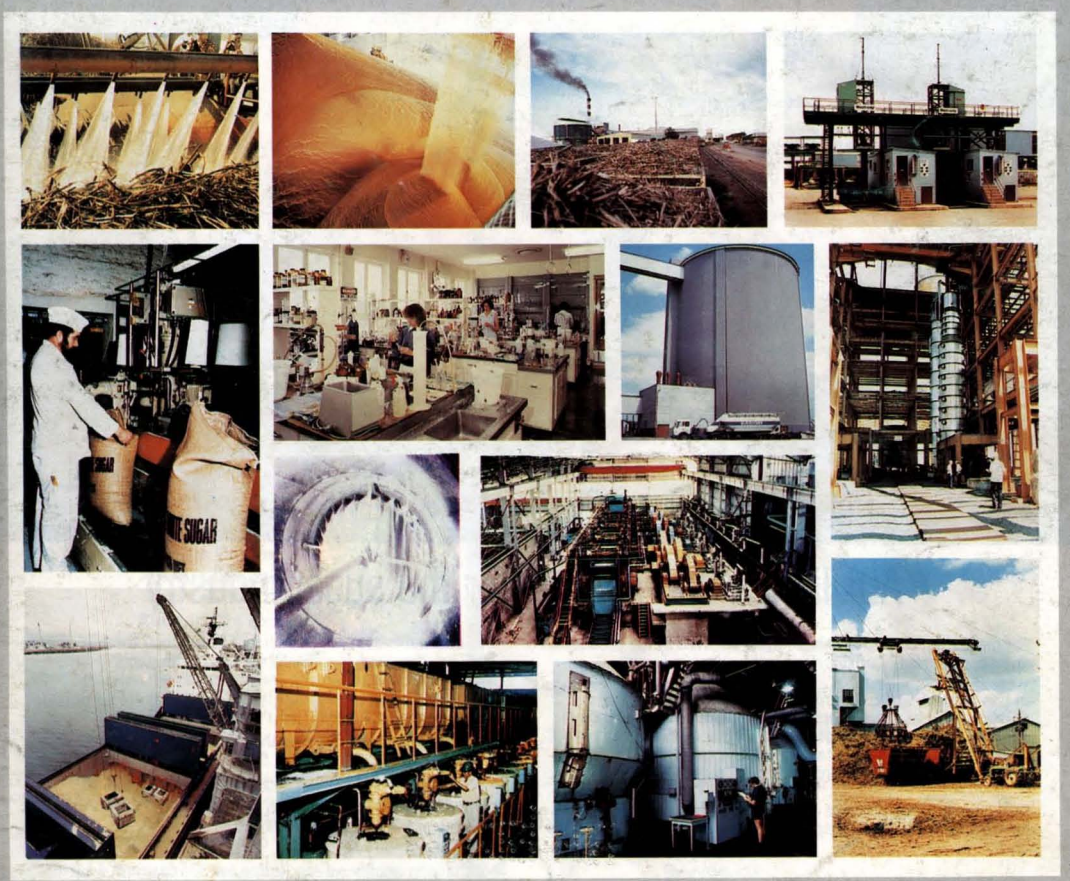
INTERNATIONAL SUGAR JOURNAL



VOLUME LXXXIX/ISSUE No. 1060

APRIL 1987

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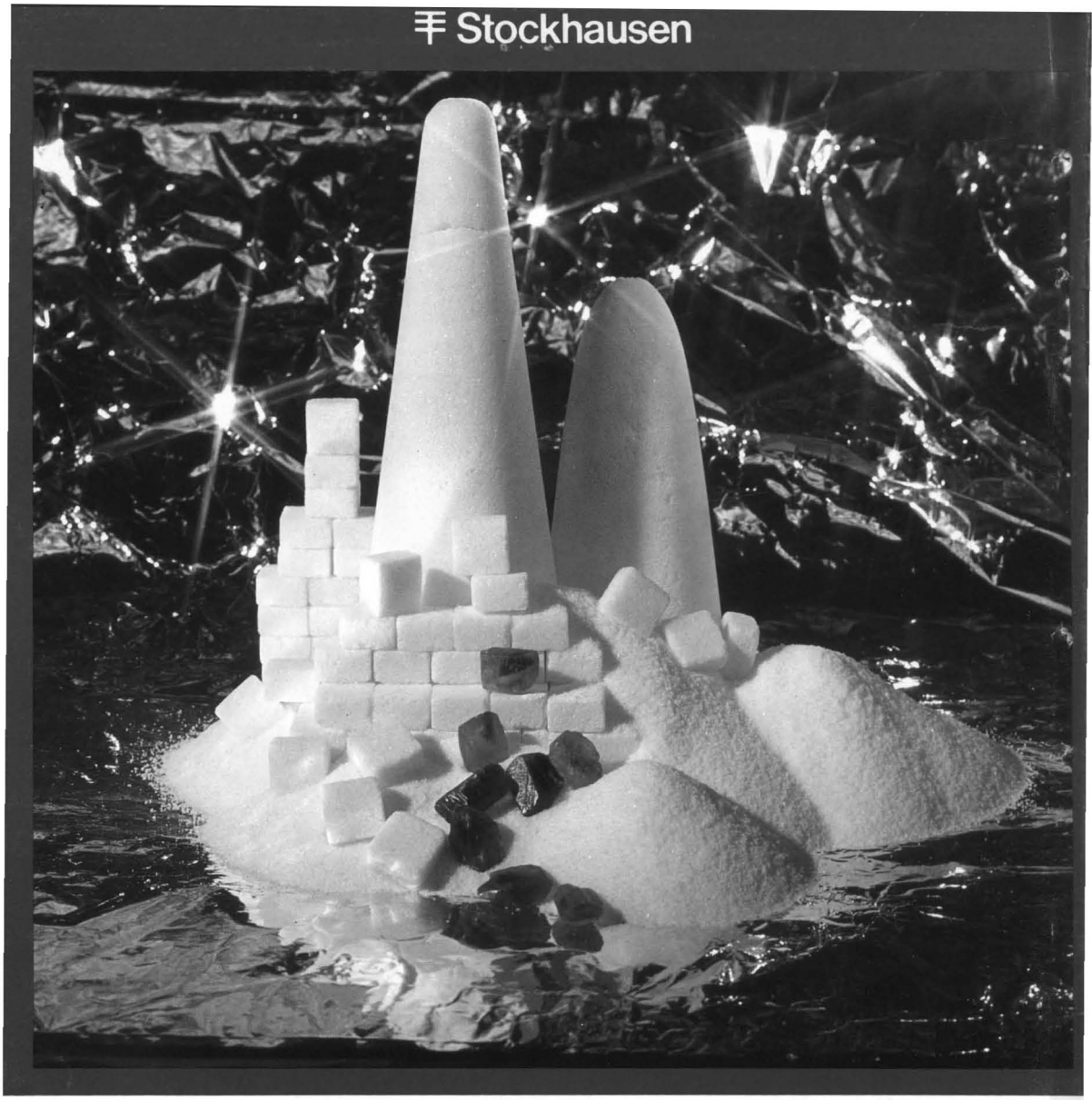

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INTERNATIONAL SUGAR JOURNAL

Volume 89
Issue No. 1060

CONTENTS April 1987

UK ISSN 0020-8841

Annual Subscription:
£50.00 post free

Single Copies
£5.00 post free

Airmail: £24 extra

Claims for missing issues will not be allowed if received more than two months from date of mailing, plus time normally required for postal delivery of journal and claim.

Published by
International Media Ltd.,
P.O. Box 26, Port Talbot,
West Glamorgan SA13 1NX, U.K.

Tel: 0639-887498 *Telex:* 21792 REF 869

Printed by Adams & Sons (Printers) Ltd.,
Blueschool Street, Hereford.
Telephone: 0432 54123

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International Media Ltd.

P.O. Box 26, Port Talbot, West Glamorgan SA13 1NX, U.K.
Telephone: 0639-887498 *Telex*: 21792 REF 869
US Office: 2790 Foster Avenue, Corning, CA 96021
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News and views

World sugar prices

During February the London Daily Prices for both raw and white sugar fluctuated considerably although within a fairly narrow band [$116 to 126.50 for the LDP and $195.50 to $209 for the LDP(W)]. There is quite a lot of uncertainty about a number of factors affecting sugar availability and demand – whether Brazil's problems will be resolved, whether the cold weather in northern India will affect sugar production and increase that country's import needs, etc. – but the trend has been to maintain prices, supported by further Soviet purchases and, at the end of the month, buying by China thought to be a fore-runner of additional purchases. The LDP rose from $185 on February 2 to $191.50 on February 28, corresponding figures for the LDP(W) being $206.50 and $207.50.

British Sugar plc ownership

The report of the Monopolies and Mergers Commission on the proposed bids by Tate & Lyle and the Ferruzzi Group for S. & W. Berisford was passed to the Secretary of State for Trade and Industry on January 16 and details were announced on February 25. The commission rejected both bids, having concluded that ownership by Tate & Lyle (giving the company 95% of the supply of sugar and sugar products in the UK) would lead to higher prices and poorer service, while for Ferruzzi to control nearly 25% of EEC beet sugar quotas would give it an influence which it could use against British interests, bringing the future of the UK refining industry in doubt.

The commission also required that Ferruzzi reduce its holding in Berisfords from 23.7 to 15% over the next two years and, in the meantime, should exercise its voting rights only to the extent of the 15%.

Both Tate & Lyle and Ferruzzi have expressed their disappointment, but Berisfords have indicated that they are happy with the prospect of continued ownership of British Sugar, although this contrasts with their readiness to sell it so recently.

The commission has clearly been convinced by Tate & Lyle, however, that something needs to be done about their refining margin. The EEC sugar regime is primarily intended to encourage and maintain the production of sugar from beet and profit margins set in Brussels favour beet sugar producers so that British Sugar has been able to dictate pricing levels which meant that, in its last financial year, Tate & Lyle made a sugar refining profit of just £4.1 million on sales of more than £400 million. The MMC found this position "fundamentally unsatisfactory" and suggested a number of possible remedies including provision of subsidies from the British Treasury or seeking the imposition of storage charges which would raise the cost of beet sugar and permit a higher refined cane sugar price. Neither of these is likely to appeal to the consumer and taxpayer.

Brazil price increases[1]

Following the election in November, the Brazilian government announced measures to reduce the growth of domestic demand which threatened to overheat the economy. The retail price of sugar was raised by 25% and that of alcohol fuel by 60%. At the same time payment for cane was raised by 32% and the prices of many sugar-containing products have remained frozen. It is possible that, although a short term downturn in offtake can be expected as the effects of hoarding are unwound, longer term growth patterns for sugar consumption will continue[2].

The price increase for fuel alcohol is much sharper and it is likely to reduce growth in the near term; however, with all new cars alcohol powered, demand for alcohol will remain buoyant.

When the Cruzado Plan was introduced a year ago, the cane price was frozen at a level which had not been increased to reflect inflation in the previous three months. Further erosion in the period to November 1986 had been a major disincentive to expansion of production. Before the price rise, cane growers in the North/North East region had gone on strike, demanding a 60% increase, although operations later restarted. But the price increase is too late to affect the current sugar crop, which has also suffered from drought and is thus likely to be lower by some one million tonnes from the previous one.

Philippines sugar industry rationalization and diversification[3]

Official estimates of 1986/87 sugar production in the Philippines have been scaled down from 1.4 to 1.3 million tonnes, following reports of cane shortage and with recent rainfall, a lower extraction rate. As a result of this, and also the change in US quota entitlement, the ratio of production quotas has been changed. The A-quota, which supplies the preferential US market, has been raised from 8 to 11%, the world market or D-quota has been raised from 10 to 19%, while the B-quota for domestic consumption has been maintained at 50%. To compensate for the increases, the C-quota for reserve sugar has been reduced from 32 to 20%.

The Philippine National Bank is now able to extend loans against the 1987/88 crop, while outstanding penalties against the 1984/85 crop will be waived and the basis for the new financing will be the level set for 1986/87 while there is also provision for low interest rates. This is to form part of a 5-year rehabilitation program against which the Sugar Regulatory Authority has sought an appropriation of 5000 million pesos, to be channelled through the PNB and Republic Planters Bank. President Aquino has stressed that support is to be limited to a production level of 1.3 million tonnes, which should provide for domestic requirements and exports under US quota; any growth must be pursued outside the the sugar industry and farmers are being urged to abandon their reliance on sugar cane as a crop.

One way of utilizing at least some cane would be to revitalize the alcohol

1 *Czarnikow Sugar Review*, 1986, (1756), 182.
2 See *I.S.J.*, 1986, **88**, 221.
3 *Czarnikow Sugar Review*, 1986, (1756), 184.

industry. Moves in this direction had already been taken by the previous regime and it is hoped the fuel alcohol program will be re-established under a new task force. A scheme has been approved which aims to use alcohol as a blend for gasoline to replace tetra-ethyl lead as an octane enhancer. Annual gasoline usage in the Philippines is estimated at some 1500 million gallons and it is intended to be able to produce 150 million litres of alcohol from cane by 1989. Interim targets are for 43 million litres this year and 100 million litres in 1988 for blending with gasoline.

US sugar support cut proposal

The Reagan Administration made it clear before Congress passed the 1986 Farm Bill that it was opposed to the high level of support given to domestic sugar producers. Following the 41% cut in the 1987 supply quota and the hostile reaction of suppliers and of US refiners, the Administration has announced its intention to introduce a bill to reduce the sugar loan rates by 6 cents/lb during fiscal 1988. The aim is to discourage domestic production and increase imports from the world market.

Included in the budget proposal, which must be approved by Congress, is a program for direct compensation to sugar growers who decide not to grow beets or cane in response to the lower loan level. This is estimated to cost the government more than $300 million for the first year; however, although the taxpayer would ultimately pay this extra cost, the consumer (who is also the taxpayer) would save some $3000 million in unnecessarily high retail cost of sugar and sugar-containing food.

B. W. Dyer & Co. note[4]: "A recurring problem in US agriculture appears to be that, whenever the government provides incentives to restrict acreage, new technology is at hand which will improve yields. An example is Hawaii where, even though acreage has declined in the past few years, production levels have remained fairly constant at roughly 1 million short tons, raw value. Hence, future production levels may not reflect the drastic decline from expected reduced acreage."

Further, while growers would receive the full six cents in crop year 1988, the amount would decline in each additional year of the program which runs to 1992. The question then arises: "What industry will take the place of agriculture when the compensation payments end?".

Dyer points out that it is unrealistic for the Administration to reduce the loan rate in time for the 1988 crop year, even if it were approved as part of the budget, because, although the crop and fiscal year officially starts in October, growers begin planting estimates in February and finalize commitments by May.

The program would affect HFS prices and thus corn prices, which would benefit the consumer and perhaps increase the outlet for raw cane sugar in the US, but would arouse the hostility of the corn lobby in Congress. The sugar farmers' and corn lobbies have in the past successfully blocked proposals to reduce government support for domestic sugar producers and with a Congress which is more protectionist than its predecessor, it cannot be said that prospects for the Adminstration's proposals are favourable.

