now it is becoming prohibitive in both cost and environmental concern, as well as waste of available resources. It is very important that each company in the coatings industry develop plans and programs to recycle, and eliminate the majority of wastes that are now sent out to a dump or landfill. If the coatings industry does not do this, as outlined in the Act, it will be forced to do so by the Federal Government or State agency, and, at best, pay a premium price for the continued practice of sending out large amounts of waste to a landfill. ☐

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(2) Wapora, Inc., Washington, D.C., issued a report entitled "Assessment of Industrial Hazardous Waste Practices, Paint and Allied Products Industry, Contract Solvent Reclaiming Operations, and Factory Applications of Coatings." Under EPA Contract No. 68-01-2656


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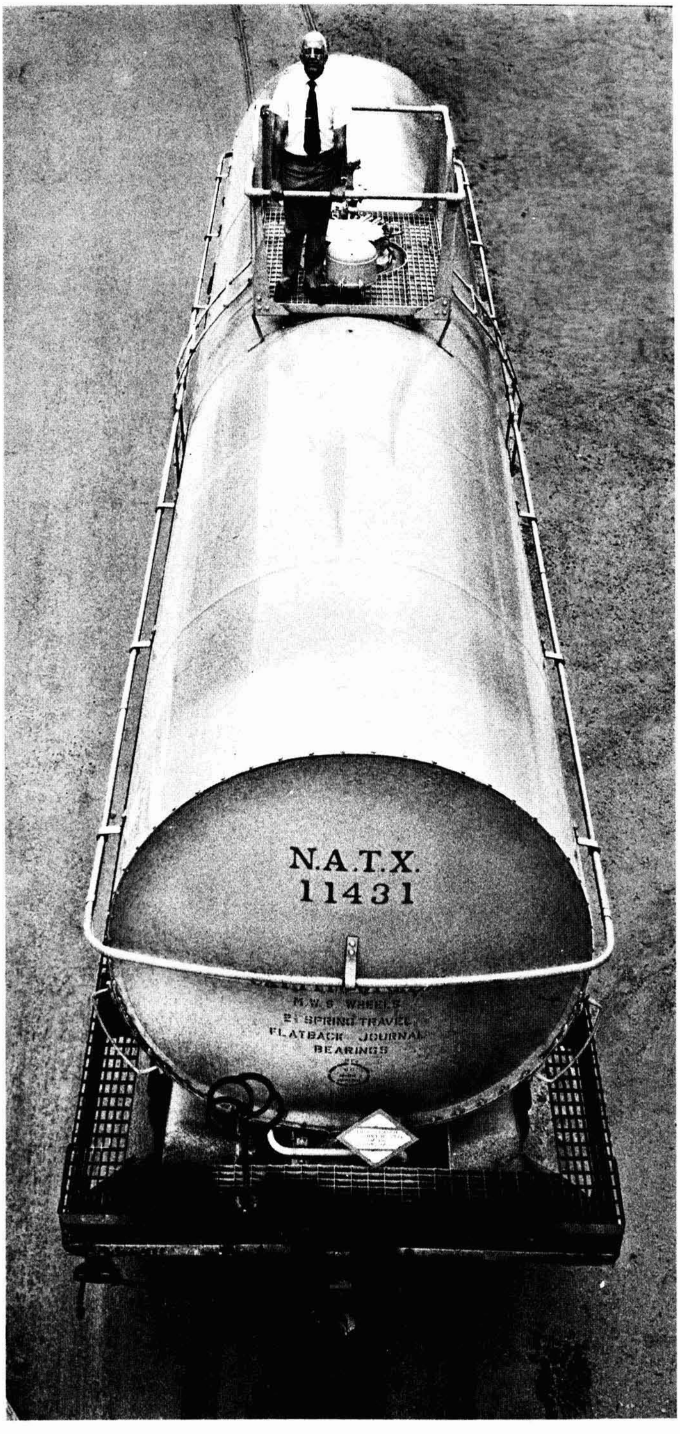
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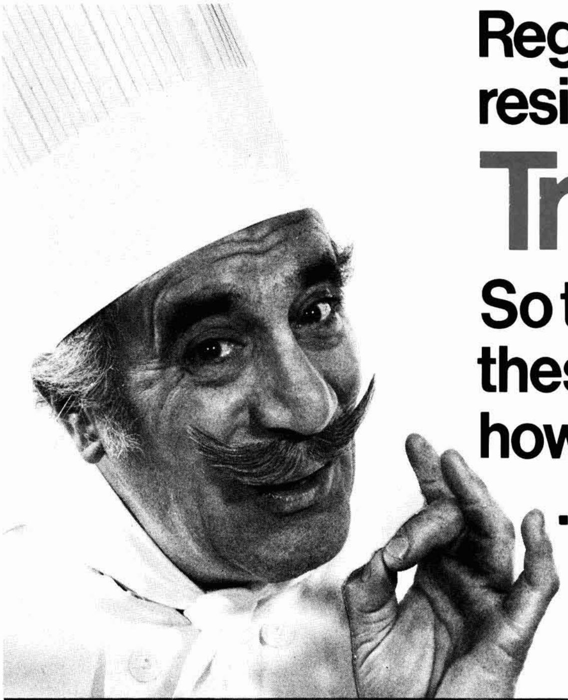

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Society Meetings

Baltimore
March 17

Howard Sholl, retired from Bruning Paint Co., Inc., was unanimously elected to Society Honorary membership. ship.

Harry House, of Verlan, Ltd. spoke on "PRODUCT LIABILITY."

Q. Is it necessary for a manufacturer to maintain very detailed quality control information?

A. Yes. Too many companies do not keep good records of batches or run tests on purchased raw materials. Many times these records are the difference between proving a product is standard and not being able to even negotiate a settlement. This valuable information is almost always the only evidence in favor of the manufacturer.

TOM COCHRAN, *Secretary*

Chicago
March 8

Dr. G.P. Bierwagen, of Sherwin-Williams Co., spoke on "PHYSICAL MODEL FOR MUD CRACKING IN LATEX COATINGS."

Honored guests in attendance included Federation officials President Neil S. Estrada and Executive Vice-President Frank J. Borrelle.

Mr. Estrada spoke on the condition of the Federation, the plans for the future, and the problems with government regulations that effect the industry.

Mr. Borrelle discussed the Society's contribution to the Federation and spoke of the 1977 Annual Meeting in Houston, October 26-28.

The after-dinner speaker was Robert W. Lenz, of the University of Massachusetts, who spoke on "A NOVEL CURING SYSTEM FOR SURFACE COATINGS."

W. KRASON, *Secretary*

C-D-I-C
March 14

Honored guests in attendance included Federation officials President-Elect John Oates, and Executive Vice-President Frank J. Borrelle.

Richard Martorano, of Rohm and Haas Co., spoke on "AIR-DRY AND LOW-BAKE WATER-BASE INDUSTRIAL FINISHES."

Officers of the Pittsburgh Society for Coatings Technology for the year 1976-77. Front row (left to right): Secretary—John S. Dahl, of J. H. Matthews Co; Vice-President—Leonard W. Magnusson, of PPG Industries, Inc.; and President—William C. Spangenberg, of Hammond Lead Products, Inc. Back row (left to right): Treasurer—Robert T. Marcus, of PPG Industries, Inc.; and Council Representative—Gerald B. Ward, of Royston Laboratories

Mr. Martorano described two new aqueous paints designed to approach the conventional thermoplastic nitrocellulose or acrylic lacquers and the thermoset bake finishes for such areas as coil coating. He discussed three types of water-based coatings: (1) Emulsion dispersions—high molecular weight discrete particles in water. They produce a hard, tough water coating; however, the gloss is effected by light scatter effect of the particles. (2) Soluble—low molecular weight resins containing acid groups; provide a clear solution producing high-gloss coatings with less durability resistance. (3) Colloidal dispersions—hybrids of emulsions and soluble coatings made by emulsion polymerization and attached functional groups, then neutralized to get a dispersion. They have higher molecular weight than the solubles but lower than the emulsions and are less affected by light scatter due to the lesser amount of resin particles.

Mrs. Ernie Mueller presented a check for $500 to the Society to establish the Ernie Mueller Memorial Fund to be used in the interest of education for deserving members of the Society. Ernie Mueller was a Past-President of the C-D-I-C Society and a selfless contributor to the industry.

President-Elect Oates commented on the finances of the Federation, discussed the upcoming Annual Meeting in Houston, and the proposed reconstruction of the Federation. Mr. Oates also outlined the activities of the Paint Research Institute and its need for feedback from the societies.

Mr. Borrelle presented a slide show on the past Annual Meeting, and detailed the various activities and publications available through the Federation.

LLOYD J. REINDL, *Secretary*

Cleveland
March 24

A moment of silence was observed in honor of the memories of Roy Ruzicka, of Glidden-Durkee Div.; George Sawyer, retired from Mobil Chemical Co.; and Harold Whitcomb, retired from Sherwin-Williams Co., who died recently.

Daniel M. Dixon, of Freeport Kaolin Co., spoke on "COMPUTER FORMULATIONS: EFFECT OF VARIOUS PIGMENTS."

Mr. Dixon proposed a system of computer evaluations for a variety of pigments and the effect each has on a given paint product. The evaluation of several pigments in several binder systems can be a very routine and time consuming effort, he said. In a computer regression analysis, the effect a given material has on a measured property can be calculated statistically from a minimum number of experiments, he reported. The statistical data derived from the computer program can determine one of three things: Is the model correct?; Does a correlation exist between any two variables?; and, Are all of the variables accounted for? Mr. Dixon described several laboratory experiments which illustrated the principles involved.

CHARLES K. BECK, *Secretary*

Golden Gate
March 14

Federation President and Society member Neil S. Estrada presented Rita Blando, of Glidden-Durkee, an award for the outstanding work performed by the Technical Committee.

James White, of Big H Equipment Co., spoke on "HIGH-SPEED DISPERSION—THEORY AND PRACTICE.

Mr. White presented 20 slides and graphs in explaining the process of high-speed dispersion and the equipment involved. He said that the process should break up agglomerates and aggregates to their particle size. The peripheral speed of the blade is very important, he said, and for good dispersion should be about 5000 fpm. In showing slides of basic tank and blade designs, he explained the advantages and disadvantages of types of equipment. Mr. White also discussed good batch techniques, stressing that solids should be kept high, the loading of pigments and extenders should be done at low speed and then turned to high speed for dispersion, and that the walls of the tank should be kept clean.

Q. What would be the best position of a high-speed blade in a conical bottom-type tank for high-speed dispersion?

A. A position of 3 to 4 times the blade diameter from the lowest point in the tank.

Q. What time is required to get a grind following the addition of pigments and extenders?

A. The time is dependent on the type of vehicle in which the dispersion is made.

A. APFEL, *Secretary*

Houston
March 8

Jack Dupont, of Rohm and Haas Co., spoke on "NONMERCURIAL FUNGICIDES."

Mr. Dupont stated that much work has been done in recent years on nonmercurial fungicide due to the 1972 EPA decision to ban all pesticides containing mercury. Many nonmercurial fungicides and mildewcides have been developed which do not exhibit the disadvantages of mercury-based materials, namely sulfide staining, short-term effectiveness, and acute toxicity, he said. Mr. Dupont discussed several ways of controlling mildew, including periodic maintenance, film erosion (controlled chalking), use of a mildewstat such as zinc oxide, mildewcide, mildewcide/mildewstat combination, and the optimization of coating composition to minimize susceptability to mildew.

An overall balance of properties should be considered when choosing a mildewcide. Cost, chemical stability, absence of side effects on wet paint film and coating performance, low toxicity, utility, storage stability, low odor and color, and convenience of use are some of the properties to be considered, he said.

Q. What is the difference between a mildewcide and a mildewstat?

A. A mildewcide kills mildew while mildewstats prevent its growth.

THOMAS RULAND, *Secretary*

Officers of the New England Society for Coatings Technology for the year 1976-77. From left to right: Secretary—George Mulvey, of Dampney Corp.; President—Thomas J. Manning, of Samuel Cabot, Inc.; Vice-President—Paul J. Mueller, of D.H. Litter Co.; and Treasurer—Martin L. Davis, of Sterling-Clark-Lurton Corp.

Kansas City
March 10

Morton Treade, of Reichard-Coulston, Inc., spoke on "MICACEOUS IRON OXIDE."

HUGO MANCO, *Secretary*

New York
March 8

The format of this meeting's program consisted of four workshops, held simultaneously. They were:

"FORMULATION OF LATEX PAINTS"—John Hendricks, of David Litter, Laboratories. Inc. Mr. Hendricks briefly traced the history of latex paints and described the film formation, stability, advantages, and ingredients of latex paints.

"CURRENT STATUS OF RADIATION CURING"—David Davis, of Cellomer Corp. Dr. Davis said that although solvent emission regulations, rising energy costs, and limited availability of natural gas for operating thermal curing ovens are providing incentives of the growth of radiation-curable coatings, he believes they will ultimately have to compete on a cost-performance basis to secure a substantial share of the industrial finishes market.

"TROUBLE SHOOTING IN THE PAINT PLANT"—Herb Hillman, of F.O. Pierce Co. Preventive maintenance, laboratory controls, and constant evaluation of plant procedures were some of the items discussed by Mr. Hillman in describing methods of problem prevention. If, however, problems do occur, he said, the cause of the problem should be sought (not who did it, but why did it happen).

"PROFILE OF GOVERNMENT SPECIFICATIONS"—Joseph Montalbano, of General Services Administration. Mr. Montalbano said that there are both good and bad specs which are subject to interpretation. He urged those involved to read, and re-read specifications, and to utilize GSA lab offices for information and interpretation.

SAUL SPINDEL, *Secretary*

Northwestern
March 15

Prior to the business meeting, a symposium was held on "COMPUTERS AND THE COATINGS INDUSTRY."

Honored Federation officials attending the meeting were President-Elect John Oates and Executive Vice-President Frank Borrelle.

Both briefly remarked on the need for continued society involvement and participation in efforts to keep the membership aware of new trends and technology that are occurring in the industry.

Robert Heskin, *Secretary*

Pacific Northwest
February 17

Marshall Ott, of Crucible Chemical Co., spoke on "Defoamers."

Mr. Ott said that silicone is most useful to the paint formulator as a defoamer.

R.P. Stewart, *Secretary*

Philadelphia
March 10

William Georgov, of J.M. Huber Co., spoke on "Problems Peculiar to the Coatings Industry in Russia."

Mr. Georgov discussed the operation of the Technical Institute in Leningrad where, he said, all work discussed prior to any practical work, must be signed by the participants. He pointed out that 90% of all trade sales are oil paint and 10% are latex paint. Paint films are applied by brush and calculated for dry film thickness, he said.

Lothar S. Sander, *Secretary*

Piedmont
March 16

Marshall Ott, of Crucible Chemical Co., spoke on "Defoamers."

Mr. Ott discussed the two basic types of materials used to control foam. Defoamers are used to break the foam after it has formed, he said. Whereas, antifoam agents are used to prevent foam during the processing stage.

It was voted to increase active membership dues from $15 to $20 per year.

Charles B. Wilson, *Secretary*

Pittsburgh
March 7

Kenneth Tator, of Kenneth Tator Associates, spoke on "Quality Control of Paint Films."

Mr. Tator indicated that control at the point of film application is a necessity, and discussed several means of determining proper application. He said that it was also important to measure the proper humidity and temperature as well as the condition of the surface as to roughness and contamination. Inspectors must know just what to look for in critical areas of the various stages of application, he added.

John S. Dahl, *Secretary*

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson). William T. Cochran, Bruning Paint Co., Inc. 601 S. Haven St., Baltimore, Md. 21224.

BIRMINGHAM (First Thursday —Warwickshire County Cricket Ground). P.A. Harris, Midland Specialty Powders, Unit 8, Bilston Industrial Estate, Staffs, England.

CHICAGO (First Monday—meeting sites in various suburban locations) Walter J. Krason, Jr., Enterprise Paint Mfg. Co., 2841 S. Ashland Ave., Chicago, Ill. 60608.

C-D-I-C (Second Monday—Sept., Jan., Mar. in Columbus; Oct., Dec., Apr. in Cincinnati; Nov., Feb., May in Dayton). Lloyd J. Reindl, Inland Div., GMC, P.O. Box 1224, Dayton, Ohio 45401.

CLEVELAND (Third Friday—meeting sites vary). Charles K. Beck, Addressograph Multigraph Corp., 19701 S. Miles Rd., Warrensville Hts., Ohio 44128.

DALLAS (Thursday following second Tuesday—Vic's Gallery Restaurant). Samuel F. Biffle, Sherwin-Williams Co., 2802 W. Miller Rd., Garland, Texas 75040.

DETROIT (Fourth Tuesday—Rackham Memorial Bldg.). Walter Stuecken, Grow Chemical Co., P.O. Box 45, Pontiac, Mich. 48056.

GOLDEN GATE (Monday before Third Wednesday—Sabella's Restaurant, San Francisco). Fred Apfel, International Paint Co., Inc. 220 S. Linden Ave., S. San Francisco, Calif. 94080.

HOUSTON (Second Tuesday—Sonny Look's Sir-Loin Inn). Thomas Ruland. Cook Paint & Varnish Co., P.O. Box 3088, Houston, Tex. 77001.

KANSAS CITY (Second Thursday—Fireside Inn). Hugo R. Manco, Farmland Industries, Inc., P.O. Box 7305, N. Kansas City, Mo. 64116.

LOS ANGELES (Second Wednesday—Steven's Steak House). Albert Seneker, Ameron, Research & Development, 4813 Firestone Blvd., South Gate, Calif. 90280.

LOUISVILLE (Third Wednesday—Essex House). J.B. Lococo, Reynolds Metals Co., P.O. Box 1800, Plant III, Louisville, Ky. 40201.

MONTREAL (First Wednesday—Bill Wong's Restaurant). J. W. A. Melsbach, Sico, Inc., 2505 de la Metropole Longueuil, Que., Canada.

NEW ENGLAND (Third Thursday—Fantasia Restaurant, Cambridge). George Mulvey, Dampney Co., 85 Paris St., Everett, Mass. 02149.

NEW YORK (Second Tuesday—varies between New York and New Jersey locations). Saul Spindel, David Litter Laboratories, Inc., 116 E. 16th St., New York, N.Y. 10003.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe). Robert Heskin, Valspar Corp., 1101 3rd St., S., Minneapolis, Minn. 55415.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). Michael Griffin, Reichhold Chemicals Ltd., P.O. Box 130, Port Moody, B.C., Canada.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, Presidential Apartments). Lothar S. Sander, N L Industries, Inc., Industrial Chemicals Div., P.O. Box 700, Hightstown, N.J. 08520.

PIEDMONT (Third Wednesday—Howard Johnson's Coliseum, Greensboro, N.C.). Charles B. Wilson, Reliance Universal, Inc., P.O. Box 2124, High Point, N.C. 27261.

PITTSBURGH (First Monday—Skibo Hall, Carnegie-Mellon University Campus). J.H. Dahl, J. H. Matthews Co., 1315 W. Liberty Ave., Pittsburgh, Pa. 15226.

ROCKY MOUNTAIN (Monday prior to second Wednesday—Gasthaus Ridgeview, Wheatridge, Colo.). Jim Peterson, Peterson Paint Co., P.O. Box 311, Pueblo, Colo. 81002.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). Morris D. Gilliam, Lanson Chemical Co., P.O. Box 128, E. St. Louis, Ill. 62202.

SOUTHERN (Gulf Coast Section—Second Tuesday; Central Florida Section—Thursday after third Monday; Atlanta Section—Third Thursday). Alfred L. Hendry. A.L. Hendry & Co., P.O. Box 17099, Tampa, Fla. 33612.

TORONTO (Second Monday—Town and Country Restaurant). H. Zapfe, Ashland Oil Canada Ltd., 2620 Royal Windsor Dr., Mississauga, Ont., Canada.

WESTERN NEW YORK (Second Tuesday—Cavalier Restaurant, Amherst, N.Y.). Leonard H. Gielinski, Spencer-Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, N.Y. 14225.

Elections

BALTIMORE

Active

Aichroth, Jeffrey T. — Lenmar Corp., Baltimore, Md.
Chodnicki, Richard C. — Kerr-McGee Chemical Corp., Bel Air, Md.
Freeman, Hutzler M. — Lenmar Lacquers, Inc., Baltimore.