EEC sugar imports and exports, 1985/86

F. O. Licht GmbH recently published[5] statistics of sugar imports and exports by member countries of the EEC for the fiscal year July 1985/June 1986 and a summary of these is tabulated below:

	1985/86	1984/85
Imports		
Raw sugar		
Belgium	2,444	272
Denmark	365	169
France	300,766	284,002
Germany, West	1,768	2,506
Holland	1,858	2,361
Ireland	177	24
Italy	254	10,150
UK	1,110,956	1,325,737
Total	1,418,598	1,625,216
White sugar		
Belgium	2	17
Denmark	352	98
France	13,866	3,715
Germany, West	26,018	24,503
Holland	1,708	1,528
Ireland	431	567
Italy	42,474	49,919
UK	1,933	1,800
Total	86,784	82,147
Total, raw value	94,330	89,290
Total imports, raw value	1,512,928	1,714,506
Exports		
Raw sugar		
Belgium	4,367	11,481
Denmark	77	29
France	155,561	41,137
Germany, West	9,062	235
Holland	15	46
Ireland	4	0
Italy	20	18
UK	30,418	619
Total	199,524	53,565
White sugar		
Belgium	534,467	570,682
Denmark	267,534	170,310
France	1,713,498	1,669,072
Germany, West	731,729	564,349
Holland	110,899	126,449
Ireland	24,679	23,021
Italy	1,889	27,105
UK	238,956	261,585
Total	3,623,651	3,412,573
Total, raw value	3,938,751	3,709,318
Total exports, raw value	4,138,275	3,762,883

In raw value terms, EEC exports increased by almost 10% while imports fell by 11%. Consequently, net exports reached 2,625,347 tonnes, raw value, against 2,048,377 tonnes in 1984/85.

Destinations for the exports when analysed show, however, that more than 3,450,000 tonnes of the 4,138,275 tonnes of total exports were in the form of white sugar to African and Asian destinations where there are few refineries so that raw sugar would not have been acceptable. While demand for white sugar is increasing the EEC will no doubt be able to continue to find markets for its surplus production.

4 *Dyergram*, 1987, (1-87), 2.
5 *Int. Sugar Rpt.*, 1987, **119**, 19 - 29.

Product news

DCE strengthen Dalamatic range

DCE Group have extended the small-to-medium sector of their Dalamatic range of automatic reverse jet fabric filter units with the introduction of the DU 45. The Dalamatic DU series of dust control units are compact, self-contained and designed for process applications with high dust burdens requiring larger air volume capacities. They achieve collection efficiencies often exceeding 99.9%.

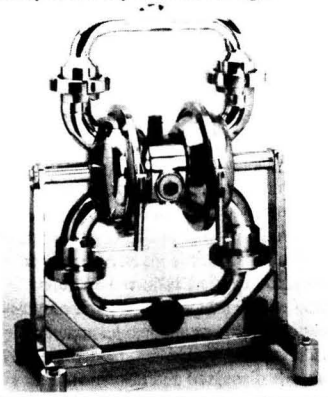
The new unit has an air volume capacity up to 9000 m^3/hr, is free standing and very compact. The DU comes with either a choice of two sizes of dust container or a rotary valve connexion and can be fitted with a fully tested design of explosion relief panel where explosive dusts are being handled.

Further details:

DCE Group Ltd,
Humberstone Lane,
Thurmaston,
Leicester LE4 8HP, UK.

Double first in pumps

Air Pumping has launched the first air-operated double diaphragm pump designed specifically for the food and pharmaceutical industries. Constructed in polished stainless steel, fitted with DIN connexions, and available in four sizes up to 3 in, the quick knock-down pump offers self priming, high heads and ability to run dry without damage.



Featuring large internal flow paths, without dead corners or garbage traps, it may be steam or chemically cleaned *in situ* and, as no lubrication is required, the product remains uncontaminated, even in the event of a diaphragm failure. It is the only double diaphragm unit to date to have been awarded USDA approval for CIP sterilization and has been very well received by U.S food manufacturers.

Further details:

Air Pumping,
P.O. Box 239,
London E6 3SG, U.K.

Continuous sugar boiling has become accepted worldwide

Regarded as a new departure just a few years ago, the continuous vacuum pan designed and developed by the French company Fives-Cail Babcock has been increasingly adopted worldwide as an answer to industrial sugar crystallization problems. During the second half of 1986 alone, Fives-Cail Babcock received orders for the supply of seven continuous vacuum pans to be installed in sugar factories in France (1 pan), Italy (1 pan), West Germany (2 pans), and Pakistan (3 pans). These raise to 80 the number of such units in operation throughout the world for the next sugar campaign.

Further details:

Fives-Cail Babcock,
7 rue Montalivet,
75383 Paris Cedex 08,
France.

Two-stage curing in a single continuous machine

The K1500 DS series of continuous centrifugals features DS or double-spinning, with separate removal of green syrup and wash liquor, to produce sugar of as high quality as a batch machine. This is achieved by having two conical baskets; the inner one has its widest diameter at the bottom and is used for separation of green syrup through a first duct. The sugar is discharged into a zone where it is mixed with added wash syrup before being fed onto the surface of a second conical basket. The wash liquor is separated on this and collected through another duct while the washed sugar is discharged from the top of the second basket. Subject to the quality of the massecuite and the cured sugar, the K1500 DS machine can handle approximately 20 tonnes/hour and more. Variants include the K1500 DSA machine with a melting facility, the K1500 DSM with a mixing facility and the K1500 DSR with a Crystal Rotor.

Further details:

Braunschweigische Maschinen-bauanstalt AG,
P.O. Box 3225,
D-3300 Braunschweig,
Germany.

ABAY HFS plant in China

In the face of strong international competition, ABAY has just signed a major contract with the China National Technical Import Corporation (C.N.T.I.C.) for the construction of a fructose production plant. This new $25 million plant, which uses American technology acquired by ABAY, will be operational in 1989 in Changsha in the province of Hunan. Processing 200 tonnes of corn per day, the unit will produce annually 6000 tonnes of starch and two types of sweeteners: 20,000 tonnes of 42% fructose and 18,500 tonnes of 55% fructose. These syrups are used in the food industry and for the production of non-alcoholic drinks. ABAY is responsible for the basic studies in Belgium, for following up the detailed studies in China, for the supply of specialist equipment and for providing technical assistance with erection and start-up. Chinese industry will participate considerably in the project by supplying all the other equipment and by carrying out the civil works and the erection of the plant.

Further details:

Abay SA.,
Rue de Genève 4,
B-1140 Brussels,
Belgium.

New books

Sugar year book 1985

335 pp; 9.5 × 13.7 cm. (International Sugar Organization, 28 Haymarket, London SW1Y 4SP, England.), 1986. Price: £10.00.

There are 53 members of the International Sugar Organization listed in the introduction to this small book, formerly the "Pocket sugar year book", yet it contains statistical data for 126 countries. Member countries supply official figures to the ISO while for the other countries the figures are obtained from the governments concerned, from statistical publications or are estimated. They generally cover the period from 1978 or 1979 to 1985 inclusive and are up to date, as of July 1986. As with its 38 predecessors, the latest Sugar year book provides a compact and authoritative assembly of statistical information on production, imports, consumption and stocks for most of the world both as individual countries and as a whole, together with prices of refined sugar for many countries in 1984 and 1985.

F. O. Licht's international sugar economic year book and directory, 1986

Ed. H. Ahlfeld. 390 pp; 21.4 × 29.2 cm (F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany.) 1986. Price: DM 145.00.

As in previous editions, the 1986 Licht year book is in a number of sections, the first providing the contents list and an index to the considerable number of advertisers. The second section carries the addresses of international organizations concerned with corn, HFS and sugar trading, manufacture and technology in some cases with the corresponding names and addresses of member organizations in individual countries. Since this Journal is concerned with technology it is among these addresses we check and find, surprisingly, that the information for ICUMSA is out of date, while it is many months since Mr. William Miller was Executive Director of the ISO. The largest part of the book follows, namely the sugar directory which provides names and addresses, telephone and telex numbers, etc., for sugar authorities, organizations, institutes, experiment stations, trade houses, producing companies, factories, refineries, HFS plants, distilleries and yeast plants. No less than 130 countries are covered, the extent of the information varying considerably. The sugar economy section includes four articles, "Surplus stocks" by A. C. Hannah of the ISO, "Developments within the EEC sugar industry" by W. D. Bensen of F. O. Licht GmbH, "Long-term prospects of the Indian sugar industry" by P. J. M. Rao of the National Federation of Cooperative Sugar Factories Ltd., and "Historic and regulatory review of alternative sweeteners" by G. T. Molitor of Public Policy Forecasting Inc., USA. Dr. E. W. Krause of the Berlin Technical University reviews new equipment and processes in the sugar industry in the next section, covering both beet and cane sugar and including 105 references to the literature. There follow articles on "The post-war evolution of sugar beet cultivation techniques" by M. Martens and R. Pieck, "Pressed sugar beet pulp" by J. P. Vandergeten and R. Vanstallen, and "Sugar cane mechanization in 1985/86" by S. W. D. Baxter. A number of the companies advertising in the year book provide short articles on their latest equipment and installations, mostly in German and English, while the next section is a Buyers' Guide, including a Spanish/English directory. Addresses of such suppliers are listed and three maps are presented showing the locations of sugar factories in Australia, Cuba and the Philippines. Finally, as usual, a pocket at the back of the yearbook includes a separately bound collection of world sugar statistics for 1985/86, occupying 78 pages and providing not only a survey of the world market for sugar in the period but also tabulated data for Europe and the World and a number of individual countries. As in previous years, Licht has produced a remarkable compendium of information, well-printed and bound and unmatched in its field.

Manual de mantenimiento para la industria azucarera (Maintenance manual for the sugar industry)

O. García G., J. Goenaga, E. Casanova and O. Valdaliso. 302 pp; 15.5 × 21.8 cm (GEPLACEA, Ejército Nacional 373, ler piso, 11520 México, D. F.) 1985.

This manual, in Spanish, is divided into two parts. The first, entitled "Season strategy and repairs" sets out the organization of a maintenance staff and its work to ensure unbroken factory operation, with chapters on cleaning, repairs, tests and adjustments, maintenance facilities, etc., while the second part is entitled "Appendices" which provides notes on the maintenance of individual items of machinery, etc., with examples of documents for use as checklists, reports, etc. For readers sufficiently familar with Spanish this will be a most useful aid.

La corrosión en la industria azucarera (Corrosion in the sugar industry)

R. Caro and R. Monduí. 137 pp; 15. 5 × 21.8 cm (GEPLACEA, Ejército Nacional 373, ler piso, 11520 México, D. F.) 1985.

This book, printed in Cuba where the authors are employed by the Instituto Cubano de Investigaciones Azucareras, is No. 6 of a series on industrial maintenance. Written in Spanish only, it is a detailed study of the subject, with discussions of the electrochemical mechanism of corrosion, its thermodynamics and the nature of polarization, galvanic corrosion, etc., the influence of geometric factors and of chloride ions, passive layers and pitting corrosion. A general treatment is given of corrosion in sugar factories, followed by more detailed discussion of corrosion of mills and cane carriers, chains, juice pumps and evaporators. Use of stainless steel tubes is discussed and also corrosion

inhibition, particularly by materials produced in the factory.

The end of a Liverpool landmark

J. A. Watson. 93 pp; 13.7 × 21.5 cm (Tate & Lyle Refineries Ltd., Thames Refinery, London E16 2EW.) 1985.

With the entry of the UK into the EEC, changes occurred in the pattern of sugar supply and trade which included an expansion of beet sugar output, reduction of raw sugar imports for domestic consumption, and a reduction in exports of refined sugar. These all meant a reduction in refining capacity was inevitable and the Liverpool refinery of Tate & Lyle Ltd. was among those closed, after 109 years of operation. The history of the first 100 years had been described in another book by the same author[1] (former Chief Chemist of the refinery) and this small volume provides an account of the final years, outlining the reasons, the history of the decision making, and the reactions and effects of the closure on the locality, as well as the legacy which sugar refining has given to Merseyside. An accompanying booklet entitled "Talk of many things" is subtitled "Random notes concerning Henry Tate and Love Lane" and provides information on Henry Tate's entry into the sugar business in 1859 and quotes from correspondence on miscellaneous subjects during the remainder of the 19th century. The combined works provide a curious and rather melancholy picture of an age that is gone for ever.

Australian sugar year book 1986

Ed. Jenny Hallson. 207 pp; 18.0 × 24.0 cm. (Publishing & Marketing Australia, 480 St. Kilda Road, Melbourne, Australia 3004.) 1986. Price: $Aust. 29.00.

The 1986 edition of the Australian Sugar Year Book follows a similar pattern to previous editions; it is very well printed, substantially bound and contains a vast amount of up-to-date information on the sugar industry of the country. This includes details of addresses, personnel, and brief histories of many of the industry's organizations from the Agricultural Bank of Queensland to the Voluntary Cane Pest Boards, while for each sugar factory are provided details of address, telephone number and telex, location, date of erection and sometimes a brief history, gross assigned cane area and number of suppliers, the 1985 mill peaks, personnel, equipment – from unloading equipment to sugar storage capacity, and statistical data from 1975 on cane crushed, sugar made and the TCTS ratio. A series of articles by industry leaders on the 1985 season is supported by a wide-ranging review of the industry during the year, plus extracts of the annual reports or reviews of the Sugar Board, the Sugar Research Institute and the Bureau of Sugar Experiment Stations. The final editorial section comprises a statistical overview of the Australian sugar industry with details of varietal composition and distribution of cane crushed in Queensland, sugar prices, production and exports, cane crushed and sugar produced, milling performances, yields, etc. The publication has been supported by a good number of suppliers to the Australian industry whose advertisements are scattered throughout the book.

US sweetener review and situation

Anon. 46 pp; 21.5 × 28.0 cm (B. W. Dyer & Co., One World Trade Centre, Suite 1531, New York, NY 10048-0115, U.S.A.) 1986.

This survey has been prepared by the Research and Statistics Department of B. W. Dyer & Co., the prominent US sugar brokers and economists. It looks back over 1986 and some earlier periods and discusses production trends in the US beet and cane sugar industries as well as sugar refining and notes the changes which have been occurring. Factors which have affected high fructose syrup production and consumption are reported as is the emergence of crystalline fructose as a proposed commercial product. Some attention is also paid to the non- or low-caloric sweeteners. This history of the US sugar program and its current status and prospects are discussed, all these subjects being backed up with tabulated information and statistics.

Zuckerwirtschaftliches Taschenbuch (Sugar Economic Pocket Book) 1986/87

K. Dankowski, R. Barth and G. Bruhns. 263 pp; 10.0 × 14.5 cm. (Verlag Dr. Albert Bartens, P.O. Box 380250, D-1000 Berlin 38, Germany.) 1986. Price: DM 33.00.