CHICAGO

Active

Ascher, Alan L. — DeSoto, Inc., Des Plaines, Ill.
Babula, Stanley E. — Sun Chemical Co., Northlake, Ill.
Barrie Edward Jr.—Staley Research Mfg. Co., Decatur, Ill.
Bedford, Stuart F. — DeSoto, Inc., Des Plaines.
Beske, Lawrence — Iowa Paint Mfg. Co., Inc., Des Moines.
Brann, Claude E. — Rust-Oleum Corp., Evanston, Ill.
Bron, William J. — Valspar Corp., Rockford, Ill.
Brown, Kenneth H. — Rust-Oleum Corp., Evanston.
Bruchert, William L. — DeSoto, Inc., Des Plaines.
Cerney, Jac A. — Whittaker Corp., Chicago, Ill.
Cherimpes, George J. — SCM Corp., Chicago.
Christopher, Philip C. — Standard T Chemical Co., Chicago.
Daunheimer, Lyn R. — Masonite Corp., St. Charles, Ill.
de Beers, Franklin M. — de Beers Laboratories, Inc., Addison, Ill.
Demere, Lois E. — Mobil Chemical Co., Rankakee, Ill.
Duninger, Joseph E. — IMC/McWhorter Resins, Carpentersville, Ill.
Dowell, Richard J. — Mobil Chemical Co., Kankakee, Ill.
Edgington, Ralph J. — Mobil Chemical Co., Kankakee.
Eggers, Warren, J. — River Valley Coatings Co., Aurora, Ill.
Engelking, Gerald L. — Standard T Chemical Co., Chicago Heights, Ill.
Ensor, William L. — DeSoto, Inc., Des Plaines.
Fabian, Henry R. — Whittaker Corp., Chicago.
Falls, Carl L. — Whittaker Chemicals & Coatings Corp., Chicago.
Gatechair, Deborah — DeSoto, Inc., Des Plaines.
Gauchel, James V. — DeSoto, Inc., Des Plaines.
George, Phillip K. — Glidden Coatings & Resins Div., SCM Corp., Chicago.
Gillespie, Dennis E. — Enterprise Paint Co., Chicago.
Goldblatt, Philip H. — Sherwin-Williams Co., Chicago.
Grazys, Gint L. — Daubert Chem. Co., Chicago.
Grobarek, Joseph F. — Midwest Lacquer Mfg. Co., Schiller Park, Ill.
Gustafson, James H. — Barrett Varnish Co., Cicero, Ill.
Haase, Bernhardt C. — Midwest Lacquer Mfg. Co., Schiller Park.
Harris, Robert R. — IMC/McWhorter Resins, Carpentersville.
Hinrichs, Robert L. — DeSoto, Inc., Des Plaines.
Holzrichter, Norman — PRA Laboratories, Inc., Chicago.
Jablonski, David R. — Thiem Corp., Milwaukee, Wis.
Jasenof, Kenneth — DeSoto, Inc., Des Plaines.
Johnson, Gary L. — Midland Div., Dexter Corp., Waukegan, Ill.
Johnson, Lennart C. — Glidden Durkee Div., SCM Corp., Chicago.
Johnson, Ralph — Enterprise Co., Wheeling, Ill.
Julian, James M. — DeSoto, Inc., Des Plaines.
Karlson, Jim — DeSoto, Inc., Des Plaines.
Kleinlein, Ronald L. — Sherwin-Williams Co., Chicago.
Korovich, Michael R. — SCM Corp., Chicago.
Kurcz, Wayne — William-Hayward Protective Coatings, Inc., Summit, Ill.
Mazur, Dennis M. — Whittaker Coatings & Chemicals Co., Chicago.
McClain, Joe E. — Whittaker Coatings & Chemicals Co., Chicago.
McCormick, Robert G. — United Coatings, Inc., Chicago.
McKenzie, Francis — Sherwin-Williams Co., Chicago.
McWright, Gregory — United States Gypsum, Co., Des Plaines.
Meyer, Diane K. — General Paint & Chemical Co., Cary, Ill.
Micek, Lawrence T. — General Paint & Chemical Co., Chicago.
Miller, Robert G. — Whittaker Coatings & Chemicals, Rockdale, Ill.
Monti, Lewis J. — Enterprise Co., Chicago.
Morgan, Jacqueline — DeSoto, Inc., Des Plaines.
Mylonakis, Stam — DeSoto, Inc., Des Plaines.
Newman, Thomas C. — Armak, McCook, Ill.
Niemiec, Matthew L.—Standard T Chemical Co., Chicago Heights.
Noren, Gerry K. — DeSoto, Inc., Des Plaines.
O'Connell, Daniel D. — United States Gypsum Co., Des Plaines.
Oswald, William A. — Pierce & Stevens Chemical Co., Carol Stream, Ill.
Parker, Don W. — Sherwin-Williams Co., Chicago.
Patel, Babu R. — Whittaker Chemical & Coatings Co., Chicago.
Perry, James — United Coatings, Inc., Chicago.
Petersen, Carl — Reliance Universal, Inc., Zion, Ill.
Plooy, Ronald J. — J.G. Milligan & Co., Oak Creek, Wis.
Pollack, Warren J. — IMC-McWhorter Resins, Carpentersville.
Norenberg, James T. — Sherwin-Williams Co., Chicago.
Richley, William H. — Mobil Chemical Co., Kankakee.
Robellard, James R. — Enterprise Paint Co., Wheeling.
Rosa, Prisco — Rea Magnet Wire Co., Inc., Fort Wayne, Ind.
Santos, Eduardo S. — SCM Corp., Chicago.
Sattelmaier, E. John — General Paint & Chemical Co., Chicago.
Schmidt, Arthur B. — Premier Paint Varnish Co., Elk Grove, Ill.
Sedgwick, Roger — Cellofilm Corp., Argo, Ill.
Sherman Charles J. — Sherwin-Williams Co., Chicago.
Shuster, Francine I. — Cargill, Inc., Carpentersville.
Simonaitis, Ben — W.C. Richards Co., Blue Island, Ill.
Sirenu, Robert C. — Jordan Paint Mfg. Co., Forest Park, Ill.
Slavka, Dennis S. — PPG Industries, Inc., Oak Creek.
Smith, Alfred E. — DeSoto, Inc., Des Plaines.
Sor, Yvonne — Rust-Oleum Corp., Evanston.
Stamenkovich, Zika N. — Shield Coatings, Inc., Chicago.
Stephens, Joycelyn — DeSoto, Inc., Des Plaines.
Stewart, John — Cellofilm Corp., Argo.
Strobel, Charles W. — DeSoto, Inc., Des Plaines.
Suciu, Dan E. — Midwest Synthetics Div., Valspar Corp., Rockford.
Sutliff, Thomas — DeSoto, Inc., Des Plaines.
Taubman, Charles M. — Whittaker Coatings & Chemicals, Rockdale.
Taylor, Laurent — Glidden-Durkee Div., SCM Corp., Chicago.
Tweet, David E. — Cargill, Inc., Carpentersville.
Walrabenstein, Marcilla R. — Mobil Chemical Co., Kankakee.

Widmer, Thomas R. — O'Brien Corp., South Bend, Ind.
Williard, James M. — River Valley Coatings, Inc., Aurora.
Wind, Donald G. — Enerprise Chemical Coatings, Chicago.
Zabulski, William J. — Rust-Oleum Corp., Evanston.
Zahora, Edward P. — DeSoto, Inc., Des Plaines.
Zipter, David K. — Rockford Chemical Coatings, Rockford.
Znidersic, Ken M. — Reliance Universal Inc., Zion.

Associate

Angelos, Evans — Hilton-Davis Chemical Co., Des Plaines, Ill.

Appelle, Leonard — Kraft Chemical Co., Chicago, Ill.

Bachar, Steven W. — Kraft Chemical Co., Chicago.

Baldin, Edward J. — Spencer Kellogg Div. of Textron, Inc., Des Plaines.

Bates, Steven R. — IMC Chemical Group, Inc., Hillside, Ill.

Bergsten, John M. — New Jersey Zinc Co., Chicago.

Beversdorf, Roy A. — Dow Chemical, U.S.A., Des Plaines.

Biermann, Robert A. — Borden Chemical Co., Elmhurst, Ill.

Blackshear, Robert H. — Buckman Laboratories, Inc., Crystal Lake, Ill.

Blattner, Richard L. — IMC-McWhorter Resins, Carpentersville, Ill.

Booth, Fred S. — Hercules Incorporated, Oak Brook, Ill.

Brandt, Thomas R. — Geo. C. Brandt, Inc., Hinsdale, Ill.

Brewster, William D. — Borden Chemical Co., Portage, Mich.

Brown, Don E. — Continental Can Co., U.S.A., Elmhurst.

Chiu, Jeffery S. — Universal Color Dispersions, Lansing, Ill.

Christiansen, Nymer A. — Hughson Chemical Co., Oak Brook.

Colbert, R. Michael — Nalco Chemical Co., Hillside.

Cranstown, Richard L. — N L Industries, Inc., Deerfield, Ill.

Culbertson, Byron J. — Dow Corning Corp., Schiller Park, Ill.

DePaszuale, Louis J. — Thompson-Hayward Chemical Co., Chicago.

Duncan, Roland J. — Kelco Co., Chicago.

Eaton, William J. — CIBA-GEIGY Corp., Park Ridge, Ill.

Edwards, Robert V. — Indiana General Div. of EMM, Valparaiso, Ind.

Erbeck, William J. — Cary Co., Addison, Ill.

Fielding, Robert J. — American Hoechst Corp., Elk Grove Village, Ill.

France, Thomas G. — Chemetron Pigments, Chicago.

Goodwin, George W. — Daniel Products Co., Downers Grove, Ill.

Grant, Patrick F. — Pfizer, Inc., Hoffman Estates, Ill.

Gratt, Stanley H. — Superior Graphite, Chicago.

Gray, Harlan G. — Union Oil Co. of Calif., Palatine, Ill.

Habeck, Frederic H. — Marine Colloids, Inc., Park Ridge.

Hamlin, Stirling S. — Scholle Corp., Northlake, Ill.

Harris, Jack M. — Thompson-Hayward Chemical Co., Chicago.

Haugen, R. Norman — Jensen Souders & Associates, Itasca, Ill.

Irby, George S. — Rohm and Haas Co., Niles, Ill.

Kaberna, Edward S. — Thompson-Hayward Chem. Co., Chicago.

Kaiser, Robert W. — Central Can Co., Chicago.

Kelly, Eugene J. — Central Can Co., Chicago.

Koshak, James A. — CIBA-GEIGY Corp., Park Ridge.

Krock, Lawrence M. — Cargill, Inc., Carpentersville.

Lajack, Denis J. — Pfizer, Inc., Hoffman Estates, Ill.

Leth, H.D. — W.R. Grace & Co., Chicago.