This is the 33rd in the series of Sugar Economic Pocket Books to be published by the Bartens company and it maintains the same format and high standards as its predecessors. The first section is concerned with statistics and these include 60 tables of data both historical and up to the 1985/86 seasons in most cases. The tables refer to the World, Europe and West Germany, this last being the largest and most detailed. The second section is concerned with trade regulations and most of this covers the EEC's basic sugar regulations; a summary is also provided in English, while other articles concern the International Sugar Agreement and rules governing pulp and molasses feed trade in Germany. The third section is one of addresses, including those of international bodies (ISO, ICUMSA, CITS, WSRO, CIBE, etc.), West European, EEC and West German organizations, including sugar factories in some cases. There are three maps and 56 pages of advertisements. The book is bound in a strong plastic cover and the type, while obliged to be small, is nevertheless clear. The basic language is German but tables are subtitled in English and the data are of course numbers applicable to all languages. The book is well produced, very convenient in size and a useful source of statistical information.

1 *I.S.J.*, 1974, **76**, 185.

Sugar Processing Research Conference, 1986

The 1986 Conference on Sugar Processing Research was held during October 19 - 21 in Savannah, Georgia, USA, at the DeSoto Hilton Hotel. This biennial conference is sponsored jointly by Sugar Processing Research Inc. and the Southern Regional Research Center of the Agricultural Research Service, US Department of Agriculture. Some 100 delegates from North America, Europe and other areas attended two days of papers on recent technical advances in the sugar industry and enjoyed the hospitality of Savannah Foods and Industries Corporation.

The Conference, opened by President George Fawcett (Savannah Foods and Industries), began with a presentation from the first winner of the S.P.R.I. Science Award, Prof. Andrew VanHook of Holy Cross College, Worcester, Mass., who spoke on "Recent events in sugar crystallization". The paper is a summary and a continuation of Professor VanHook's life-work in this area. Several papers relating to crystallization followed; of particular interest was "Sucrose crystal deformation caused by impurities in refinery and raw house products" by J. Bruijn and P.G. Morel du Boil (Sugar Milling Research Institute, South Africa), who reported their findings that crystal elongation along the C-axis is caused by oligosaccharides. An oligosaccharide fraction from refinery molasses was, compared with other poly- and oligosaccharides, the major crystal habit modifier and crystallization rate deterrent. R. E. Dickey and J. F. Dowling (Refined Sugars Inc., Yonkers, NY) discussed their use of computerized visual measurement of crystal sizes to study remelt recovery and the effects of seed volume and crystal habit on yield.

Sugar colour and polysaccharides in sugar processing and products were other areas of interest. A paper from British Sugar plc, Norwich, UK, entitled "Studies on the colour of UK beet white sugar", by N. W. Broughton, D. Sargent, B. J. Houghton and A. Sissons, outlined fascinating work on colorant properties and development in process and emphasized the importance of high molecular weight colorant (> 1000 daltons) in beet white sugars. A report on colorant work at S.P.R.I. by M. A. Clarke and R. S. Blanco, also emphasized the importance of high molecular weight colorants. The new SURE decolorization process was explained by D. Frank, L. D. Metcalfe and J. Park (Akzo Chemie America, Chicago, IL), who presented results of the process on raw sugars and various process liquors, both cane and beet. In a related area, M. A. Godshall discussed her work at S.P.R.I. on the isolation, separation and identification of flavour fractions and components of beet and cane sugars with special emphasis on some new techniques for beet sugar flavour analysis.

The polysaccharides of sugar cane, their properties and purposes, were the subject of a paper by E. J. Roberts of S.P.R.I. Dr. R. A. Kitchen (B.C. Sugars, Vancouver, Canada) described the isolation of a new polysaccharide, one not previously identified in cane sugar processing, and postulated a *Lactobacillus* organism as a possible source for this compound. A. W. Miller (Southern Regional Research Center) talked about his work, with co-authors F. W. Parrish (S.R.R.C.) and M. A. Clarke (S.P.R.I.) on determining conditions for optimum production of dextran in cane juice, and his use of HPLC for analysis of dextrans and co-products. Some recent work at S.P.R.I. on the effect of dextrans and other polysaccharides on lead subacetate clarification in pol measurement, and on levels of high and low molecular weight dextrans in sugar refineries, was reported by M. A. Clarke, E. J. Roberts and T. B. T. To.

R. Riffer (C & H Sugar, Crockett, CA) described several areas of study on polysaccharides, including affinity chromatography, light scattering (areas of interference in haze analaysis were suggested) and metal complex formation of dextrans. Dr. Riffer also emphasized the importance of iron in colour formation from invert, and he described an improved procedure for analysis of the carbon fraction in Canesorb/bone char mixtures. A paper from B. Dewar and A. Ho (Redpath Sugars, Toronto, Canada) discussed their experiences with methods of separation of Canesorb/char mixtures, and presented results of test procedures over some years of use of the mixture.

Guest speaker, Professor A. P. G. Kieboom (Delft University, Holland), on sabbatical at Massachusetts Institute of Technology, gave a detailed and absorbing presentation on "Mechanism of the alkaline degradation of monosaccharides", co-authored by J. M. de Bruijn and H. van Bekkum. Dr. Kieboom showed the products and

Professor Andrew VanHook, winner of the S.P.R.I. Science Award

pathways of these reactions, which are so important to decomposition and sugar loss in process, and explained the many analytical techniques used to trace them. There followed several papers on the production of invert syrup, which demonstrated the importance of invert degradation reactions. R. W. Percival and J. E. Schuler (Rohm and Haas Co., Coral Gables, FL) described the use of ion exchange resins in decolorizing, deashing and inverting raw sugar to produce liquid invert, and compared results with those of traditional processes. M. Wnukowski and C. C. Chou (Amstar Corp., New York) reported their trials on production of liquid invert from refinery fine liquor, and compared gel and macroporous resins. A. I. Macdonald and M. J. Daniels (British Charcoals and Macdonalds, Greenock, Scotland) explained the uses of immobilized enzymes in sugar processing and the application of these enzymes to production of sucrose and invert syrups.

Analytical technology was the subject of papers by E. Rajakyla (Finnish Sugar Co. Ltd., Kantvik, Finland) who discussed the use of reverse-phase chromatography in carbohydrate analysis, and by W. S. C. Tsang, who reported his work at S.P.R.I. on HPLC analysis of carbohydrates with a comparison of detectors and evaluation of recent developments, co-authored by M. A. Clarke and M. M. Valdes. Dr. Tsang presented a new HPLC procedure for direct analysis of raw sugars. J. C. Thompson and J. Frazee (Lantic Sugar Ltd., Saint John, Canada) demonstrated the application of analytical technology to the modern cane sugar refinery in their presentation "Integrating laboratory instruments in the process control laboratory".

A fresh viewpoint on research, with emphasis on the essential aim for any company of increased sales, was the subject of a paper by J. Ahvenainen and J. Kuusisto (Finnish Sugar Co. Ltd., Jokioinen, Finland). Dr. Ahvenainen described the goals of the product application department and gave examples of suiting product to customer requirements.

At the closing banquet, Mr. William W. Sprague, Jr., President of Savannah Foods and Industries, spoke on the future of the sugar industry from economic, political and sociological viewpoints. The S.P.R.I. Science Award was presented to Professor VanHook by Dr. C. C. Chou, Chairman of the Award Committee. Stanley E. George (B.C. Sugar, Vancouver, Canada) was recognized for his many contributions as a former President of S.P.R.I., and Joseph A. Metzler received congratulations on his retirement after many years as Treasurer for the organization.

On the days following the technical sessions, delegates again received the gracious hospitality of Savannah Foods, who had welcomed them with flowers and a string quartet at the opening reception and buffet. There were tours of the Savannah sugar refinery, followed by an outdoor "Low Country Shrimp Boil and Oyster Bake". Ladies and friends of the delegates, after two days of touring historic areas and enjoying Savannah's beauty with Mrs. Beverly Ballina, Ladies Program Chairman, were also welcomed to this unique attraction of the coastal Georgia area.

Workshop on raw sugar quality

On October 22, 1986, a Workshop on Raw Sugar Quality was held in Savannah, Georgia, under the auspices of Sugar Processing Research Inc. The Workshop was attended by some one hundred delegates, from North and South America, Europe, Africa, and Australia.

After an opening presentation by Margaret A. Clarke (S.P.R.I.) on recent trends and factors in sugar manufacture that influence raw sugar quality, three panels discussed various aspects of the subject, with question periods after each speaker. The first panel, on colour, pol and raw sugar quality, featured a joint presentation by Jay Meikle (C & H Sugar) and Dr. Toshio Moritsugu (Hawaiian Sugar Planters' Association) on the joint program of their organizations for improvement of Hawaiian raw sugar quality and the benefits thereof. Dr. Jaap Bruijn, Director of the Sugar Milling Research Institute in Natal, explained the relationship of quality factors to cane quality and milling factor in South African raws; Dennis Martin and Dr. John Williams of Tate and Lyle Sugars, London, discussed the experience of a large refinery receiving a variety of raws.

In the second panel discussion, on ash, invert and raw sugar quality, George Fawcett (Savannah Sugar) and Jean L. De Chazal (Colonial Sugars), whose presentation was made by Calvin Rousse, reviewed the problems of high ash raws to refineries and gave examples of losses associated with high invert levels. Dr. Fernando Cordovez (Central Palmar, Venezuela) considered processes in the raw sugar factory to control ash, invert and other non-sugars, especially polysaccharides. Dr. Joseph Orsenigo (Florida Sugar Cane League) explained the effects of growth regulators on composition of cane juice and sugars (invert can actually be lowered), and showed some problems in cane harvesting that can affect sugar quality. Dr. Chung Chi Chou (Amstar Corporation) pointed out the problems caused to refineries by raw sugars made with sulphitation or hydrosulphite treatment. He then discussed problems of product quality and environmental control that result from raw sugar quality factors.

The third panel, on the subject of microbiological control and raw sugar quality started with an outline by Dr. Benjamin L. Legendre (US Dept. of Agriculture, Houma, LA) of field and cane yard conditions that affect microbiological infection and dextran development. Thereza Balogh (Redpath Sugars, Canada) told the Workshop about microbiological control in the refinery and on effluents, and controls used on raw sugar input. Michael Steele (R. Markey & Sons, New York) presented a thorough discussion of raw sugar storage, and how various quality parameters could be affected by warehouse and shipping

conditions. Peter Skinner (Tate and Lyle Enterprises, Florida) summed up the microbiological systems and factors affecting them in a raw sugar factory, and outlined procedures to ensure good raw sugar quality.

The proceedings of the Workshop will be published by Sugar Processing Research Inc. in due course.

ENERGY MANAGEMENT

Bagasse drying

By Abilio Arrascaeta and Paul Friedman
(Instituto Cubano de Investigaciones Azucareras, Güiro Marrero, Quivicán, Habana, Cuba)

Introduction

The drying of bagasse using its own combustion gases has several very important advantages[1,2]:
(1) Decrease in fuel consumption of between 10 and 20% depending on the temperature of the boiler stack gases[3-11]. The increase in efficiency of both "traditional" and "modern" boilers is shown in Fig. 1.
(2) Reduction of air pollution[4,9,12,13] from values of about 10,000 mg/Nm^3 of ash to less than 300 mg/Nm^3.
(3) Reduction of losses in storage of moist bagasse, reported[14] to be as high as 25%.
(4) Increase in density of pre-dried bales (3 times) and briquettes or pellets, 12 -

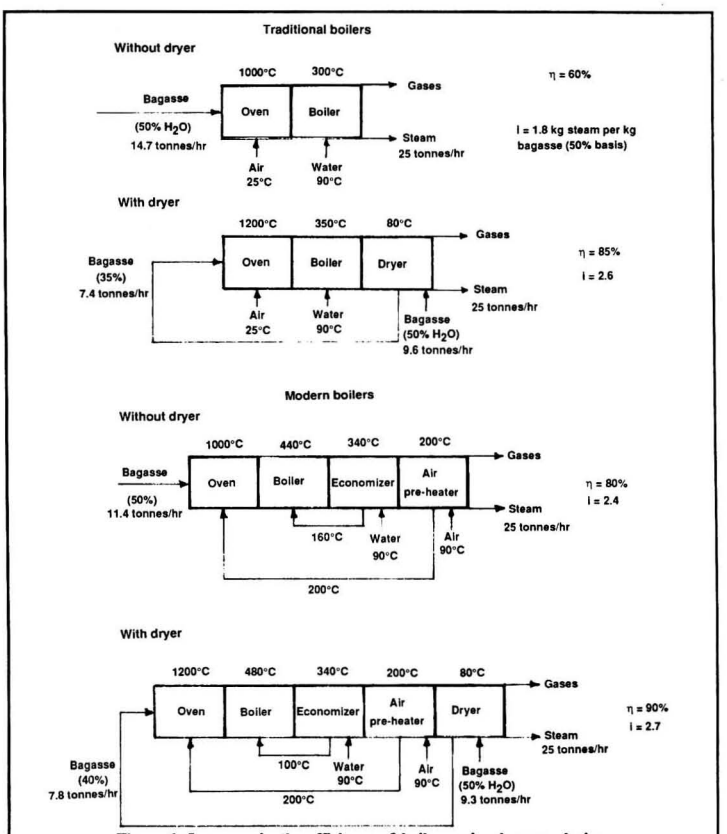


Figure 1. Increases in the efficiency of boilers using bagasse drying

1 Friedman & Arrascaeta: *CubaAzúcar*, 1984, (July - Sept.), 27 - 37.
2 Arrascaeta & Friedman: *I.S.J.*, 1984, **86**, 3 - 6.
3 Furines: *Sugar J.*, 1976, **39**, (3), 39 - 40.
4 Shishido: *Rpt. Hawaiian Sugar Tech.*, 1979, 130 - 132.
5 Fraser: *ibid.*, 133 - 136.
6 Correia Maranhão: *Proc. 17th Congr. ISSCT*, 1980, 2000 - 2011.
7 Ferm: "Bahco bark drying system an experienced and profitable way to improve hog fuel burning" (Report of Swedish Pulp and Paper Mission to North America), 1981, 109 - 124.
8 Nordfeldt & Hedenhag: "Fläkt biomasster, a system for efficient use of wet fuels", *ibid.*, 1981, 197 - 207.
9 Documents R8000, R8101, R8105, R8107 - 8112. (Rader Companies Inc.), 1981.
10 Arrascaeta & Friedman: *Paper presented to the First National Energy Forum*, Havana, Cuba, 1984.
11 Yang *et al.*: *Zuckerind.*, 1984, **109**, 552 - 554.
12 Nelson: *Paper presented to Amer. Soc. Sugar Cane Tech.*, 1977.
13 "Bison system combi-dryer and pre-dryer" (Bison-Werke, Springe, Germany), 1984.
14 Lois *et al.*: *CubaAzúcar*, 1981, (Jan. - March), 27 - 35.