Mack, Eugene K. — Container Sales Corp., Westchester, Ill.

McLaughlin, Thomas C. — Pfizer, Inc., Hoffman Estates.

Merwin, James K. — AMSCO Div., Palatine.

Meyer, Herbert J. — IMC-McWhorter Resins, Carpentersville.

Morris, Billy J. — AMSCO Div., Palatine.

Nielsen, Ada C. — Nalco Chem. Co., Oak Brook.

Norton, John P. — Tammsco, Inc., Cassopolis, Mich.

Olson, Richard H. — IMC-McWhorter Resins, Carpentersville.

Osborne, Harold W. — American Hoechst Corp., Elk Grove Village.

Peters, Frank C. — Universal Color Dispersions, Lansing, Ill.

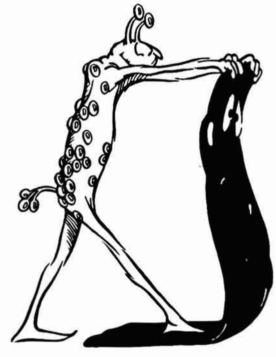
Powell, T. Clifford — Johns-Manville Sales Corp., Oak Brook.

Pruitt, Ronnie M. — Dow Chem., U.S.A., Des Plaines.

Ressa, Frank J. — Ideas, Inc., Wood Dale, Ill.

Schendel, Dennis E. — AMSCO Div., Palatine.

Siegall, Michael L. — Daniel G. Hereley Co., Chicago.



Smith, John L. — Monsanto Co., Des Plaines.
Stamm, John J. — GLS Chemicals Div., Chicago.
Wik, Leonard M. — Titanium Pigment Div., N L Ind., Oak Brook.
Wasser, Richard J., Jr. — New Jersey Zinc Co., Chicago.
Young, Leonard J., Jr. — E.I. duPont de Nemours & Co., Inc., Pigments Dept., Chicago.

Educator/Student

Cliffe, Roger W. — Northern Illinois University, DeKalb, Ill.

HOUSTON

Active

Bounds, Lee H. — Reliance Universal, Inc., Houston, Tex.
Forrester, Wellington K. — Cook Paint & Varnish Co., Houston.
Jones, Jackie D. — Reliance Universal, Inc., Houston.
Patrick, Marcia S. — PPG Industries, Inc., Houston.

Associate

Smith, Daniel A. — Hooker Chemicals & Plastics Corp., Niagara Falls, N.Y.
Welsh, George B. — E.I. du Pont de Nemour & Co., Inc., Houston, Texas.

KANSAS CITY

Active

Zukovich, John G. — Pratt & Lambert, Inc., N. Kansas City, Mo.

LOS ANGELES

Active

Cohen, Rudolf A. — Spectra-Tone Paint Corp., S. El Monte, Calif.
Hemple, Robert L. — Southern Lacquer & Paint Corp., South Gate, Calif.
Ko, Benita U. — Koppers Co., Inc., Los Angeles, Calif.
Williams, Ralph A. — Inmont Corp. Anaheim, Calif.

Associate

Kim, Keith K.S. — AMSCO Div., Union Oil of Calif., La Mirada, Calif.
Tator, David P. — Amaerican Cyanamid Co., Commerce, Calif.

LOUISVILLE

Active

Carlson, Glenn E. — Olympic Stain, Louisville, Ky.
Davis, Arthur E. — Devoe & Raynolds Co., Inc. Louisville.
Pegis, Anton E. — Mobil Chemical Co., Louisville.
Wilson, Herbert — Reliance Universal, Inc., Louisville.

Associate

Miculis, Mark A. — P.B. & S. Chemical Co., Lexington, Ky.
Rogers, Richard H. — Anderson & Co., Akron, Ohio.

NORTHWESTERN

Active

Kokes, James E. — Ti-Kromatic Paints, Inc., St. Paul, Minn.
Soud, Hussein M. — Valspar Corp., Minneapolis, Minn.
Starkey, Allen C. — Rohm and Haas Co., Wayzata, N.J.

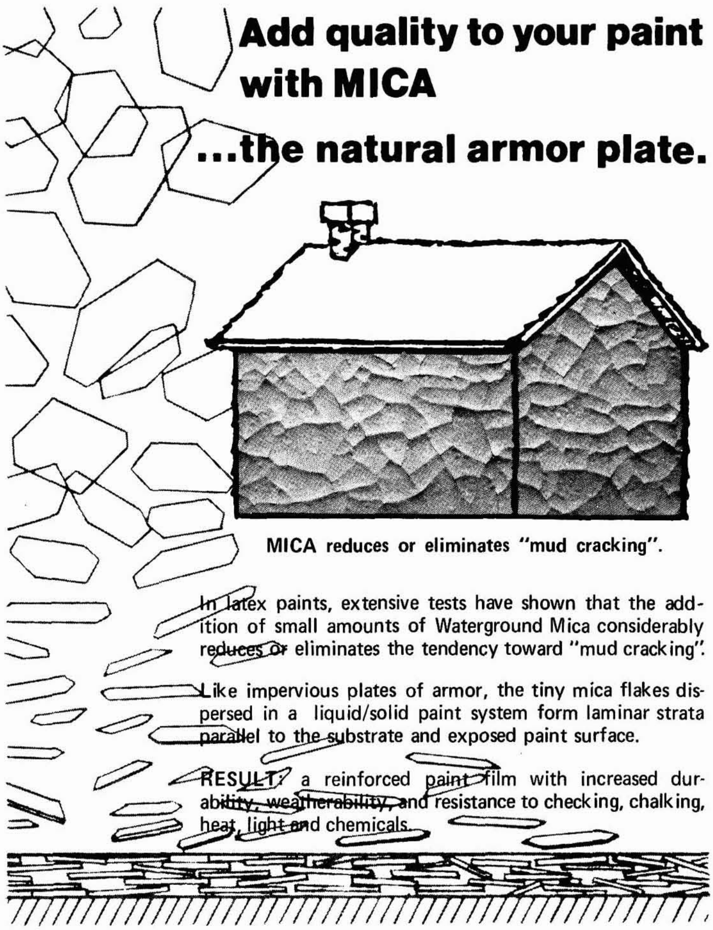
PHILADELPHIA

Active

Barr, James K. — Pfizer, Inc., Easton, Pa.
Poist, John E. — Pfizer, Inc., Easton.

Associate

Meyer, Charles A. — Hilton-Davis Chemical Co., Newark, N.J.
Neal, Grady — Dow Chemical Co., Moorestown, N.J.



Technical Articles in Other Publications

Compiled by the Technical Information Systems Committee—H. Skowronska, Chairman

Defazet
Deutsche Farben-Zeitschrift
(In German)

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Depke, F.M.—"Coatings Based on Epoxy Resins;" 14-19.
Grüber, H.—"Coatings Based on Polyurethanes;" 20-23.
Klopfer, H.—"The Coating as Subject for a Building Contract;" 24-28.
Schuhmann, H.—"Experience Concerning Application Techniques in the Protection of Buildings;" 28-33.

Double Liaison - Chimie Des Peintures
(In French)

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F-75006, Paris, France

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Farbe und Lack
(In German)

Published by Curt R. Vincentz Verlag, 3 Hannover, Postfach
6247, Schiffgraben 43, Germany

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Published by Sawell Publications, Ltd., 127 Stanstead Road,
London SE23 1JE, England

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Karl-Heine-Strasse 27, 7031 Leipsig, E. German DDR

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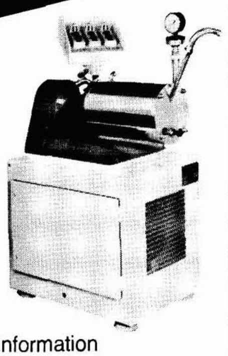


Meetings/Education

Southern Society Annual Meeting Draws 273; New Officers Elected

A total of 273 registrants attended the 41st annual convention of the Southern Society for Coatings Technology, held March 23-25 in New Orleans, La.

President of the Society is Thomas E. Marek, of Coronado Paint Co., Edgewater, Fla. President-Elect Berger G. Justen, of Tropco Paint Co., Tampa, Fla., served as Program Chairman for the event.

Technical Program

The following presentations were featured on the two-day technical program:

"Synergistic Opportunities in the Coatings Industry"—S. T. Greer, of PPG Industries, Inc. (The Keynote Address).

"Dynamics of Roller Spatter and Tracking"—F. J. Glass, of Union Carbide Corp.

"Some Hope for Measuring and Predicting Rheological Performance"—Dr. Eric Erenrich, of N L Industries, Inc.

"The Use of Titanium Coupling Agents in Coatings"—Dr. Gerald Shugman, Salvatore J. Monte, and Daniel J. Seeman, of Kenrich Petro-Chemicals.

"Pigment Testing from a Manufacturer's Point of View"—Albert E. Medas, of American Hoechst.

"Enzymatic Hydrolysis of Cellulosic Thickener"—Percy Singleton, of Dow Chemical Co.

"Carbon Blacks for Coatings—Past, Present and Future"—Errol J. Queen, of Cities Service Co.

"Comparative Dusting of Common Paint Pigments"—A. L. Hendry, of A. L. Hendry & Co., and Chairman of the Society's Safety & Environmental Committee.

"What Happens After the Fire"—Thomas E. Marek.

Also featured were student papers from the University of Southern Mississippi—Presented by Jackie Rockette, Randy Hanson, and Mike Leggett.

Business Session

Presentations at the business session included the following:

A review of Federation activities by Neil Estrada, President, and James McCormick, Treasurer.

A report from the National Paint and Coatings Association, presented by James Elliott, NPCA Field Secretary.

Reports from the Atlanta, Gulf Coast, Miami, and Central Florida Sections of the Society that membership recruiting is bearing fruit and attendance at monthly meetings continues good.

Report on the Symposium on "Water-Borne and Higher-Solids Coatings," held Feb. 14-16 in New Orleans, and jointly sponsored by the Society and University of Southern Mississippi. The symposium, which attracted a total attendance of 213, was again a financial success, and the Society contributed $5000 to USM—these funds representing partial proceeds from the symposium.

Twenty-five year pins were presented to Fred Ball, Al Hendry, Harry Fields, and George Korem.

Bazel Secord was elected to Society Honorary Membership.

New Officers

Officers elected for 1977-78 were: President—Berger G. Justen; President-Elect—A. Roy Neal, of Rico Chemicals, Inc., Toccoa, Ga.; Vice-President—Al Hendry, of A. L. Hendry & Co., Tampa, Fla.; Secretary-Treasurer—Thad Broome, of Precision Paint Corp., Atlanta, Ga.; and Council Representative—J. T. Robertson, of Southern Coatings & Chemical Co., Sumter, S.C.

Leo Roon Contributes $100,000 to PRI

The Paint Research Institute is pleased to announce that it has received a contribution of $100,000 from Leo Roon, well-known figure in the coatings industry for many years.

The contribution was made on two occasions: $40,000 in 1968 and $60,000 recently. Both will be combined into the "Leo Roon Fund," which will not only support Paint Research Institute research grants but also furnish the cash prizes for the annual Roon Awards. The awards, for outstanding papers presented at the Annual Meeting, will now be administered by PRI.

Founder and President of both Roxalin Flexible Finishes, Inc. and Nuodex Products Co., Mr. Roon has long been active in furthering coatings research and technology. He served as Trustee of the Paint Research Institute from 1960-62. Earlier (in 1957), he established the Roon Awards for Annual Meeting papers.

Mr. Roon was honored by the Federation and the Paint Research Institute for his many contributions to the coatings industry, and presented with a scroll to commemorate the occasion, at the 1975 Annual Meeting in Los Angeles.

Mr. Roon is retired and lives in La Jolla, Calif.

Rolla Short Courses Attract 124; Fall Schedule Announced

The winter session of the Paint Short Courses held at the University of Missouri—Rolla from January 17 to February 18 attracted 124 students which was slightly less than the 140 who attended that session in 1976. The drop in attendance was attributed to the unusually bad winter and the closing of many industrial plants. However, a very successful session was conducted, reported course director Lewis P. Larson.

Five Paint and Coatings Short Courses have been planned for the fall session:

Sept. 12-16—35th Introductory Short Course on the Composition of Paints and Chemical Coatings.

Sept. 19-23—7th Paint Inspectors and Quality Controllers Short Course.

Sept. 26-30—3rd Introductory Short Course on the Tinting, Shading, and Matching of Color Paints and Chemical Coatings.

Oct. 3-7—29th Advanced Chemical Coatings Workshop.

Oct. 10-14—26th Paint Short Course for Maintenance Engineers, Architects, and Painting Contractors.

For further information contact Norma Fleming, Coordinator, Extension Div., University of Missouri—Rolla, 501 W. 11th St., Rolla, Mo. 65401; or Lewis P. Larson, Director, Box 3073, Columbus, Ohio 43210.

Rensselaer to Offer Program On Color Technology in June

The principles, management, and development of color technology will be subjects of three intensive continuing-studies courses offered by Rensselaer Polytechnic Institute, Troy, N.Y., June 6 to 24.

"Principles of Color Technology," (June 6-10) will focus on both theory and practice in the description, specification, and measurement of color, and will be of particular value to those having no previous formal education in the field.

"Color Technology for Management," (June 13-14) is designed for executives responsible for research, production, or sales of colored products in reaching correct management decisions based on the principles of color technology, particularly where instrumental or computational techniques are involved.

"Advances in Color Technology," (June 20-24) is designed to provide the latest information on the developments and techniques of color science and technology, utilizing both lectures and laboratory workshops. Attendance is limited to applicants having two or more years' experience in instrumental color measurement, or a shorter period of experience plus completion of the course, "Principles of Color Technology," or an equivalent course.

Tuition, covering instruction, text, and notebooks, is $350 for "Principles," $225 for "Management," and $400 for "Advances."

For complete information, or to register, contact Office of Continuing Studies, Rensselaer Polytechnic Institute, Troy, N.Y. 12181.

PRI Trustees, Society Technical Committee Chairmen To Meet in June in Cleveland

Arrangements have been completed for meetings in Cleveland of the Paint Research Institute Trustees on June 8 and 9, followed by a meeting of the Constituent Society Technical Committee Chairmen with the Federation Technical Advisory Committee on June 10.

Both groups will have the opportunity to meet for informal discussions at a joint reception on June 9.

The PRI Trustees normally meet in June of each year, and the Technical Committee Chairmen/Technical Advisory Committee meeting has been scheduled to tie-in so that members can be briefed on current PRI research projects.

Future of Paint Industry to be Topic Of Joint St. Louis/Kansas City Meeting

A two-day meeting focusing on "The Evolutionary Paint Industry," jointly sponsored by the St. Louis and Kansas City Societies for Coatings Technology, will be held June 3 and 4 at the Millstone Lodge, Gravois Mills, Mo.

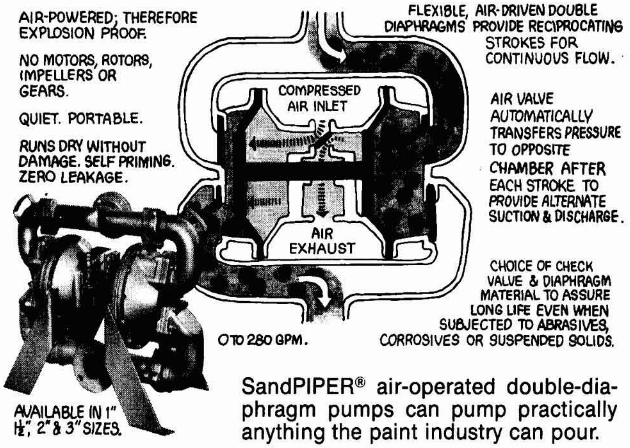
The technical session, to take place June 4, will include the following presentations:

"Future Chemistry Aspects of Future Surface Coatings"—Dr. Stig E. Friberg, of the University of Missouri—Rolla.

"Why High Solids"—James Larson, of Cargill, Inc.

"Semi-Bulk Handling Systems—Dry and Wet Materials"—Lee Raden, of Fabricated Metals, Inc.

The registration fee of $35 includes lunch and a dinner-dance which will be held Saturday evening. Checks should be made payable to the Kansas City Society for Coatings Technology, and sent to William Fitzpatrick, Cook Paint & Varnish Co., P.O. Box 389, N. Kansas City, Mo. 64141.



Kent State Schedules Summer Rheology Course

A course on "Applied Rheology for Industrial Chemists" will be conducted for the second year at Kent State University, June 27 through July 1. Lectures will be presented on 18 subjects related to rheology, kinematics and dynamics, dispersion, interfacial and polymer rheology. Discussion will be divided equally between principles and application.

The course is designed for individuals charged with the responsibility of research, development and production in the coatings, adhesives, elastomers, and plastics industries. Participants should gain insights which will enable them to write and understand specifications, improve quality control, tailor materials for prescribed end uses, and learn techniques in rheology.

Program Chairman Carl J. Knauss, Assistant to the Chairman of the Chemistry Department and the Rheology Laboratory Director at Kent State, has announced the following presentations:

JUNE 27

"Rheology of Dispersions"—Dr. Irvin M. Krieger, of Case-Western Reserve University.

"Basic Concepts of Rheology I and II"—Dr. Hershel Markovitz, of Carnegie-Mellon University.

"Some New Thoughts on Dispersion Theology"—Dr. Walter K. Asbeck, Consultant.

JUNE 28

"Experimental Methods for Measuring Viscoelastic Properties of Liquids"—Dr. John D. Ferry, of University of Wisconsin.

"Stress Relaxation and Creep" and "Plastic Yield"—Dr. Rodney D. Andrews, of Stevens Institute of Technology.

"Kinetic Rheology, Liquid-to-Solid Conversion"—Dr. Raymond R. Myers, of Kent State University.

JUNE 29

"Rheological Aspects of Adhesion"—Dr. Armand F. Lewis, of Lord Corp.

"Polymer Physical Property Measurements in the Industrial Laboratory"—Dr. Ray D. Hoffman, of U.S. Steel Corp.

"A Practical Approach to Structure Property Correlations"—Dr. Henry P. Schreiber, of Ecole Polytechnique.

"Rheology of Water Base Systems"—Dr. Otto C. C. Lin, of E. I. du Pont de Nemours & Co., Inc.

JUNE 30

"Rheological Characterization of Elastomers"—Dr. Edward A. Collins, of B. F. Goodrich Chemical Co.

"Brush Application of Coatings" and "Roll Application of Coatings"—Dr. Edward J. Glass, of Union Carbide Corp.

"Rheology in Polyethylene Processing and Properties"—Dr. Ramesh Shroff, of Chemplex, Inc.

JULY 1

"Fracture Behavior of Brittle Materials"—Dr. Donald L. Hunston, of Naval Research Laboratory.

"Fluid Flow Problems and the Use of Polymeric Additives"—Dr. Robert Y. Ting, of Naval Research Laboratory.

Registration fee of $285 covers reference material, instruction, coffee breaks, and lunches.

Lodging can be obtained on-campus.

For additional information, write Carl J. Knauss, Chemistry Dept., Kent State University, Kent, Ohio 44242, or call (216) 672-2327.

CIBA-GEIGY Offers Course In Color Technology

A comprehensive two-and-one-half-day seminar on "Colorimetry and Optics of Pigmented Systems" will be offered during 1977 by the Colorimetry Laboratory, Pigments Dep., CIBA-GEIGY Corp.

Course location and dates are as follows: Toledo, Ohio, June 7, 8, 9; Chicago, Ill, September 27, 28, 29; and Los Angeles, Calif., November 15, 16, 17.

The seminar will provide theoretical and practical background in applying colorimetry to solve colorant formulation problems in pigmented systems such as mass color fibers, plastics, and coatings. Specific "how to" instruction will be given on formulation and colorant selection techniques that can decrease costs and reduce formulation time.

Course tuition is $150., including instruction materials and luncheons. Ruth Johnston-Feller, a part-time consultant to CIBA-GEIGY, and Dennis Osmer, Manager, Colorimetry Laboratory, CIBA-GEIGY, are course instructors.

For further information on the course, write Dennis Osmer, Colorimetry Laboratory, Pigments Dep., CIBA-GEIGY Corp. Ardsley, N.Y. 10502.

Protective Performance of Coatings to be Topic Of NDSU Symposium, June 1-3

The 17th Annual Coatings Symposium sponsored by North Dakota State University will present "Improving Protective Performance of Coatings." The program will be held June 1-3 at NDSU, Fargo, N.D.

The symposium is designed to explore such important concepts basic to coatings performance as adhesion, mechanical properties, photochemistry of film degradation, and corrosion. The approach for the meeting has been to interface basic theory and principles with practical approaches to problem solving.

The following papers are scheduled for presentation:

"Relationships Between Polymer Structure and Adhesion"—Carl A. Dahlquist, of 3M Company.