Table I. Installations of bagasse dryers using stack gases

Firm and locations	Year	Vendor	Type and size (dia. × length), m	Feed capacity, tonnes/hr	Moisture content, % In	Moisture content, % Out	Ref. No.	Comments
Palo Alto Sugar Factory, Donaldsonville, Louisiana	1910	Self-made	Tower	1.4	54.47	44.45	15	Pilot dryer
Atlantic Sugar Association, Florida	1976	Vincent Processes	Rotary drum (3)	30	54	46	3	Stack gases, 218°C
St. Mary Sugar Co., Louisiana	1976	Stearns-Roger	Rotary drum 3.6 × 12	50	52	36	12	Stack gases, 315°C
Waialua Sugar Co., Hawaii	1979	-	Rotary drum	35	44.8	33.5	4,5	Stack gases, 244°C
Açucareira Santo Antonio, Brazil	1980	Self-made (Individual)	Pneumatic	4.5(5)	40	6		Stages, 220°C Now used in 3 boilers
Davies Hamakua Sugar Co., Paauilo, Hawaii	1980	Rader Co. Inc.	Rotary drum 3.6 × 9 (2)	65 10.7	50 35	35 16	16	Pellet production
Hilo Coast Processing Co., Pepeekeo, Hawaii	1980	Rader Co. Inc.	Rotary drum 4.2 × 9	72	48	35	9	
Central Azucarero Don Pedro, Batangas, Philippines	1982	Fred Hausman Ltd.	Pneumatic (Tower) (2)	24	52	24	18,19	Operation with one dryer
Central Aidsisa, Bacolod, Philippines		Stearns-Roger	Rotary drum 3.6 × 12	45	54	48	19	Stack gases, 258°C
Central Victoria, Bacolod, Philippines		Silver	Rotary drum 2.4 × 15.7	13	50	45	19	Originally for furfural plant
Sugar Research Inst., Mackay, Queensland	1980	Self-made	Pneumatic	2	50	-	17	Pilot-scale
Chun Cheng Sugar Factory, China	1983	Self-made	Pneumatic		53	45	11	Pilot-scale, gases 140°C
Central Pablo Noriega, Quivicán, Cuba	1983	Self-made	Pneumatic	0.5	47	34	24	Pilot-scale, gases 200°C
Central Pablo Noriega, Quivicán, Cuba	1984	Self-made	Pneumatic	7	46	28	10	Industrial prototype, stack gases, 300°C

15% moisture content, (6 times) to reduce storage and transport costs.

Although Kerr[15] built the first bagasse dryer in 1910, it was not until 1976 that Furines[3] reported the operation of an industrial bagasse dryer using boiler stack gases. Since then a number of units have been installed as shown in Table I. In addition, more than 30 dryers have been installed in the forestry industry in Sweden, Canada, USA, etc. for drying wood residues such as sawdust, bark and hog-fuel which are very similar to bagasse in nature.

15 *Louisiana Bulletin*, 1911, (128); quoted by Boulet; *Sugar J.*, 1975, **37**, (10), 40 - 47.
16 Bouvet & Suzor: *Sugar y Azúcar*, 1980, **75**, (8), 22 - 27.
17 Edwards: *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 203 - 206.
18 Morales: *Proc. 29th Ann. Conv. Philippines Sugar Tech.*, 1982, 102 - 109.
19 Arrascaeta: "Bagasse dryers", *Internal Report* (ICINAZ, Cuba), 1985.

The importance of bagasse as a raw material and renewable energy resource for a developing country such as Cuba and the significant contribution that bagasse drying could play is shown by an excerpt from a recent speech by President Fidel Castro[20]; "Starting from a harvest of 9 million tonnes of sugar they calculate that they can produce the equivalent in energy of two and a half million tonnes of oil additionally; that is a large number, they say that perhaps more, by means of the drying of bagasse using the heat from the chimney and pelletizing it and utilizing other residues of the cane harvest. They are already considering not only using this bagasse in the sugar industry but also in other types of boilers".

Materials and methods

After carrying out a review of the world literature it was found that little information had been reported on the properties of bagasse which could be used for the design of dryers and auxiliary equipment such as cyclones, classifiers, pneumatic transport and others.

A study on the determination of geometric properties and density of bagasse particles was reported by Ponce *et al.*[21].

Ponce[22] also completed a bench-scale study on the terminal velocities of bagasse particles. This was continued in a pilot-scale bagasse dryer with a 500 kg/hr capacity by Arrascaeta & Friedman[2,23].

An industrial prototype dryer of 7 tonnes/hr capacity was then designed, constructed and operated during the 1983/84 and 1984/85 harvest seasons and its performance was evaluated.

Results and discussion

The results of the study to determine the geometric properties and density of bagasse particles has previously been reported by Ponce *et al.*[21]. In a subsequent study on the terminal velocities of bagasse particles it was found that the results reported by Grobart[24] and quoted by Arrascaeta & Friedman[2] were a bit high. Ponce[22] developed the following equations based

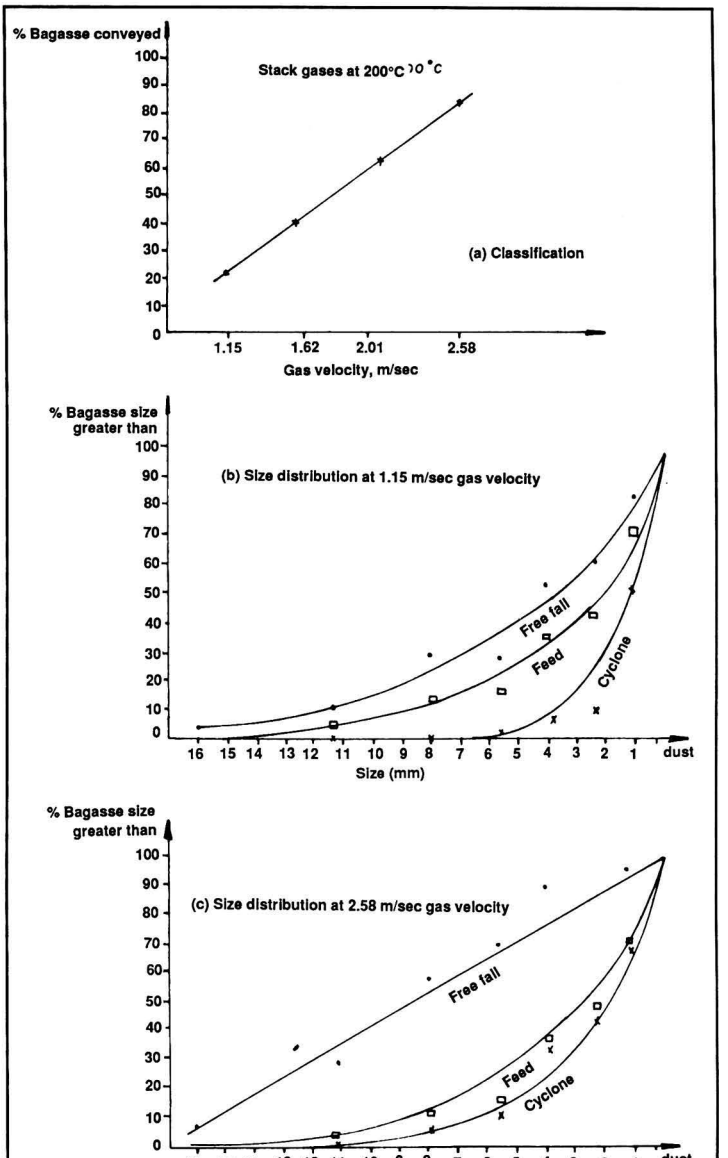


Figure 2. Classification of bagasse

20 Speech given at First National Energy Forum, Dec. 6, 1984.

21 *I.S.J.*, 1983, **85**, 291 - 295.

22 "Terminal velocities of bagasse particles", *Internal Report* (ICINAZ, Cuba), 1984.

23 *Paper presented to the 44th Congr. Asoc. Técn. Azuc. Cuba*, 1984.

24 *Control Cibernética y Automatización*, 1973, 7, (4).

ISJ Abstracts

Cane sugar manufacture

Regional differences in raw sugar production in Thailand — a geographical contribution

P. Traub. *Zuckerind.*, 1986, **111**, 559 - 565 *(German).*

A survey is presented of cane growing and processing in the four regions of Thailand. Almost half of the 43 factories are located in the central region and together make up 65% of the total crushing capacity, although the northeast region excels in the average cane sugar content and raw sugar recovery; despite the second highest average cane sugar content, the northern region has the poorest sugar yield, while the national average of 9.3% is low by international standards. The poor performance is attributed to the use of outdated equipment, lack of qualified personnel and the need for a more rational approach to processing than that based on high throughput.

Experimental verification of a dynamic model of a vacuum pan

L. W. Qi and A. B. Corripio. *J. Amer. Soc. Sugar Cane Tech.*,1985, **5**, 77-84.

A dynamic mathematical model of pan boiling has been developed and used for computer simulation to predict the conditions at any time in the pan, given a set of initial conditions. The model is based on the assumption of a well mixed pan, negligible heat loss and absence of false grain and conglomerates. The principal mathematical relations embodied in the model are set out, and results of comparison between the predicted and true parameters for *A*-massecuite boiling are discussed; these indicated a reasonably good fit.

Impact fracture properties of cane varieties

W. Keenliside. *J. Amer. Soc. Sugar Cane Tech.*, 1985, **5**, 85 - 89.

A series of mechanical fracture tests was carried out on five cane varieties, and values obtained of Young's modulus, the modulus of rupture, toughness and fracture energy. The cane stalks were supported on two anvils 3 inches apart, and a hammer allowed to descend at a point midway between the anvils at a speed of 2.5 ft/sec; after hitting the stalk, it continued to move at the same speed until the cane was fractured, during which process continuous measurement was made of hammer depression, load applied and total energy expended. Significant differences found for Young's modulus appeared to be associated with fibre content and milling characteristics; however, CP 65-357 (the standard variety in Louisiana and known for its good milling properties) had the second highest value of the modulus (the highest being that of high-fibre L 79-1003) while the values of its other parameters did not differ significantly from those of poor milling varieties. It is therefore suggested that further analysis should be made with higher velocity hammers on other varieties, and that more detailed analysis should be made of fracture energy using the swinging pendulum technique as well as examination of the microscopic structure of the individual fibres.

Factors affecting mill extraction

H. S. Birkett, S. J. Clarke, Y. K. Cho, W. Keenliside and J. A. Polack. *J. Amer. Soc. Sugar Cane Tech.*, 1985, **5**, 101 - 108.

A computer model has been developed to simulate operation of a 5-mill tandem in which the cane fibre content is assumed to be 14% and its Brix content 13.5%; 25% imbibition on cane and a 60% imbibition efficiency are also assumed. The effects of a number of parameters were analysed by varying each, one at a time, and the results presented in graph form. The main conclusions were that extraction was chiefly governed by the quantity of imbibition water applied, imbibition efficiency and type of scheme used (simple, compound, etc.), while parameters having a lesser influence were cane fibre content, the number of mills in the tandem and the point at which bagacillo was returned to the tandem. Cane Brix content had no effect, and it is considered that Brix curves alone are of marginal value in determining which mills are not performing satisfactorily; it is recommended to determine the pol and moisture contents of the feed and discharge material at each mill as well as analyse the juice from the front and back rollers and combined juices leaving each mill in the tandem.

Cane mill for Thailand

S. Cecek and J. Cerny. *Czechoslovak Heavy Ind.*, 1986, (7), 18 - 21.

The Skoda six-mill tandem supplied to Tamaka Sugar Industry Co. Ltd. in 1983 replaced a tandem that had provided an extraction of 93 - 94% at a crushing rate of 7000 tcd. In its first season, the new one gave a reduced extraction of 94 - 95% at 8000 tcd crushing rate and 25% imbib-ition. As a result of subsequent modific-ations, including installation of two light-duty feed rollers for each mill and replacement of the top rollers of the 1st and 3rd mills with Lotus rollers, a reduced extraction of 96.5 - 96.9% was achieved at an hourly crushing rate of 475 tonnes, a cane fibre content of 12.1 - 13%, 20 - 35% imbibition and an imbib-ition water temperature of 65°C; 1st mill pol extraction was 75 - 79.5% and final bagasse moisture content 50.5 - 51.5%.

Visit to Hilo Coast Processing Company

W. Keenliside. *Sugar Bull.*, 1986, **64**, (18), 6, 8.

Information is given on the bagasse dryer and furnace at the 4500 tcd sugar factory operated by Hilo Coast Processing Co. in Hawaii.

The sugar industry in Thailand

W. Keenliside. *Sugar Bull.*, 1986, **64**, (19), 8, 11; (20), 6, 8.

A brief account is given of the Thailand sugar industry, with information on factory equipment and processes and comparison with practices in the USA. It is pointed out that, while generally the Thailand sugar industry is more advanced

than the Louisiana industry in terms of the equipment used, the cane quality is so poor that the equipment and skills are not severely tested, and difficulties could arise if there were an increase in juice purity to the upper 80's (the average mixed purity is given as 76.7).

Felixton — a new sugar mill in Zululand

R. H. Renton. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 1 - 4.

Details are given of the processes and equipment at the new sugar factory designed to crush 3.3 million tonnes of cane annually and provided with a diffuser rather than a milling tandem because of the high-fibre, low-purity cane grown in the area.

Sixtieth annual review of the milling season in Southern Africa (1984 - 1985)

J. P. Lamusse. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 10 - 29.

An account is given with tabulated data of cane milling in South Africa, Swaziland, Zimbabwe and Malawi in 1984/85. While the quantities of cane harvested and sugar produced reached record levels in the first three countries, results for Malawi were below those achieved in 1983/84. The average extraction of South African factories was 97.42% and overall sugar recovery 85.96%.

The Chemical Engineering Diplomate: a new source of senior process personnel

J. V. Pillay. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 30 - 32.

At a symposium held at the SMRI on training in the sugar industry, three disadvantages of the Diploma in Sugar Technology were identified (over-specialization, insufficiency of demand and the status of the diploma holders by comparison with senior engineers). It was recommended to cease courses towards the diploma and instead provide training towards a Diploma in Chemical Engineering. The syllabuses of both courses are compared and the involvement of the SMRI in the chemical engineering course is discussed.