"Improving Performance of Coatings with Titanate Coupling Agents"—Salvatore J. Monte, of Kenrich Petrochemicals.

"Basic Principles of Corrosion Important in Coatings Formulation"—Zeno W. Wicks, Jr., of North Dakota State University.

"Interrelationships Between Steel Surfaces, Phosphatability, and Corrosion Resistance"—Howard Bender and Joseph Wojtkowiak, of General Motors Research Laboratories.

"Formulation, Application, and Performance of Acrylic Latex Maintenance Paints"—Martin Grourke, of Rohm and Haas Co. Research Laboratories.

"Variables Influencing Performance of New Corrosion Inhibitive Coatings"—Robert Van Doren, of NL Industries, Inc.

"Stress Analysis—A Tool for Understanding and Improving Coatings Performance"—Loren W. Hill, of NDSU.

"Photochemistry of Film Degradation and Stabilization"—S. Peter Pappas, of NDSU.

"Early Failure Detection by Chemiluminesence"—David Mendenhall and Richard Nathan, of Battelle Memorial Institute—Columbus Laboratories.

The registration fee of $220 includes symposium enrollment, dormitory room accommodations, and meals. For more information, or to register, contact Polymers and Coatings Dept., North Dakota State University, Fargo, N.D. 58102.

People

Frederick K. Daniel has been chosen as the recipient of the New York Society for Coatings Technology's PAVAC Award for 1977. This honor is bestowed on members of the Society who have made outstanding contributions to the advancement of the coatings industry and the New York Society.

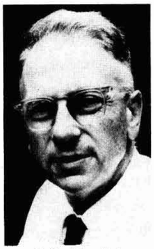
Mr. Daniel is President of the Daniel Products Co., Jersey City, N.J., and has been a long-time member of the New York Society where he has served as Chairman of the Technical, Program, and Awards Committees as well as being a member of the Board of Directors from 1968-70. He is also a member of the Federation's Liaison Committee.

The 1977 ISCC Godlove Award was presented to **Hugh R. Davidson** at the Annual Meeting of the Inter-Society Color Council, April 19. The Award is presented for "outstanding contributions to the knowledge and use of color." Mr. Davidson, who began his career in color in 1946, is a founder of Davidson Colleagues, a color consulting firm.

The Pigments Dept. of Sun Chemical Corp. has promoted **Edward J. Wood** to Sales Manager for U.S. and Canadian operations; **Jack Cambrey** was appointed Marketing Manager. In addition, **William E. Breagy** was named Midwest Regional Manager in Chicago, Ill., and **Robert E. Leber** was appointed Western Regional Manager headquartered in Los Angeles. **Dale L. Stahl** was promoted to Chicago District Sales Manager.

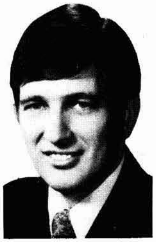
The Baltimore Society for Coatings Technology has elected **Howard G. Sholl,** former Vice-President, Technical Director, and General Manager of the Bruning Paint Co., to Honorary Society Membership. Mr. Sholl, who recently retired, is a Past-President (1958-59) of the Federation of Societies for Coatings Technology and is currently a member of its Board of Directors. He was the first recipient of the Herman Shugar Award of the Baltimore Society in 1956 for his outstanding contribution to the coatings industry.

Vernon O. Webb and **Andrew A. McAllister** have been appointed Accounts Managers for E.I. duPont de Nemours & Co., Inc.—Pigments Dept. They were formerly Marketing Representatives for the department.



F.K. Daniel

H.R. Davidson



E.J. Wood

J. Cambrey

Karl W. Herman has been appointed by Drew Chemical Corp. as Consultant to its Waste Water Treatment Div. He was previously Technical Manager of the company's Marine Div. Drew Chemical has also promoted **Wiley G. Lee** to Regional Manager of the Southwest Region of the Waste Water Div. and **Lee G. Soukup** was named Senior District Manager of the Central Sales District.

Diamond Shamrock Corp. has named **Frank B. Hawkinson** as Advertising Manager for the company's Process Chemicals Div., Morristown, N.J. He will be responsible for the division's advertising, public relations, and promotional activities.

In a series of managerial appointments, J.M. Huber Corp. has named **Joe C. Wood, Jr.** Chief Engineer of the Clay Div., **Ned Harbeson** was promoted to Assistant Manager and Production Manager, and **Roger Dozier** was appointed Chief Plant Engineer of the Wrens, Ga. and Edisto, S.C. facilities.

Arthur J. Cook has been named Manager of Marketing for Hunter Associates Laboratory, Inc., Fairfax, Va. He will direct the activities of the International Marketing Group, selling in foreign markets through the company's overseas operations, as well as those of Domestic Marketing and Field Service Dept.

The Metalworking Chemicals Div. of Amchem Products, Inc. has promoted **Mark A. Kuehner** to Product Manager, Autophoretic coating chemicals. He was formerly a Group Leader in the steel industry product line.

Tenneco Chemicals, Inc. has named **Joanne E. Messura** Color Systems Merchandising Manager at the Piscataway, N.J. facility.

B.F. Goodrich Chemical Div. has appointed **David E. Weaver** Research and Development Consultant in the latex group at the company's Technical Center in Avon Lake, Ohio. He has been with B.F. Goodrich since 1950, and most recently served as Senior R&D Scientist.

Nalco Chemical Co. has named **Dale E. Walker** to Regional Sales Manager for the Eastern Region.

Armin Szatmary has been appointed Sales Manager of Premier Mill Corp., Temple, Pa.

LeRoy P. Clark has been named Assistant General Manager of the Louisville Resins Operation of Reliance Universal, Inc. He was formerly the Manufacturing Manager of the facility.

Merck Chemical Div. has appointed **Richard E. Freeman** Manager of Market Planning at its Rahway, N.J. headquarters.

Charles Dauderman has been named Technical Director of the Chemical Coatings Div. of Valspar Corp.

Dr. Alexander Ross has been named Vice-President—Research for Spencer-Kellogg Div. of Textron, Inc. He has been Director of Research for the company since 1974 and will remain at the R&D labs in Buffalo, N.Y. The division has also appointed **Paul V. Genco** Marketing Manager of Chemical Products and **Carl L. Schwenk** Product Manager of Chemical Products. Spencer Kellogg has announced the retirement of **Byron F. Swackhamer** effective March 1, following 43 years of service to the paint industry. Most recently, he served as Assistant to the President of the company and is a Past-President of the Philadelphia Paint and Coatings Association.

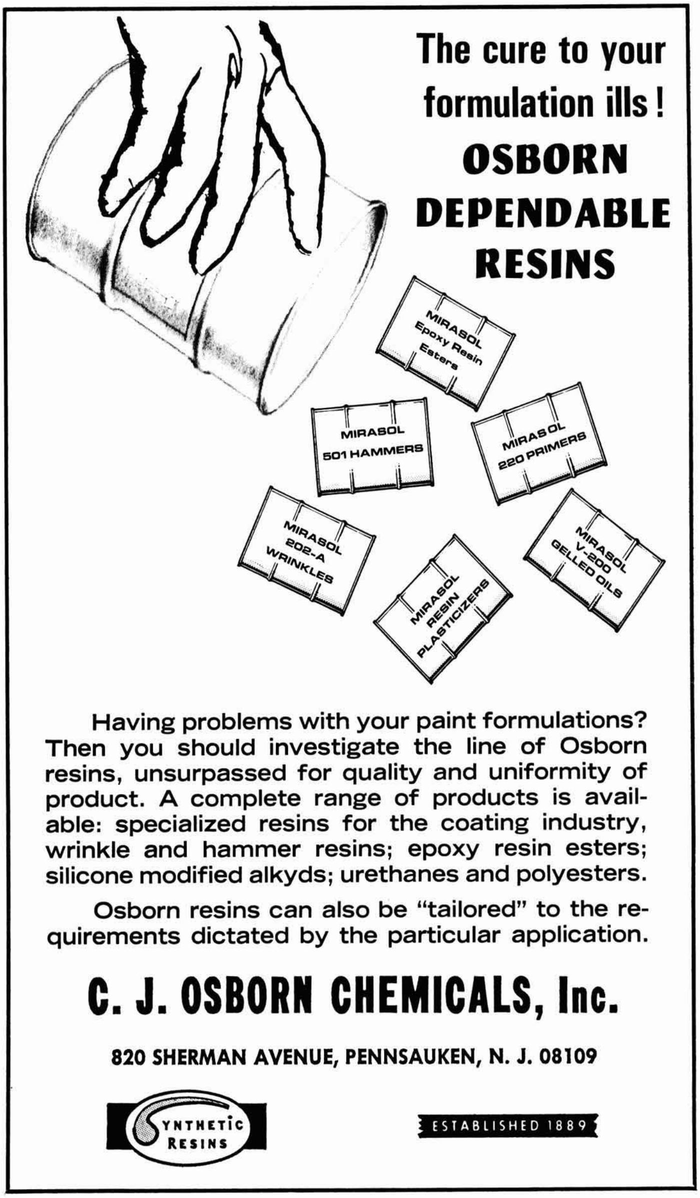
People (Continued)

Thomas D. Schroeder has joined Thiokol/Chemical Div. as Technical Sales Representative in the midwest.

In two managerial appointments, International Paint Co., Inc. has named **John S. Cole** Manager of Southwest District Sales in Houston, and **P.A. Thomsen** Regional Manager for Southern and Western Florida and the Caribbean Islands.

Barry Miller has joined the staff of ICD Group, Inc., New York, N.Y. He will be responsible for the marketing and sales of organic chemicals, intermediates, and colorants.

J. T. Williamson has been named Vice-President and General Manager of Freeport Kaolin Co., Gordon, Ga. He succeeds **F. A. Gunn,** who will assume the post of Senior Technical Advisor.



The newly formed Glidden Coatings & Resins Div. of SCM Corp. has named **Irving J. Foote,** formerly Vice-President of Manufacturing, to an expanded post encompassing the engineering dept., with the newly appointed director of Engineering, **Edward W. Geis,** reporting to him. Also, **Edward M. Kane** has been named Director of Business Planning with additional responsibility for the division's marketing research efforts. In the corporation's Glidden Pigments Div., **Craig J. Hartzell** and **William M. Burr, Jr.** have been named Sales Representatives for TiO_2, inorganic pigments, and fine silica particles.

William J. Skelton has been named Materials Manager for the Industrial Chemical Div. of American Hoechst Corp.