Assessment of a stirrer installed in a low-grade pan at Noodsberg

L. Bachan and B. Webb. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 39 - 42.

A 5-bladed impeller was installed in one of the three low-grade pans at Noodsberg with the aim of solving the problem of insufficient pan activity, apparent excessive boiling times (which had forced the factory to reduce massecuite volumes) and associated false grain formation. Trials are reported in which, at the maximum rated speeds of 48 and 32 rpm, the boiling time was cut by 30% to 5.1 hours at a massecuite volume of 38.9 m^3 compared with 7.5 hr at a massecuite volume of 37.3 m^3 in an unstirred pan; the purity at discharge was approx. 53 in both cases. At stirrer speeds of 41.2 and 27.5 rpm, the boiling time was reduced by 16% and the final purity was decreased to just over 50. In all cases, massecuite Brix was approx. 95°. At the rated massecuite volume of 42.5 m^3, the boiling time in the stirred pan was 62% of that in the unstirred pan boiling 40 m^3 of massecuite. The stirrer improved the evaporation rate by about 50% at a low massecuite volume, and by about 80% at a high volume. The use of injection steam did not affect the evaporation rate. Massecuite exhaustion after cooling was unaffected by the stirrer, although the cooling time was reduced. The stirrer also had no effect on crystal size distribution.

Massecuite boiling

E. E. A. Rouillard. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 43 - 47.

Two series of experiments are reported that were designed to provide a better understanding of the mechanism of circulation and to determine factors affecting it. In one series, aimed at defining the variables that influence heat transfer, vapour hold-up and hydraulic losses and at development of equations to form a mathematical model of pan circulation, the apparatus consisted of a single steam-jacketed tube 0.1 m in diameter and 1.3 m long; in the other series, designed to assess the effects of tube length, head above the tubes, steam pressure, vacuum and Brix on the evaporation rate, an experimental pan was used in which four tubes, each with its own steam jacket and 0.1 m in diameter but of differing lengths, were connected to a common downtake and vapour space. Graphed and tabulated results showed that the evaporation rate fell with increase in massecuite Brix, tube length and hydrostatic head and rose with higher vacuum, steam pressure and massecuite purity.

Program for simulating and evaluating a continuous *A*-sugar pan

R. G. Hoekstra. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 48 - 57.

An account is given of the Continuously Operating Raw Pan Simulation and Evaluation (CORPSE) computer program for steady-state simulation based on solution of simultaneous algebraic equations that describe the mass and heat transfer in each compartment (considered as a stirred tank reactor) and mass balances across the compartment. Unknown variables were: total solids; total sucrose; and crystal sucrose, water and crystal contents, while additional unknowns for the evaluation mode included compartment volumes, pan vapour pressure, supersaturation and the coefficients of mass and heat transfer. Application of the model is described for (1) evaluating process parameters from observations of an operating pan (the program performing a least-squares fit if more than the minimum number of data are submitted), (2) sizing of compartments and calandria heat transfer areas for design purposes, and (3) showing how different values of

controllable process variables affect pan operation.

Analysis of crystal residence time distribution and size distribution in continuous vacuum pans

P. W. Rein, M. G. S. Cox and D. J. Love. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 58 - 67.

From results of residence time distribution tests on a number of continuous pans in South African factories, a mathematical model incorporating a number of well-mixed tanks-in-series has been developed to represent massecuite flow and facilitate comparison between pans. Attempts to predict theoretically the effect of residence time distribution on crystal size distribution have been partly successful, but size distribution appears to be also affected to a large degree by pan conditions; the attainment of more uniform conditions in a continuous pan is of advantage over batch pans in this respect. It is concluded that, in any continuous pan application where product crystal size distribution is important, it is desirable to use seed of good C.V., to have a flow system equivalent to at least 12 tanks-in-series and provide good circulation and uniform boiling conditions. Under these conditions, size distributions comparable to or better than those achieved in batch pans should be possible, as in the case of *A*-pans installed recently in Tongaat-Hulett factories.

Decreasing sucrose losses across the clarifier and filter stations at Sezela

S. S. Munsamy. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 68 - 72.

Details are given of modifications to the clarification and filtration plant and processes at Sezela that were aimed at reducing residence time and increasing filtrate temperature in order to reduce the purity drop from clear juice to filtrate and increase clarifier mud filtrability. The route taken by filtrate being recycled to clarification was shortened, the temperature of the mud and filtrate was raised by injecting vapour into the mud line and mixer and into the filter boots, milk-of-lime was added to the mud which was withdrawn from the clarifiers at a lower solids concentration, bagacillo quality and the mud-bagacillo mixing efficiency were improved, and flocculant was added to the filter feed. The result was a fall in purity drop from 3.51 in 1983/84 to 1.70, and a filtrate suspended solids content of 0.37% at a feed solids of 3% compared with 1.07% at 5% mud solids in the previous season.

An evaluation of sucrose inversion and monosaccharide degradation across evaporation at Darnall mill

K. J. Schäffler, D. J. Muzzell and P. M. Schorn. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 73 - 78.

High-temperature exhaust steam at 180 - 190°C is supplied to the three Kestner pre-evaporator effects and to the two clear juice heaters at Darnall without any adverse effect on the juice except in one of the pre-evaporator units, where it may accelerate inversion which is already increased by prolonged juice retention (although the degree to which the steam contributes to this is not quantifiable). The use of GLC to determine glucose, fructose and sucrose in and out of the pre-evaporator showed that glucose losses were negligible, while sucrose inversion losses across the Kestners, in the last of the four Fletcher effects and in the last of three Hulvap effects were a function of retention time rather than steam temperature. Noticeable colour formation was attributed to fructose degradation. The glucose:Brix and/or glucose:chloride ratios proved to be sensitive indicators of inversion; estimates of inversion using glucose as a monitor were much greater than those obtained from inversion tables.

Preliminary study on the extraction of some impurities from cane during diffusion

G. R. E. Lionnet. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 92 - 95.

Investigations are reported in which the effects of a number of variables on diffusion juice quality were determined. Laboratory diffusers consisting of five 6-litre stainless steel jacketed vesels equipped with stirrers were used in three main series of experiments, one of which involved finely prepared cane from a Jeffco cutter-grinder and two involved a coarser preparation typical of actual factory practice from a modified Waddell shredder. Results showed that temperature increased the juice colour significantly without corresponding increases in pol extraction, while fine cane preparation increased pol extraction without having similar effects on impurities. While the effects of pH were less pronounced, increase in the value generally raised the levels of impurities present in the juice. The inclusion of tops in the material fed to the Jeffco unit increased juice colour significantly, while trash caused an even greater increase.

A reliable, high-efficiency sugar mill boiler

B. St. C. Moor. *Proc. 59th Ann. Congr. S. African Sugar Tech. Assoc.*, 1985, 118 - 125.

A detailed description is given of a 150 tonnes/hr bagasse/coal boiler installed in 1984 at Maidstone factory. Because of continuous operation of the factory for 9 - 10 months in the year, high cane fibre (generally 16 - 17%) and very high and variable bagasse moisture content (51 - 57%), and large exports of energy in the form of bagasse, steam and electricity, the boiler incorporated a number of novel features which could have application elsewhere; they include a modified 3-pass main bank, a large steam drum, arrangement of heat recovery equipment, mounting of the induced-draught fans and chimney stack on the concrete flue gas scrubber, and the control instrumentation. During its first season, the boiler performed highly satisfactorily in respect of efficiency and reliability.

Beet sugar manufacture

Microcomputer control of sugar crystallization

J. Virtanen. *Sugar J.*, 1986, **48**, (9), 8 - 9.

See *I.S.J.*, 1984, **86**, 175 - 179.

Reconditioning plane and external cylindrical surfaces of large diameter by honing

I. G. Poplavskii. *Sakhar. Prom.*, 1986, (6), 21 - 24 *(Russian)*.

The value of honing as a means of reconditioning thrust faces and bearing surfaces such as the journals of turbine and generator rotors, scroll sections of DDS-type diffusers, the distributor head faces of vacuum filters, rigid flange couplings, etc. is discussed and the equipment used described.

Industrial loudspeaker communication in sugar factories

E. U. Lubman. *Sakhar. Prom.*, 1986, (6), 29 - 32 *(Russian)*.

Intercommunication by loudspeaker between the various process stations in a sugar factory and the central laboratory and central control is described, covering both the conference system and the subscriber selective conference system.

Anti-corrosion protection of sugar factory process equipment

V. A. Voityuk, V. V. Pukish and S. M. Khelemskii. *Sakhar. Prom.*, 1986, (6), 32 - 34 *(Russian)*.

After a brief indication of the type of equipment most vulnerable to damage by corrosion and the chief causes of corrosion, the need to protect plant is discussed. While priority should be given to treatment of valuable equipment such as diffusers, these pose a number of problems which are listed. Various means of anti-corrosion protection are described with an indication of the costs.

Compartmented (juice) heaters

V. G. Belik *et al. Sakhar. Prom.*, 1986, (6), 35 - 37 *(Russian)*.

Information is given on compartmented heaters for raw, 1st carbonatation, 2nd carbonatation and thin juice installed at a Soviet sugar factory to replace multi-pass surface heaters. Advantages of the new heaters include reduction of labour requirements for descaling.

Unevenness of sugar beet factory operation and specific consumption of energy resources

V. N. Filonenko and A. N. Zagoruiko. *Sakhar. Prom.*, 1986, (6), 37 - 40 *(Russian)*.

Using two factories of different slicing capacities as examples, the authors show how fluctuation in steam and electricity consumption may occur as a consequence of variation in vapour bleed requirements (basically dependent on the amount of juice passing through the heaters) and of variation in the power demand of drives resulting from changes in the quantities of cossettes and juice being processed. However, it is shown how it is possible to calculate specific energy consumption with a high degree of accuracy by allowing for these factors and help to visualize where energy savings are possible.

Recycle water supply for turbosets

V. P. Adamenko, V. P. Khomenko, B. S. Margulis, A. V. Il'in and B. M. Margulis. *Sakhar. Prom.*, 1986, (6), 40 - 41 *(Russian)*.

A scheme is outlined for water supply from a cooling tower and its treatment for use with turbosets and other power plant equipment.

Experience in operation of a beet cleaning line

E. I. Lipovoi, I. Ya. Mantula and N. D. Khomenko. *Sakhar. Prom.*, 1986, (6), 43 - 45 *(Russian)*.

An account is given of operation of the various pieces of beet cleaning equipment, particularly a drum-type washer, at a Soviet sugar factory. Of various problems that have arisen, the failure of the support assembly in the washer has given most trouble, but modifications (illustrated by diagrams) have provided a solution.

Effect of mechanical damage to sugar beet roots on storage properties and processing parameters

S. Ya. Filippishin, A. L. Shoikhet, L. I. Chernyavskaya, E. G. Tomilenko and N. I. Pavlyuchenko. *Sakhar. Prom.*, 1986, (6), 45 - 47 *(Russian)*.

The higher losses and poorer processing quality associated with high levels of damage caused by mechanical harvesting, loading and transport were demonstrated by analysis of samples taken from a pile in which the beet were stored for 57 days. The various parameters measured were compared with those of beet in a control pile where the major difference lay in the much lower degree of damage.

Factors affecting white sugar colour. II. The sources of white sugar colour

N. W. Broughton, B. J. Houghton and A. Sissons. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 54 pp.

Colour balances were established for British Sugar factories during the 1984/85 campaign and for thick juice processing during the post-campaign period. Tabulated average values and ranges of values show very large increases in colour during evaporation, low-grade boiling and crystallization as well as in standard liquor tanks and heaters and in the raw pans. Marked colour formation occurred in the low green syrup tanks and heaters during thick processing but not during the campaign. Standard liquor colouring matter during the campaign made up 93% of the white massecuite colour, the rest being formed during boiling. Standard liquor in British Sugar factories consists of thick juice plus recycled

sugar-end products (wash syrup, raw sugar and low-grade sugar which is possibly affined). Wash syrup colouring matter is usually the largest single contributor to colouring matter recycled to standard liquor, while thick and thin juice contribute 52% and 40%, respectively, of the total filtered standard liquor colour; of the 35% total colouring matter in standard liquor from recycled sugar-end material, 10% is formed at the sugar end and the rest is recycled thick juice colour, which thus contributes 77% of standard liquor colour, of which 18% is formed in evaporation and 59% is present in thin juice, i.e. colouring matter from the beet end. The distribution of white sugar crystal colour between that included in the crystal and that in the syrup film remaining on the surface after washing was determined by eliminating potassium (the major cation in white sugar) and colouring matter from matched pairs of massecuite and white sugar. Included colour made up between 48% and 64% of the total, while external colour ranged from 29% to 56%. Much more K in massecuite was eliminated than colouring matter; the higher the ratio of K to colour removed, the greater is likely to be the production of colouring matter in the crystal. If much of the white sugar colour is internal (an average of 57% was found), normal washing in centrifugals will not reduce the colour content to the same extent as ash. Analysis of internal colouring matter revealed a preponderance of alkaline degradation products of glucose and fructose, of fructose-glycine Maillard reaction products and especially of caramelization products formed by sucrose degradation at high temperature. The value of the colour:ash ratio as an indicator of the extent of a colour problem for a given factory is discussed. Future research will aim to show which of two possibilities is preferable for control of white sugar colour: regulation of beet-end colour so as to reduce formation of the high molecular weight compounds at the sugar end, or regulation of the compounds at the sugar end before recycling to standard liquor.

Investigation of industrial factors decreasing sugar crystal colour

G. Mantovani, G. Vaccari, G. Sgualdino, D. Aquilano and M. Rubbo. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 26 pp.

Investigations of boiling at three Italian sugar factories during the 1985 campaign showed an increase in colour and ash content in the final massecuite tightening phase brought about by the inclusion of mother liquor droplets in the crystals, which are larger after tightening. From these findings, it is concluded that, to reduce the crystal colour content, it is necessary: (1) to grow relatively small crystals, e.g. by increasing the amount of seed; however, sufficiently fine scrubbers would be needed for centrifugalling of the sugar, while the larger the surface area, the greater will be the amount of mother liquor adhering to the fine crystals. (2) To reduce the residence time of massecuite in the pan and exhaust the massecuite in the crystallizers under kinetic conditions that do not favour colouring matter inclusion; this would necessitate an extra crystallizer. (3) To avoid boiling to high Brix, which would reduce vapour consumption and the amount of water to be added in the crystallizers.

Extraction and modernization work at the Aarberg Sugar Factory and Refinery Limited

H. R. Brunner, K. Geckert, H. D. Kimmich, D. Bourée and R. Michel. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 22 pp.

See *I.S.J.*, 1986, **88**, 4A.

Factory generation and import of electrical power in synchronism with the public electricity supply system

J. S. Hogg, J. S. Unwin and I. Bunker. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 42 pp.

Experience at British Sugar in operation of generating plant in parallel with the public electricity supply system is described. Brief accounts are given of systems adopted some years ago at Ely and Wissington factories with the aim of selling surplus electricity, and the present power situation throughout the company is outlined. Although considerable improvements have been made in thermal energy usage, the fall in consumption has not been matched by an equivalent reduction in electricity consumption since there has been no significant change in the type of process plant in use, so that power consumption has remained unchanged, while some of the measures adopted to improve heat efficiency have entailed greater use of electricity. As a result, many factories now need to purchase electricity to supplement their own power generation. Details are given of the latest installation, that at Ipswich factory, together with the process conditions that have necessitated it. The fully automatic system involves two turbo-alternators operating in parallel with each other and with the public supply system; one turbine is a high-pressure unit operating at fixed load, while the other is a low-pressure turbine operating at varying load. Under an agreement, the public utility provides 3 MVA of electricity and receives 0.45 MVA. Information is given on voltage and governor control, on load shedding and on the protection system. The scheme has operated so successfully that four similar installations are under way.

The utilization of low-grade heat

D. A. G. Brown and D. C. Hogan. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 71 pp.

Areas in the factory where significant quantities of heat are rejected, usually at lower temperature than those used in the process, are examined; the major sources of low-temperature heat are the flue gases from the pulp dryer and boiler, carbonatation gas, surplus condensate and pan vapour. Apart from the heat content and temperature, other factors affecting the potential of a heat source

are: its physical properties (whether liquid or gaseous, and its pressure if it is in gas form); contaminants that could foul heat exchanger surfaces, cause corrosion or require gas venting from heat exchangers; and its possible contribution to the effluent problem where it is steam or contains much water vapour. The significance of heat sinks, i.e. streams of low temperature material that requires heating, is explained, and the principles and limitations of heat recovery are discussed. Details are given of ways in which waste heat can be utilized, including descriptions of types of heat exchanger (with a list of the advantages and disadvantages of the plate type, its comparison with the rotary regenerative air preheater and use of a heat pipe or runaround system where available space is limited), dilution of pulp dryer gas with flue gas, the heat transformer (which acts as heat pump but without high energy input), mechanical vapour compression and low-temperature pulp drying.

Pulp pressing additives

P. Mottard and A. Carrière. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 34 pp.

Various additives for increasing the dry solids content of pressed pulp are discussed, plus midbay acidification control as used in British Sugar factories. Reference is made to experiments conducted at various times with calcium chloride, aluminium sulphate, calcium phosphate and calcium sulphate (in the form of gypsum or prepared from milk-of-lime + sulphuric acid or from sludge + sulphuric acid), and the results obtained are discussed. Of relatively new materials tested, talc showed promise initially but then gave disappointing results, pectin methyl esterase seemed to bring no improvement in pressing, while Sophos products (manufactured by Biosoph Laboratories and basically comprising non-ionic surfactants combined with a lubricant) have been found to increase pulp output by some 20% without appearing to affect the dry solids content.

Examination of the microprocessor system for control of a DDS diffuser. II

W. Jankowski, A. Korgul and A. Wokroj. *Pomiary, Autom., Kontr.*, 1985, **31**, (9), 33 - 35, 228; through *Ref. Zhurn, AN SSSR (Khim.)*, 1986, (12), Abs. 12 R489.

Results are presented of investigations in 1984/85 on the use of a microprocessor control system for a DDS diffuser. The possibility of stabilizing cossettes flow is demonstrated, and certain relationships and interactions between a number of factors in the diffusion process are indicated.

The gyratory quality of sugar centrifugals — measurement and evaluation using vibration technology

U. Zimmer. *Zuckerind.*, 1986, **111**, 627 - 634 *(German)*.

Two methods of evaluating the gyratory properties of a centrifugal basket are described: experimental imbalance measurement, in which a definite weight is applied to a marked spot on the basket (e.g. the upper rim) so as to impart imbalance, and operational imbalance measurement, in which the imbalance is created by e.g. massecuite. While the imbalance in the former method is constant in quantity and position and thus gives reproducible values, in the latter method the imbalance alters in quantity and direction both during a cycle and between cycles, so that reproducible values cannot be obtained and mathematical and statistical methods are necessary for evaluation purposes. However, both methods provide a great deal of information. Their application is explained with the aid of measurements made on specific makes of centrifugals.

Construction and operation of the Maguin drum-type beet slicer

H. Hartmann. *Zuckerind.*, 1986, **111**, 634 - 636 *(German)*.

Details are given of Maguin 1430-600 and 1860-600 beet slicer and of its merits.

Experience with drum-type beet slicers at Euskirchen in the 1985 campaign

T. von. Döring. *Zuckerind.*, 1986, **111**, 641 - 642 *(German)*.

The advantages of a Putsch drum slicer over a disc type are discussed on the basis of experience at Euskirchen, where one new drum type and two older disc types operated during the 1985 campaign. The new slicer was of greater throughput (about 90% greater per revolution) and provided cossettes of much higher quality.

New possibilities of chemically preserving stored sugar beet

J. Zahradnicek *et al. Listy Cukr.*, 1986, **102**, 145 - 154 *(Czech)*.

Descriptions are given of a number of preparations that have been tested over the period 1979/85 on stored beet with the aim of reducing losses caused by respiration and other physiological processes as well as by fungal and bacterial infections. The results obtained on both a laboratory and factory scale are presented for Fundazol 50 WP (a fungicide containing benomyl as active ingredient), Kamin RMO (a quaternary ammonium salt detergent), the sodium salt of maleic hydrazide, pyrocatechin, Flordimex (containing ethephon as active ingredient), Ethrel, the diethanolamine salt of maleic hydrazide, Neroxon-50, Perozin 75-B and Novozir MN-80 fungicides, Sencor WP-70 herbicide, CO_2 sublimate, and a milk-of-lime/calcium hypochlorite mixture. Fundazol 50 WP and the last-mentioned mixture proved to be the most effective; the former as a 0.3% suspension at 8 - 10 litres/tonne of beet reduced sugar losses by 32 - 56%, while 55 kg/m^3 CaO mixed with 3% calcium hypochlorite by weight gave 31% reduction and ensured that the beet were in a very healthy state at the end of storage. Neither preparation left any residue, and both were easy to use.

Sugar refining

Control of pan station throughput at Odessa sugar refinery

V. I. Prishchepa, O. M. Teseoglu, A. O. Poltorak and Yu. M. Skakovskii. *Sakhar. Prom.*, 1986, (6), 24 - 27 *(Russian)*.

Computerized control of the boiling cycle in each of the batch pans at Odessa so as to ensure processing of a given amount of massecuite is described, and the benefits in the form of a 120 - 150 tonnes reduction in daily steam consumption indicated. The refinery takes its steam from the city supply, so that it is subject to fluctuations in steam parameters; the automation system described is not able to eliminate the adverse effect of these fluctuations on the length of the boiling cycle, and so start-up of the pans has to be staggered.

Energy savings in the new refinery of Tirlemont

M. Braeckman. *Sugar J.*, 1986, **48**, (10), 19 - 22.

See *I.S.J.*, 1985, **87**, 16A.

Electric boilers: an alternative source of steam

J. A. Bezerra. *Sugar J.*, 1986, **48**, (11), 5 - 10.

See *I.S.J.*, 1986, **88**, 40A.

Some incentives for improving raw sugar quality

J. B. Alexander and A. B. Ravnö. *Sugar J.*, 1986, **48**, (11), 17 - 20.

See *I.S.J.*, 1985, **87**, 16A.

Good manufacturing practices in a refinery

W. F. Barton, D. R. Bishop, J. R. Kerr and J. B. Wheatley. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 13 pp.

Details are given of the program introduced at the Saint John refinery of Lantic Sugar Ltd., in Canada for raising the levels of general hygiene, tidiness and cleanliness in accordance with the code of good manufacturing practices set out by the Canadian Federal Dept. of Agriculture. An inspection program was also formulated to monitor conditions, and a rating system was devised whereby a given area was assigned points corresponding to a level of hygiene ranging from unsatisfactory to excellent. Direct and indirect benefits of the scheme are listed.

Product quality

D. S. Martin and M. L. Burge. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 12 pp.

Quality control at Tate & Lyle Sugars (U.K.) Ltd. is described, starting with purchasing specifications for packaging materials (of importance because of the constant pressure to reduce costs while ensuring a high standard of construction, appearance and properties for storage and transport). Criteria to be applied in quality control are discussed and mention made of quality control manuals that lay down the minimum level of activity required to guarantee that finished products leaving the refinery meet company standards in all respects. Customer complaints and the procedures used to deal with them are discussed.

Air oxidation to self ignition of the two components of a Canesorb/bone char refinery stock

V. R. Deitz. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 24 pp.

A heated stream of air was directed at the bottom of cylindrical samples of Canesorb/bone char mixtures before and after treatment in a Herreshoff regeneration kiln at Crockett refinery, and known volumes of effluent withdrawn for CO and CO_2 analysis. CO_2 is formed by oxidation of both adsorbed organic impurities and the carbon support, so that the difference in CO_2 content before and after kilning could be proportional to the quantity of organic impurities retained after washing. Results showed that the Canesorb fraction adsorbed sufficient organic impurities to lower its self ignition point to a significant degree, but that passage through the kiln restored it to its original value. Granular carbon in supplementary systems at the refinery behaved in a similar fashion. In 4 - 5 days the Canesorb/char mixture in the No. 1 house handled the same colour load as the granular carbon in 2 - 3 days. Many properties of the Canesorb/char mixture were dominated by the bone char (representing 91.7% by weight of the mixture), but some of the Canesorb properties appeared to be enhanced in the presence of the char. Efforts made some years ago to study the chemical reaction in kilning are described in an appendix.

Fine tuning a refinery: "sucrose"

D. E. Webster. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 16 pp.

An account is given of Vancouver refinery operations over the past 25 years, including the effort to increase the weekly melt in order to reduce the number of operating weeks per year so as to reduce energy consumption and unit labour costs. Introduction of the Canesorb process for decolorization of two-thirds of the melt has contributed to savings in energy and labour, while other changes mentioned include installation of a flotation clarifier for washed raw liquor and a 3-vessel line for mud sweetening-off, and reduction in the amount of sweet water in process from the char and mud filters by discharging it to the drains when the sugar content has fallen to 3% rather than 0.3% previously (simultaneously lowering the amount of ash returned to process). Breaking the vacuum of a pan at the end of a cycle with steam rather than air has cut the turn-round time by 5 - 10 minutes per pan, lessened the number of vacuum pumps in use from five to two, saved energy and reduced the noise level on the pan floor. Rapid increase in the bacterial counts of glucose occurred when the sugar, of low pH, was blended with

sucrose of neutral pH; this increase was prevented by adjusting the pH of the blend to 8 with NaOH. A thick, white gel-like deposit that formed on adsorbent which had been used for liquor decolorization was identified as a fermentation mixture of water-soluble dextran and water-insoluble curdlan resulting from inadequate cleaning of feed tanks and pipes. Mention is made of the system of random checking of packaged sugar weight and of improvements made to the weighing system. Apart from complying with official regulations, the scheme also helps to reduce sucrose loss, which a recent balance showed to be 0.66% of input, compared with an average for the 25 years of 0.81% (0.55 - 1.24%).

Fine tuning a refinery: personnel

C. Laur. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 21 pp.

Details are given of the procedures for assessing and hiring personnel, training and work evaluation at Béghin-Say S. A. in France.

Fine tuning a refinery: some thoughts on plant maintenance

J. C. Robinson. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 8 pp.

Aspects of refinery maintenance discussed including planning and scheduling of maintenance work, the quality of repairs, preventive maintenance, spare parts inventories, and the question of whether to repair or replace equipment when replacement parts are no longer available and/or the repair costs are too high. The importance of equipment standardization is stressed.

Fine tuning a refinery: energy considerations

L. Faucheux. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 20 pp.

Sources of heat loss in a refinery and means of reducing the losses are discussed, including: insulation of piping; proper maintenance of steam traps (the four main types of which are described); prevention of steam and air leaks; minimization of condensate losses; reduction of blowoffs to the atmosphere; adequate Brix control; recovery of waste heat; and improvement in boiler efficiency through reduction of excess air, use of an economizer, scale prevention, reduction in blowdown and recovery of waste heat from it, preheating of combustion air and attention to boiler operation. The value of energy audits is also discussed.

Sugar refinery filtration and clarification of carbonatated syrups

G. Gaudfrin. *Paper presented to 45th Ann. Meeting Sugar Ind. Technol.*, 1986, 29 pp.

The theory of filtration is expounded, followed by a discussion of sweetening off and filter cake dewatering. The conventional method of filtering carbonatation liquor is explained and descriptions are given of the equipment used, including the Sweetland, Suchar, US and Gaudfrin autodisc filters; the advantages and disadvantages are given for each type. Details are then given of press filters for filter cake treatment, of the Gaudfrin drained cloth filter and continuous pressure disc filter and belt filters.

The performance of ion exchange resins in decolorizing carbonatation liquor: an analysis of performance data

J. C. Williams. *Proc. 1984 Sugar Processing Research Conf.*, 1 - 21.

A pilot plant trial is reported on decolorization of carbonatation liquor using IRA 958 acrylic anion exchange resin followed by IRA 900 polystyrene resin at 3 bed volumes per hr and 70 - 75°C. After sweetening-off, each resin was backwashed separately and the pair regenerated in reverse order with 4 BV of 12.5% brine, with an acid wash being included in the regeneration every 15th cycle. Samples of feed and resin were taken every 4 hr (each cycle lasted 40 hr) for colour, pH, ash, invert and Brix measurement. Regression equations obtained from analysis of the results are applicable to prediction of the performance of a resin decolorization system under any set of conditions. The experiments demonstrated how the use of macroporous resins and pairing them can extend the operating life of a system, although resin fouling by colorants still occurred and could be overcome by replacing the brine regenerant with alkaline brine. Mechanical fouling by chalk in the carbonatation liquor was eliminated by the acid washing, absence of which would have led to a three times faster decline in the performance of the acrylic resin. The effects of rise in pH, reduction in ash and the use of acid washing on improvement in decolorization performance were indicated. The results formed the basis of a resin plant which was due to come on stream at the Thames refinery of Tate & Lyle Sugars Ltd. in 1985.

Comparative evaluation of powdered active carbons

V. V. Smol'yaninov, A. I. Gromkovskii and N. N. Neklyudova. *Sakhar. Prom.*, 1986, (7), 25 - 27 *(Russian)*.

Comparative tests on 10 Soviet and other active carbons showed that, while the Lurgi-Bayer, Norit, Darco, SV-50 (Japanese) and Bustini (Rumanian) products had a much higher decolorization efficiency than the three Soviet carbons and had better adsorptive properties in terms of methylene blue (indicating a better micropore condition), there was little difference between the carbons in terms of iodine, representing coarser impurities. However, the filtration properties of the non-Soviet carbons are considered too low, and a 1:4 or 1:5 mixture with the Soviet carbons is recommended. Gluconate-4, a Polish carbon, was as good as the best of the Soviet carbons in decolorization performance but was the second poorest in impurity adsorption.

Laboratory studies

Application of electron microscopy to the study of sugar crystal surface

F. L. Falcón. *ATAC*, 1985, (Jan./Feb.), 30 - 35 *(Spanish)*.

A number of electron micrographs are reproduced and discussed. The nature of the crystal characteristics (terraces, steps, etc.) provides insight into the mechanism of crystallization in each case.