Morris Birrell, Sales Director for Reckitt's (Colours) Ltd., Yorkshire, England, has retired following many years in service to the coatings industry.

The new officers of the Society of Plastics Engineers were installed at the 35th Annual Technical Conference in Montreal, Quebec, April 25-28. Assuming office were: President—**Dr. Lawrence J. Broutman,** of Illinois Institute of Technology, Chicago, Ill.; President-Elect—**Jack L. Isaacs,** of General Electric Co., Louisville, Ky.; First Vice-President—**Donald K. O'Leary,** of Service Color Corp., Fairlawn, N.J.; Second Vice-President—**Joseph Magliolo, Jr.,** of Southwest Chemical and Plastics Co., Seabrook, Texas; Secretary—**George P. Schmitt,** of IBM Corp., Endicott, N.Y.; and Treasurer—**Howard T. Ysteboe,** of Berg Electronics Div., du Pont Co., Cumberland, Pa.

Obituary

William Victor Jones, 71, a charter member and Past-President of the Houston Society for Coatings Technology, died March 19. He was retired from the Vice-Presidency of the Kuhn Paint Co. and a Member of the Board of the National Paint and Coatings Association.

George J. Hutzler, 53, former Vice-President and Research Director of Spencer Kellogg Div. of Textron, Inc. died March 22. He was Past-President of the Western New York Society for Coatings Technology.

Literature

Organic Chemicals

A new brochure lists specialty organic chemicals currently not offered in commercial quantities but which could be produced by the Industrial Chemical Div. of American Hoechst Corp. The brochure, "Development Products 1976-77," lists the chemicals alphabetically, by chemical classification, and by empirical formula. The booklet is available from American Hoechst Corp., Industrial Chemicals Div., Chemicals Dept., Rt. 202-206 N., Somerville, N.J. 08876.

Energy Savings

A new bulletin discusses efficiency in automotive production and potential plant energy savings now possible through chemical treatment. The brochure also details such automotive industry problems as lost production time through inefficient boiler operation; corrosion, scale, and fouling control in recirculating or once-through cooling water systems; removal of oil and suspended solids; and spray booth problems. Bulletin A/M-1, "Chemicals and Services for the Automotive Industry," is available from Nalco Chemical Co., 2901 Butterfield Rd., Oak Brook, Ill. 60521.

Acid

A new, 14-page brochure details the use of methane sulfonic acid and amine blocking agents in acid catalytic coatings. MSA, a strong, but nonoxidizing acid, can have its catalytic action temporarily blocked by partial neutralization with a volatile amine, thus providing increased pot life of a catalyzed system. In the heat curing of a film the amine volatilizes, leaving the free acid behind with the result of no residual amine left on the finished coating. For bulletin No. S-280 write Pennwalt Corp., Organic Chemicals Div., Three Parkway, Philadelphia, Pa. 19102.

Monomers and Oligomers

An eight-page brochure describes the end uses and physical properties of a new line of monomers and oligomers. Also detailed are applications and storage and handling information. For a copy of the booklet on Reactor® and Uvithane® products write Thiokol/Chemical Div., Marketing Communications Dept., P.O. Box 1296, Trenton, N.J. 08607.

Microspheres

Literature is now available describing a new heat-activated expandable filler, for use in producing formable printing inks and coatings. The product is a hollow spherical Saran® polymer particle containing a blowing agent. Upon heating, the individual spherical resin particles expand to 64 times their original volume. When used with conventional binders and thickening agents, the microspheres produce heat-expandable inks with three-dimensional effects, plus raised coatings for paper, textiles, and nonwovens. Information on Saran Microsphere Experimental Resin XD-8217 is available from R.T. O'Boyle, Designed Products Dept., Dow Chemical U.S.A., 2040 Dow Center, Midland, Mich. 48640.

IR Spectrophotometer

Literature is now available which describes a new infrared spectrophotometer. Designed to be both versatile and accurate, as well as simple to operate, the instrument features an extended wavelength range of 4000 cm^{-1} to 200 cm^{-1}. Four scan speeds are offered, three slit programs and a time drive facility allowing transmission changes with time to be recorded on the instrument's own Flowchart recorder. For additional information on Model 597 spectrophotometer write Perkin-Elmer Corp., Instrument Div., Main Ave., Mail Station 12, Norwalk, Conn. 06856.

Surfactant

A bulletin discusses the introduction of a new liquid surfactant for use in pulp mill systems for pitch control and in the deinking process to emulsify inks. The product is a blend of low-foaming surfactants that will perform over a wide pH range. For more information on Nalco 7684, write Nalco Chemical Co., 2901 Butterfield Rd., Oak Brook, Ill. 60521.

Fourier IR Spectrometer

A 24-page booklet describes the series 7000 FT-IR system and its applications, spectral coverage, solvent subtraction ability, speed, and accuracy. Examples of spectra are given and the system's simplified design for complicated experiments is discussed. For more information write Nicolet Instrument Corp., 5225 Verona Rd., Madison, Wisc. 53711.

Inorganic Chemicals

Information on more than 200 products is contained in a new 20-page brochure now available. The catalog presents a representative selection of a broad line of inorganic chemicals and reagent chemicals. For the booklet "Inorganic Chemicals," write Ashland Chemical Co., IC & S Div., Dept. IC, P.O. Box 2219, Columbus, Ohio 43216.

High-Speed Color Measurement

Information has been published which details a new high-speed, high resolution spectrophotometer for the paint, textile, printing, and plastic industries. The instrument reportedly accommodates the full range of materials and colorants normally measured in industry and the laboratory, and can accurately measure large or small samples, liquid or solid, reflectance or transmittance. For more information on the Spectra-Sensor Scanning Spectrophotometer write Applied Color Systems, Inc., P.O. Box 5800, Princeton, N.J. 08540.

Micrometering Pump

A data sheet has been published listing the specifications, uses, and benefits of a new oscillating metering pump capable of handling liquids in quantities as small as 5 ml/hr against a pressure of up to 10,000 psig. The pump drive uses the spring cam principle and has virtually no backlash. It provides for continuously variable metered flow with a setting accuracy of 0.001% of the full stroke. For more information on the Type FMLK pump write American Lewa, Inc., 11 Mercer Rd., Natick, Mass. 01760.

Scaler

A new solid-state electronic scaler which uses a system of multiplier/divider circuits is discussed in literature now available. The scaler takes the pulses from a flowmeter and converts them electronically into any desired value—whether larger, smaller, whole number or fraction. Readings may easily be changed from English to metric readout. The entire system sells for under $900. For more information write S. J. Controls, Inc., 2815 Junipero Ave., Long Beach, Calif. 90806.

Consistency Meter

A new inexpensive instrument to measure the consistency of many products that cannot be readily measured with flow-type or efflux-type viscometers is described in a new bulletin. The device measures in Zahn Grams (ZG). For the bulletin write Paul N. Gardner Co., P.O. Box 6633, Station 9, Fort Lauderdale, Fla. 33316.

Color Match System

A newly-released bulletin describes the abilities of a color match system which "reads" a standard, "stores" the reflectivity values, and compares samples with the stored data. The variation between two colors is displayed digitally, and additional samples can be matched without re-standardizing. Absolute color readout sensitivity is 0.01% on one standard scale, and 0.1% on two others. Complete information on Du-Color® is available from Neotec Instruments, Inc., 2431 Linden Lane, Silver Spring, Md. 20910.

Gas Chromatographs

Literature has been published detailing a complete new line of complementary gas chromatography instruments and accessories. Each instrument in the line provides identical chromatographic performance so that most methods developed on one instrument can be transferred to any other instrument in the line. Particular attention has been given not only to system control, via microprocessors, but also to improvement in the design of the components and accessories important to performance. These include detectors, pneumatic units, columns and column oven, injectors, and sampling systems.

For further information write Perkin-Elmer Corp., Instrument Div., Main Ave., Mail Station 12, Norwalk, Conn. 06856.

Acrylic/Epoxy Coatings

Information concerning a two-component water reducible primer and finish protective coating system is now available. Providing chemical resistance properties similar to solvent-based, chemically cured epoxies currently in use, the system is recommended for use in a variety of applications and environments. Suggested uses include application over plaster, wallboard, steel, and masonry, and may also be applied directly over previously painted surfaces. For more information on Aqualock® system, write Porter Coatings, Marketing Services Dept., 400 S. 13th St., Louisville, Ky. 40201.

Chlorinated Rubber

A four-color brochure discusses the use of chlorinated rubber in paint formulations, and its effectiveness in combating corrosion due to chemicals, salt and water vapor. A comparison with other systems is included, as are resistance data for many types of chemicals. Typical case histories are discussed and illustrated. For copies of bulletin No. 764-20, write Specialty Chemicals Div., ICI United States, Inc., Wilmington, Del. 19897.

Book Review

FOAM CONTROL AGENTS

Henry T. Kerner
Chemical Technology Review No. 75
Noyes Data Corp.
Parkridge, N.J. 07656
1976 (365 pages)

Reviewed by
I. H. McEwan
Canadian Industries Ltd.
Toronto, Ontario, Canada

This is one of a series of reviews of various technologies prepared by culling the U.S. Patents from the early 1960s to-date. In this case, a very broad net has been cast resulting in a catch of little interest to readers of JCT. Out of 365 pages, some 17 or so have some relevance. It is interesting to realize how wide an audience may be interested in Foam Control Agents, including those whose aim is to generate foam as well as to suppress it.

Coming Events

FEDERATION MEETINGS

(Oct. 26-28)—55th Annual Meeting and 42nd Paint Industries' Show. Astrohall, Houston, Texas. (FSCT, Suite 830, 1315 Walnut St., Philadelphia, Pa. 19107).

SPECIAL SOCIETY MEETINGS

(June 3-4)—Kansas City and St. Louis Annual Joint Meeting. Millstone Lodge, Lake of the Ozarks, Mo. (James N. Edwards, Conchemco, Inc., P.O. Box 37, Kansas City, Mo. 64141).

(June 13)—Golden Gate Society Manufacturing Seminar, "Government Agencies' Regulations—Have Reasons." (Louie F. Sanguinetti, Jasco Chemical Corp., 1090 Terra Bella, Mountain View, Calif. 94042).

(Sept. 14-15)—Montreal and Toronto Societies Symposium. In Toronto on the 14th. In Montreal on the 15th.

OTHER ORGANIZATIONS

(June 1-3)—Symposium on "Improving Protective Performance of Coatings." North Dakota State University, Fargo, N.D. (Dr. Zeno W. Wicks, Jr., Polymers and Coatings Dept., North Dakota State University, Fargo, N.D. 58102).