HPLC of carbohydrates

H. Bauer, H. Quast, A. Shalaby and P. Rocek.*LaborPraxis*, 1985, **9**, 660 - 662, 669 - 670, 672, 674, 676; through *Anal. Abs.*, 1986, **48**, Abs. 1D97.

A review is presented, with 36 references, of the literature on methods for separation and detection of carbohydrates, along with their limitations.

The production and use of ^{11}C-labelled sucrose in the crystallization process

V. K. Kudrik, V. O. Shtangeev, V. K. Maidanyuk, L. F. Luk'yanchuk and T. G. Shevchenko. *Sakhar. Prom.*, 1986, (6), 19 - 21 *(Russian)*.

Details are given of the technique used in the preparation of ^{11}C-labelled sucrose, which was then used in studies of massecuite crystallization during boiling. In one pan, the footing contained the radiosucrose, while in another the feed syrup was doped. In addition to determination of the proportion of labelled sucrose molecules formed, glucose and fructose solutions were irradiated with gamma rays, and the distribution of the two monosaccharides and their degradation products in the crystal mass then determined. Subsequent investigations confirmed that the impurities concentrated on the surface of the crystals. Advantages of ^{11}C over ^{14}C for radiosucrose preparation include greater safety because of the shorter half-life of the former isotope (20.34 minutes compared with 5750 years), easier sample preparation, the possibility of using samples in both solid and liquid form, and simplicity with which the radioactivity is measured.

Measurements of saccharides and ethanol in stored burnt cane billets utilizing HPLC

P. C. Ivin. *Proc. Australian Soc. Sugar Cane Tech.*, 1986, 193 - 199.

Samples of burnt cane billets were taken over a 72-hr storage period and analysed by three HPLC methods for sugars and ethanol. Over 24 hr, c.c.s. fell by 9% and dextran rose by 2240 ppm on extract Brix. Fructose and glucose (each initially about 0.2%) doubled in 24 hr and rose by 500% after 72 hr, with similar levels for the two sugars in all but two cases. Ethanol rose from 250 ppm to a maximum of 600 ppm after 72 hr, while the trisaccharide (neo-kestose, 1-kestose and raffinose) content rose from 400 - 800 ppm to a maximum of 5200 ppm; the main trisaccharide was 1-kestose (>3000 ppm), while 6-kestose, if present, may have been co-eluted with raffinose. Tetrasaccharides varied from 100 ppm in fresh cane to 700 ppm after 72 hr. No direct correlation was found between cane quality and the increase in the various impurities that would be expected to cause processing difficulties. Although 72 hr was considered an excessive period, it was chosen so as to ensure that the trace concentrations of oligosaccharides present after 24 hr would increase and permit easier identification.

Further development of batch sugar boiling. I. Comparative analysis of mathematical relations defining the sucrose crystallization rate

M. A. Karagodin and R. Lástity. *Cukoripar*, 1986, **39**, 55 - 57 *(Hungarian)*.

A number of mathematical relations appearing in the literature are examined for their accuracy in calculation of the crystallization rate in batch boiling, and the empirical formula of Nakhmanovich & Zelikman found to be the most suitable, with a regression coefficient of 0.992 at supersaturation coefficients in the range 1.0 - 1.15, a purity of 75 - 100 and a temperature of 60 - 90°C. It takes the form $K_v = -550 + 10.5Q - 190{,}000 (P - 1)^2 + 2450Q (P + 1)^2$, where K_v = crystallization rate, Q = purity and P = supersaturation. Comparison between laboratory experimental boiling and calculations based on a mathematical model incorporating the formula showed very close agreement in the crystallization rates from one-quarter of the way through the boiling process, with the values coinciding at the three-quarters point.

The osmotic pressure of sugar solutions

D. E. Sinat-Radchenko. *Sbornik Pishch. Prom.*, 1985, **31**, 34 - 37 *(Russian)*.

The role of osmotic pressure in membrane technology, e.g. reverse osmosis for beet thick juice concentration, is examined, and a nomogram and formulae presented for calculation of the osmotic pressure of sugar solutions in the temperature range 0 - 90°C and Brix of 5 - 80°.

Development in the immunochemical assay of dextran

J. H. Curtin, R. J. McCowage and R. Hoskinson. *Sugar J.*, 1986, **48**, (9), 5 - 8.

An immunological assay is described which was based on the formation of an insoluble specific antibody/antigen complex between dextran molecules and an α-1,6 glucan antiserum prepared from a purified standard dextran of 40,000 molecular weight and of low polydispersivity containing approx. 95% α-1,6 linkages and 3.5% α-1,3 linkages. The amount of complex formed was measured by nephelometry. In preparation of a standard graph using solutions of dextran T2000 in 5% sucrose solutions, reponse was linear over the range 0 - 100 mg/litre dextran, and dextran molecular weight had little effect in the range T2000 - T40. Satisfactory repeatability was obtained in dextran analysis in 5 g/100 ml raw sugar samples, and recovery of dextran added to

raw sugar ranged from 96% to 102.7%. Good correlation was obtained between the immunochemical procedure and the haze method. Other glucans and polysaccharides present in raw sugar did not interfere with the analysis.

Raw sugar factory analytical control

S. J. Clarke. *J. Amer. Soc. Sugar Cane Tech.*, 1985, **5**, 90 - 100.

Chemical control techniques and sources of possible error in analysis of the various materials are discussed with particular reference to the situation in Louisiana sugar factories. Tabulated data are presented to demonstrate the need for consistent and reproducible analytical procedures, and mention is made of the formation of a committee to recommend standard methods for the analysis of bagasse, filter cake and molasses. Polarimetric measurement of sucrose was to form the basis of the methods, with emphasis on uniformity of sample preparation.

Thermal conductivity of raw sugar

M. Vender. *Sugar J.*, 1986, **48**, (10), 14 - 17.

The thermal diffusivity and thermal conductivity of raw sugar from various Australian regions were calculated from the temperature profiles measured in a 200-kg cylindrical drum and in a 800-kg rectangular bin. Although the average thermal conductivity value for 32 sugars (0.175 W/m/sec) was practically identical to that obtained by Sandera & Mircev[1], values for individual sugars deviated from the average by as much as ± 30%. The results are tabulated.

Mid-infra-red transmission spectroscopy of sugar solutions: instrumentation and analysis

B. L. Mills, E. C. Alyea and F. R. van de Voort. *Spectrosc. Lett.*, 1986, **19**, (3), 277 - 291; through *Anal. Abs.*, 1986, **48**, Abs. 7F5.

An IR spectrometer, the Spectroprocessor IV (Shields Instruments Ltd., York, England), designed for application to aqueous samples, is described; it was used to record the absorption spectra from 5 to 10 μm of glucose, maltose, sucrose, lactose and mannose in pure solution. Absorbances of 5% solutions of the individual sugars (plus fructose and galactose) at 8.95, 9.00 and 9.61 μm are tabulated, together with concentration calculated on the basis of lactose as reference standard. The largest error was generally observed for fructose. No isosbestic point for all the sugars was found, but certain binary mixtures could be analysed. None of the wavelengths could be used to determine the sum of sucrose, and glucose and fructose.

Pipeflow viscometer for measuring massecuite consistency

P. Jelinkova, P. Kadlec and Z. Bubnik. *Sb. VSCHT Praze*, 1984, **E57**, 73 - 94; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (12), Abs. 12 R488.

A description is given of a pipeflow viscometer designed for the determination of massecuite consistency. The instrument was used to measure the viscosity of molasses and artificial massecuite. Results are compared with values obtained using a Reotest-2 rotary viscometer.

Determination of sucrose solubility by a dynamic method

T. Prasil, L. Drobny and P. Kadlec. *Sb. VSCHT Praze*, 1984, **E57**, 197 - 209; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (12), Abs. 12 R490.

A unit for determination of sucrose solubility is described and results of measurements with it are given. The dynamic method used is based on determination of change in solution concentration with time after addition of a solid phase at constant temperature but varying initial concentration. The change in concentration is determined by means of a special continuous refractometer. Extrapolation of the function between the rate of dissolution and the concentration of the solution gives the concentration of a saturated solution at a given temperature. The method was used to measure the concentration of saturated sugar solution at 20°, 25°, 30° and 35°C. Comparison of the values with tabulated data obtained by Vavrinecz and Vasatko & Smelik showed that the mean experimental values were lower than the tabulated ones by 0.5%, which represents the standard deviation of the measured values at 25°C.

Potentiometric flow-injection determination of sugars using a metallic copper electrode

P. W. Alexander, P. R. Haddad and M. Trojanowicz. *Anal. Lett.*, 1985, **18**, (A16), 1953 - 1978; through *Anal Abs.*, 1986, **48**, Abs. 8C19.

The reducing sugar sample solution is injected into a water stream and reacted with a stream of carrier solution containing Cu (II) and NH_3 or Na tartrate in a heated coil of PTFE (polytetrafluoroethylene) tubing (70 - 250 cm × 0.5 mm). The reduction of the Cu (II) by the sugars is monitored at a copper electrode; sensitivity is highest at low flow rates (e.g. 1 ml/min) and high temperature (e.g. 100°C). The method was also used in the analysis of 100-μlitre aliquots of a solution containing maltose, glucose, sorbose and fructose (25 mM each) by cation exchange HPLC on Sugar-Pak I with water as mobile phase (0.3 ml/min) and post-column derivatization with 0.5 mM $CuSO_4$ and 50 mM NH_3 at pH 10 (0.5 ml/min).

Chromatography of monosaccharides and disaccharides

K. Robards and M. Whitelaw. *J. Chromatogr.*, 1986, **373**, (1), 81 - 110; through *Anal. Abs.*, 1986, **48**, Abs. 8C21.

Paper, thin-layer, gas and column chromatography of mono- and di-saccharides is reviewed. Much of the practical information is in tabular form. There are 364 references.

1 *Zuckerind. Czechoslov.*, 1935, **58**, 145 - 148.

By-products

The Sucrotech/Biowastech process

L. Upton and H. Doelle. *GEPLACEA Bull.*, 1986, **3**, (06), 6 pp.

Details are given of the Sucrotech/ Biowastech process developed at the University of Queensland. The continuous Sucrotech half of the process is designed to convert sucrose to ethanol and, if required, to fructose or sorbitol in a single stage, using a mutant strain of *Zymomonas mobilis*. Its advantages include substantially lower fermentation times than with conventional methods, a higher sucrose/ethanol conversion efficiency, reduced scale formation and sterilization requirements, the absence of need for separation of yeast used as inoculum, reduced substrate concentration and the ability to use existing ethanol facilities. The Biowastech part of the process produces single-cell protein (Bioprotein-SCP) from vinasse by means of *Candida ingens*. The protein, in powder form, can be stored for long periods and is ideally suited to transportation. Installation of a station for the combined process at a sugar factory is illustrated diagrammatically.

Pulp dryer outfall housing exposion incident and investigation

R. J. Parker and J. N. Smith. *Paper presented to 28th Tech. Conf. British Sugar plc*, 1986, 39 pp.

On January 5, 1985, a mild explosion occurred in the outfall housing of a beet pulp dryer at the Brigg factory of British Sugar plc, resulting in the partial collapse of the housing brickwork and emission of flames above the unit (but without causing any major fire in the dryer building). The pulp drying plant at the factory is described and an account given of events preceding the incident. Details are then given of the investigative work that followed and of steps taken to avoid any recurrence. Although it was not possible to determine the mechanism of the explosion, the prime cause was the absence of feed material entering the dryer during start-up; tests have shown that overdried material will ignite when exposed to temperatures in the range of 200 - 300°C in an air stream containing a normal concentration of oxygen, while fine dry pulp dust can form an explosive mixture with normal air.

Sugar beet pulp in cattle fodder

V. Potthast. *Die Zuckerrübe*, 1986, **35**, 206 - 208 *(German)*.

Various aspects of the use of molassed pulp as cattle fodder are discussed, including the feed value of the three grades classed as low-, medium- and high-sugar with respective contents of 8 - 14%, 14 - 21% and >21%, how they should be used as part of a given ration and problems that have to be faced, such as care in the amount of sugar fed (particularly to dairy cattle), the adverse effect of filter-cake addition to the pulp (which reduces the amount of organic matter and net energy in the ration through the introduction of ash) and the hardness of pellets.

The effects on waste water pollution of three-stage growth of fodder yeasts on molasses vinasse enriched with fatty wastes

M. Kramarz and J. Biobrowski. *Przem. Ferm. i Owoc.-Warzyw.*, 1985, **29**, (4), 19 - 21; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (12), Abs. 12 R422.

Results are reported of laboratory studies on three-stage cultivation of fodder yeasts on molasses vinasse enriched with waste from the butter and fats industry. The centrifugate, obtained after separation of the yeasts, was enriched with mineral components and the second stage of yeast cultivation then carried out, followed by further centrifuging to separate the yeast, enrichment of the centrifugate and the third stage of cultivation. The method used yields 59.2 g of biomass per dm^3 vinasse and reduces the COD from 72,000 to approx. 14,000 mg O_2/dm^3. To provide maximum biomass yield and waste water purification, approx. 1%, 1.5% and 2% of carbon source in the form of waste from the fats industry should be added at the 1st, 2nd and 3rd stages of cultivation with a mixed culture of *Candida utilis* and *C. lipolytica*.

Utilization of sodium acetate for production of *Aspergillus niger* conidia and for control of the pH of the molasses substrate during citric fermentation

A. Nowakowska-Waszczuk and K. Kedziora. *Przem. Ferm. i Owoc.-Warzyw.*, 1985, **30**, (6), 28 - 31; through *Ref. Zhurn. AN SSSR (Khim.)*, 1986, (13), Abs. 13 R448.

Experimental investigations showed that good growth of *A. niger* mycelium was obtained by adding 1% or 2% sodium acetate to the molasses-based feed at pH 6. Addition of 1% acetate did not affect the activity of the mycelium used as inoculum in the production of citric acid. It was noted that acetic acid could be used to control the pH of the feed, but the amount used was about 150% greater than that of H_2SO_4.

Studies on the fermentative production of L-lysine. III. Evaporation, preservation and drying of L-lysine fermentation broth

Y. T. Liu and S. L. Sang. *Rpt. Taiwan Sugar Research Inst.*, 1985, (110), 25 - 34.

In laboratory investigations, evaporation of L-lysine fermentation broth (obtained from cane molasses) to 40% dry solids at pH 4 and a temperature below 80°C gave 90% recovery; addition of sodium bisulphite had no effect on evaporation. The concentrate was stable at room temperature when stored for up to 5 months. Because of its high viscosity, drying of the high Brix concentrate proved difficult, while drying at low Brix was time-consuming and caused partial degradation of the lysine. However, good results were obtained by addition of 15% corn starch to 40°Bx concentrate at pH 4.5 followed by drum drying at 154°C.

on his data from a bench-scale installation:

$$V_f = 1.667d^{0.245}\,[(1 + X)/D_g]^{0.5}$$

$$V_p = 1.262d^{0.305}\,[(1 + X)/D_g]^{0.5}$$

Where: V_f = terminal velocity of fibre-like particles, m/sec,

V_p = terminal velocity of pith-like particles, m/sec,

d = average screen size for fraction, mm,

X = moisture content of bagasse on dry basis, kg water/kg dry bagasse, and

D_g = gas density, kg/m³.