(June 5-10)—Short Course on "Polymer Blends, Grafts, and Blocks." Lehigh University, Bethlehem, Pa. (Jone Svirzofsky, Materials Research Center, Coxe Laboratory, Bldg. #32, Lehigh University, Bethlehem, Pa. 18015).

(June 6-24)—1977 Program in Color Technology at Rensselaer. June 6-10—"Principles of Color Technology;" June 13-14—"Color Technology for Management;" June 20-24—"Advances in Color Technology." Rensselaer Polytechnic Institute, Troy, N.Y. (Office of Continuing Studies, Rensselaer Polytechnic Institute, Troy, N.Y. 12181).

(June 7-9)—Second International Deburring & Surface Conditioning Conference and Exposition. Holiday Inn/Kennedy Convention Complex, Chicago, Ill. (Technical Divisions Dept., Society of Manufacturing Engineers, 20501 Ford Rd., Box 930, Dearborn, Mich. 48128).

(June 13-17)—Short course on "Advances in Emulsion Polymerization and Latex Technology." Lehigh University, Bethlehem, Pa. (Dr. Gary W. Poehlein, Emulsion Polymers Institute, Sinclair Laboratory #7, Lehigh University, Bethlehem, Pa. 18015).

(June 16-19)—Oil and Colour Chemists' Biennial Conference. Grand Hotel, Eastbourne, Sussex, England. (The Director & Secretary, Oil and Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HAO 2SF, England).

(June 20-24)—Colorimetry Short Course, The Institute of Optics, University of Rochester, N.Y. (Prof. David L. MacAdam, The Institute of Optics, University of Rochester, Rochester, N.Y. 14627).

(June 26-29)—American Society for Testing and Materials Annual Meeting. Denver, Colo. (ASTM, 1916 Race St., Philadelphia, Pa. 19103).

(June 27-July 1)—Course on "Applied Rheology for Industrial Chemists." Kent State University, Kent, Ohio. (Carl J. Knauss, Chemistry Dept., Kent State University, Kent, Ohio 44242).

(July 10-15)—Third Congress of the International Colour Association, "Color 77." Rensselaer Polytechnic Institute, Troy, N.Y. (Dr. Fred W. Billmeyer, Jr., Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, N.Y. 12181).

(July 14-15)—European Conference on Flammability and Fire Retardants. Sheraton Hotel, Brussels, Belgium. (Vijay Mohan Bhatnagar, 209 Dover Rd., Cornwall, Ontario, Canada K6J 1T7).

(July 18-22)—3rd International Conference in Organic Coatings Technology. Athens, Greece. (Carole Brookshire, University of New York at New Paltz, New Paltz, N.Y. 12561).

Coming Events (Continued)

(Aug. 8-12)—Gordon Research Conference on "Chemistry and Physics of Coatings and Films." Proctor Academy, Andover, N.H. (Dr. Alexander M. Cruickshank, Director, Gordon Research Conferences, Pastore Chemical Laboratory, University of Rhode Island, Kingston, R.I. 02881).

(Sept. 12-Oct. 14)—Paint Short Courses at University of Missouri—Rolla. Composition of Paints and Chemical Coatings—Sept. 12-16; For Paint Inspectors and Quality Controllers—Sept. 19-23; Tinting, Shading, and Matching Color Paints—Sept. 26-30; Advanced Chemical Coatings Workshop—Oct. 3-7; For Maintenance Engineers, Architects, Painting Contractors—Oct. 10-14. (Norma Fleming, Extension Div., University of Missouri—Rolla, 501 W. 11th St., Rolla, Mo. 65401).

(Sept. 14-15)—Symposium on "UV Polymerization and the Coatings Industry," sponsored by Newcastle-upon-Tyne Section of Oil and Colour Chemists' Association. (H. Fuller, Tioxide International Ltd., Carlton Weathering Station, Yarm Back Lane, Stockton-on-Tees, Cleveland TS21 1AX, England).

(Sept. 25-28)—First International Convention of Oil & Colour Chemists' Association of Australia. Canberra, Australia. (Oil & Colour Chemists' Association of Australia, P.O. Box 93 Punchbowl, 2196, Australia).

(Oct. 5-7)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency O'Hare, Chicago, Ill. (Jere Lawrence, NCCA, 1900 Arch St., Philadelphia, Pa. 19103).

(Oct. 11-15)—Intercolor 77, "Colour Technology—Today and Tomorrow." Schweizer Mustermesse Halls 22 and 24, Basel, Switzerland. (John Fletcher, Mack-Brooks Exhibitions Ltd., 62-64 Victoria St., St. Albans, Herts, England AL1 3XT).

(Oct. 18-20)—"Finishing '77" Conference and Exposition. Cobo Hall, Detroit, Mich. (Jon Grove, Association for Finishing Processes of SME, 20501 Ford Rd., Dearborn, Mich. 48128).

(Nov. 7-10)—Society of Plastics Engineers National Technical Conference on "Safety and Health with Plastics." Regency Inn, Denver, Colo. (Eugene E. Wilson, SPE, 656 W. Putnam Ave., Greenwich, Ct. 06830).

(Nov. 7-10)—International Symposium on Chromatographic Analysis of Polymers and Related Materials. Chicago, Ill. (Jack Cazes, Chairman, Waters Associates, Inc., Maple St., Milford, Mass. 01757).

(Nov. 14-16)—14th Annual Meeting of the Society of Engineering Science, Inc. Lehigh University, Bethlehem, Pa. (Dr. George C. Sih, Director, Institute of Fracture and Solid Mechanics, Lehigh University, Bethlehem, Pa. 18015).

(Nov. 18-20)—Annual National Decorating Products Show. McCormick Place, Chicago, Ill. (National Decorating Products Association, 9334 Dielman Industrial Drive, St. Louis, Mo. 63132).

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(April 18-23)—OCCA-30. Oil and Colour Chemists' Association 30th Annual Technical Exhibition. Alexandra Palace, London, England. (The Director & Secretary, Oil and Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex HAO 2SF, England).

(May 4-6)—Pacific Northwest Society Spring Symposium. Seattle, Wash. (John Hatfield, Reliance Universal, Inc., 1660 Cross St., S.E., Salem, Ore. 97302).

(June 4-9)—XIVth FATIPEC Congress. Budapest, Hungary. (Dr. L. Kovacs, Magyar Kemikusak Egyesulete, H-1368 Budapest Pf. 240, Hungary).

(July 10-13)—World Conference on Future Sources of Organic Raw Materials. Toronto, Canada. (Chemical Institute of Canada, 906-151 Slater St., Ottawa, Ontario, Canada K1P 5H3).

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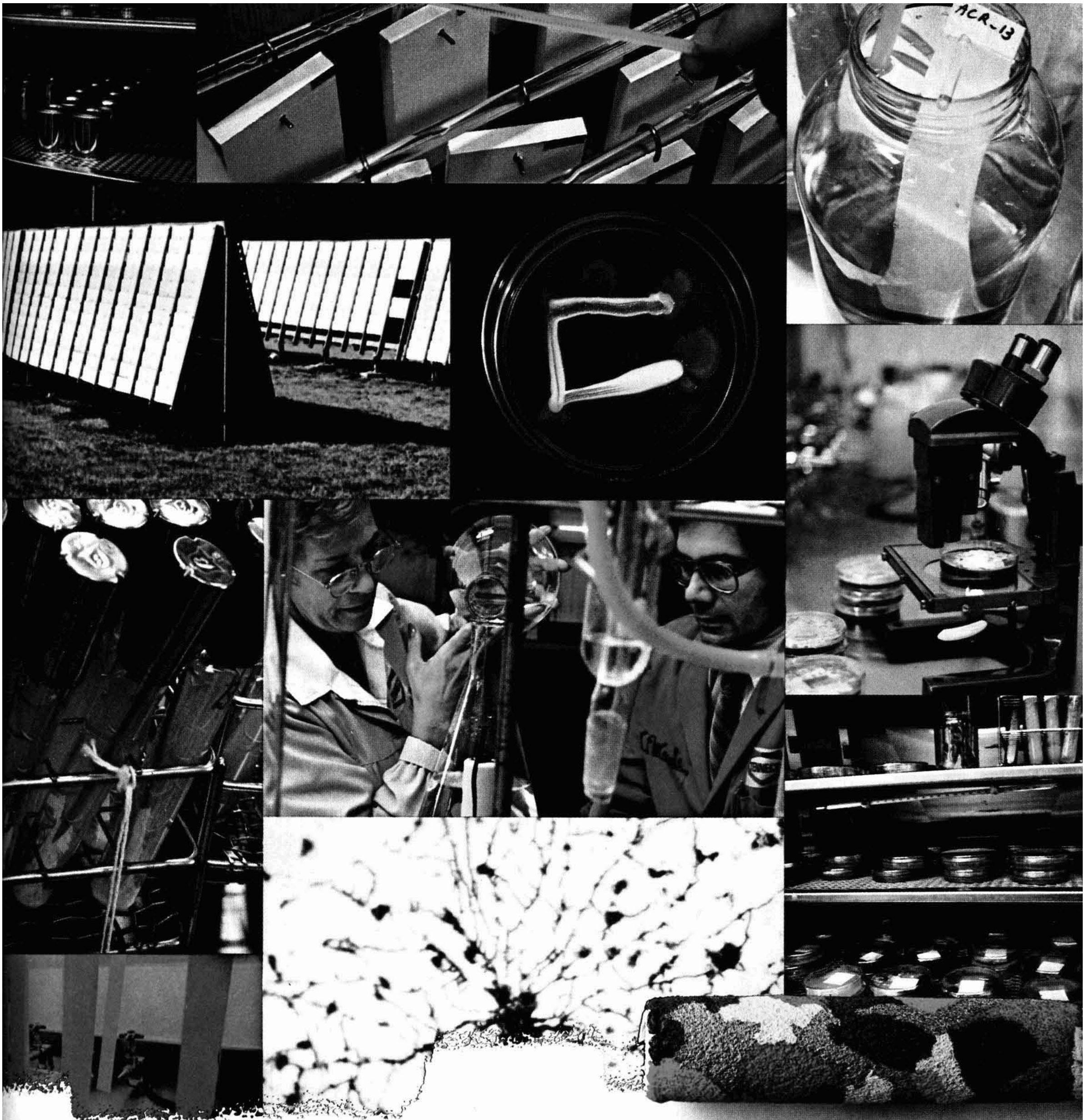
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