Arrascaeta & Friedman[23] obtained the results shown in Fig. 2 in a pilot-scale bagasse dryer of 0.5 - 1 tonne/hr capacity. The results shown are in accordance with those obtained in a pilot-scale dryer[25] at the Sugar Research Institute, Mackay, Queensland, where all bagasse was conveyed pneumatically at 3 m/sec.

The most significant results of the industrial prototype dryer are the following:

(a) 6 tonnes/hr bagasse of 46% dried to 28% H_2O.

(b) 70% of stack gases cooled from 300 to 100°C.

(c) Boiler efficiency increased from 72 to 82%.

(d) Steam generation increased from 2.25 to 2.59 kg steam/kg bagasse (50% basis).

(e) Dust in flue gas reduced from about 2000 to 300 mg/Nm³.

The dryer (see Figures 3 and 4) is simple to construct, install and operate. The investment cost is low and the pay-out time is about half a harvest season (fuel oil at $175 per tonne).

Because of these excellent results a number of bagasse dryers of this type but with capacities of 10, 20, 40 and 50 tonnes/hr will be installed in Cuban sugar factories in the next few years.

Conclusions

The drying of bagasse has several significant advantages and a number of dryers have been installed in the world sugar industry. Results are now available for the design of bagasse dryers and auxiliary equipment.

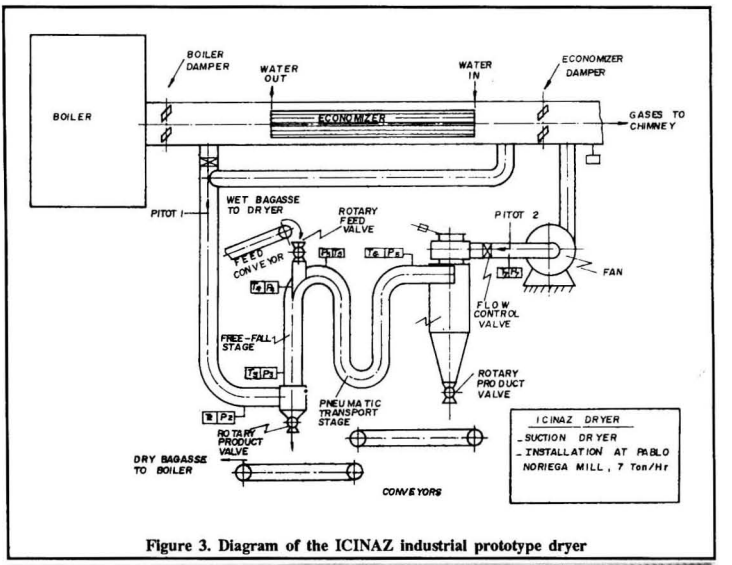


Figure 3. Diagram of the ICINAZ industrial prototype dryer

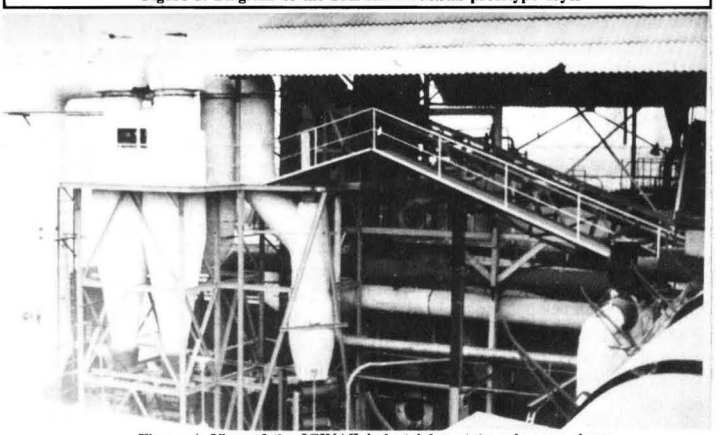


Figure 4. View of the ICINAZ industrial prototype bagasse dryer

The ICINAZ bagasse dryer operated during the 1983/84 and 1984/85 harvest seasons with excellent results and dryers of this type with higher capacities are now being installed in other Cuban sugar mills.

Summary

The advantages of bagasse drying are described and a list of bagasse dryers is given. The results of bench and pilot-scale studies on the terminal velocities and classification of bagasse particles is reported. An industrial prototype bagasse dryer of 7 tonnes/hr wet feed is described and the operational results are reported, the most significant being: 6 tonnes/hr bagasse at 46% dried to 28% moisture content; increase in boiler efficiency from 72 to 82% and in steam generation from 2.25 to 2.59 kg steam/kg bagasse (50% basis). The investment was paid off in less than one harvest and it is planned to install more dryers in Cuban sugar factories.

25 Allen: *Personal communication*, August 2, 1983.

Colour formation and elimination from crystals*

By P. W. van der Poel, J. L. M. Struijs, J. P. M. Vriends and A. A. W. Marijnissen
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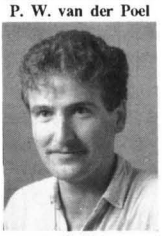
J. P. M. Vriends


A. A. W. Marijnissen

Introduction

Colour is the most widely accepted and possibly the most important quality parameter of white sugar. Nowadays, demand for the production of high quality white sugar and the need to reduce costs justify intensive attention to "colour". Colour is a priority subject for the 1987 meeting of CITS and there is a sub-committee on "colour" working under the chairmanship of Professor Reinefeld. The British Sugar team has paid full attention to the subject at the technical conferences as well as at the meetings of the "colour" sub-committee. Cost reduction and improvement of quality may both result from a better control of the factory operations. This philosophy, postulated by Deming, seems to be the key for the success of, for instance, the Japanese industry, which has succeeded in realising cost reduction and quality improvement at the same time.

It is necessary to know exactly what happens in the various stages of the factory operations to achieve both goals: quality improvement and cost reduction. As far as concerns colour, the comprehensive study of the British Sugar team has been very helpful to understand the phenomena related to "colour"[1]. The characteristics of the colorants were investigated against the background of 89 literature references. Methods were developed for molecular weight determinations as well as for the determination of colour inside the crystals and colour on the crystal surfaces.

Non-sugar balances as well as "colour" balances have been followed in CSM factories for many years. The results were used in optimization of the vacuum pan house operations. The experiences in CSM are much in agreement with the recommendedations of the British Sugar team. Their work has met great appreciation at our factories; in the laboratories as well as in the training programs.

Relationship between colour of sugar and colour of massecuite

Above a certain level, further increase in the amount of wash water in the centrifugals does not result in an improvement of the quality of the sugar. We call this level the maximal amount of wash water. On application of the maximal wash water in the centrifugals we find the ratio of colour of the sugar to colour of the massecuite to be more or less independent of the origin and nature of the colorants. The ratio (colour of sugar:colour of massecuite) on application of the maximal amount of wash water is about 0.8% for stirred pans and optimal process control. This means that for practice in CSM the total colour of the massecuite determines the minimal colour of the sugar which can be obtained from it. Colour originating from thick juice is not easier to eliminate than colour from after-product sugar.

Included colour

Affination with alcohol causes precipitation of colour substances. These may be dissolved by washing with water. This precipitation of colour substances is especially observed in after-product sugars. This is why we abandoned affination with alcohol and used aqueous sugar solutions for our affination tests.

Colour elimination in the centrifugals

The efficiency of mother syrup and crystals separation in the centrifugals depends on the "quality" of the crystals, the conditions at the centrifugals and the amount of wash water.

Quality of the crystals

We have reviewed this subject at previous British Sugar conferences[2]. Predominant parameters are: the crystal regularity and crystal size distribution, the presence or absence of conglomerates, and occlusions.

These parameters may be controlled by the pan boiling process, in which pan stirrers, vacuum pan control, and full seeding procedure are the tools to control the quality of the crystals.

The conditions at the centrifugals

The governing conditions are: centrifugal force (fixed by the r.p.m. and diameter), cycle time, amount of wash water, and syrup wash, should this be employed. The amount of wash water is the predominant parameter, provided that the division of the cycle time and the conditions of the centrifugals are optimal.

Relationship between sugar quality and the amount of wash water

Drean *et al.*[3] derived a regression equation, describing the efficiency of Watson Laidlaw centrifugals with Ward Leonard drives. The formula was:

$$1000A = 83.418 - 0.137T + 0.00436T^2 - 2.386 \log_e (CW^{1.313} S^{3.474})$$

in which: A = ash content of sugar, W = wash in seconds, T = delay to wash in seconds after charging, C = cycle time in seconds from charge to stop, and S = top speed in r.p.m.

In a simplified form, with the wash water as the only variable, this can be written as:

$$A = a \log_e W + b$$

in which A = the ash content of the sugar which we relate to the quantity of

* *Paper presented to the 28th Tech. Conf. British Sugar plc., 1986, here slightly condensed*

1 Shore *et al.*: *Paper presented to the 27th Tech. Conf. British Sugar plc.*, 1984; *Sugar Technol. Rev.*, 1984, **12**, 1 - 99.

2 van der Poel *et al.*: *Papers presented to the 17th and 27th Tech. Conf. British Sugar plc.*, 1964 and 1984.

3 Quoted by Eichhorn & Bollman: *Zeitsch Zuckerind*, 1967, 246 - 251

mother liquor which remains with the crystal, and W = the amount of wash water % weight of massecuite.

The values of a and b depend on the conditions at the centrifugals and on the quality of the crystals. Regression equations are descriptive for a given situation. Generally, they cannot be extended to other situations. We used the formula to determine a logarithmic function for the plotting and curve fitting of the remaining mother liquor quantity as a function of the amount of wash water. In order to make the plotting and curve fitting applicable for massecuites of different ash contents, we use the ratio (ash content of the sugar:ash content of the massecuites). For some applications we use the potassium contents instead of the ash contents. We use the same curve fitting for colours. In this case we plot the ratio (colour in sugar:colour in massecuite) as a function of the amount of wash water.

Our experience is more or less in agreement with this relationship. Figure 1 gives the general shape of the curve. We confine ourselves for this example with the general shape without calibration. More details referring to examples from practice are presented in the course of this paper.

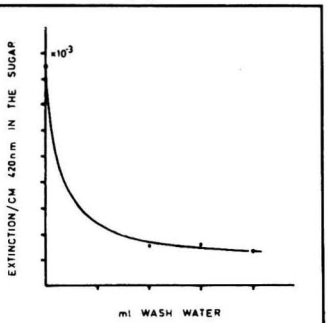

Fig. 1. Non-sugar elimination as a function of the amount of wash water

Figure 1 relates to laboratory tests. In practice the curved part of the graph is the most important.

The elimination of the non-sugars is not the same for all kinds of non-sugars[4]. Although the wash curves have approximately the same shape, the elimination of non-sugars such as colour, saponins and polysaccharides is less efficient than the elimination of ash components.

The mass transfer between the syrup layer on the crystals and the surrounding or passing wash syrup depends on the mass transfer coefficient of the component in question. The mass transfer coefficient in its turn is a function of the diffusion coefficient. It is easy to imagine that components with high molecular weights need more time to penetrate into the wash syrup and are eliminated less efficiently than, for instance, ash components.

Figure 1 illustrates that from a certain level the elimination of non-sugars scarcely improves with increasing amounts of wash water. It is not necessary that these non-sugars are incorporated in the crystals. The non-sugars may also be located at places on the crystals or in the centrifugals which are not easily accessible to the wash syrup or the water. The non-sugars may be located at the back of the crystals referring to the direction of the wash water flow, or in conglomerates.

4 Verhaart *et al.*: *Comptes rendus XIII Ass. Gén. Comm. Int. Tech. Sucrerie*, 1967, 163 - 190.

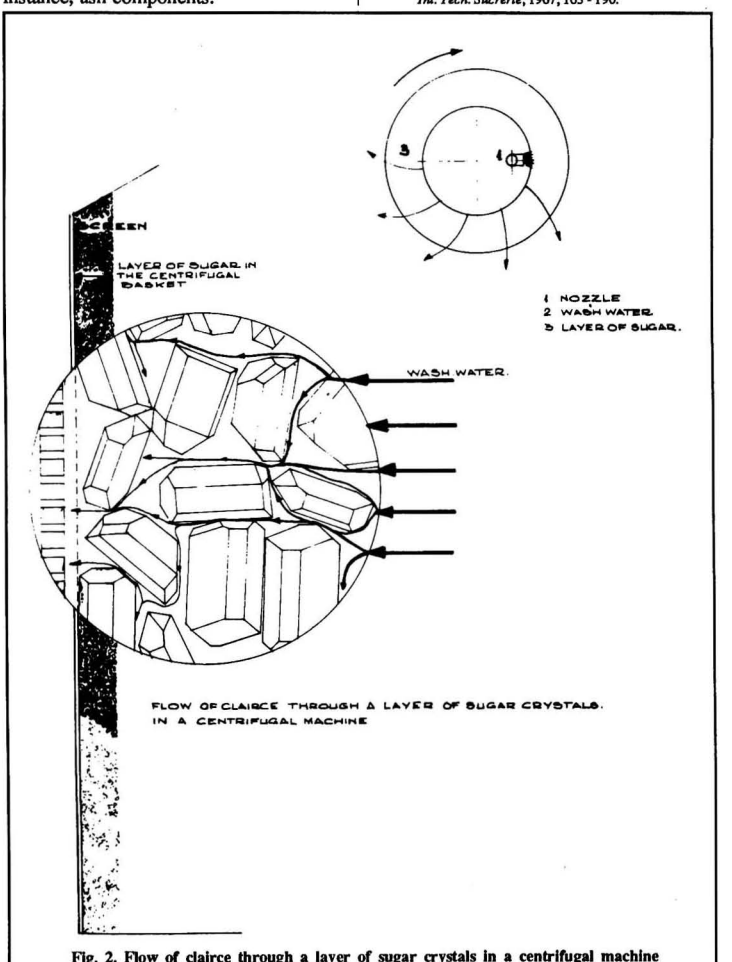

Fig. 2. Flow of claircе through a layer of sugar crystals in a centrifugal machine

Another possibility is that the atomizers do not cover the whole layer of sugar in the centrifugal baskets.

Figure 2 presents schematically the flow of wash syrup through the layer of sucrose crystals in the centrifugal baskets.

Some practical experience at CSM

We studied in our factories the efficiency of first product centrifugal batteries and here present results of two. Factory A has very good pan boiling, but Factory B has no pan stirrers, limited automatic process control and no full seeding. Table I records the figures concerning the centrifugals.

Table I. First product centrifugals data

Factory	A	B
Curing		
Massecuite per cycle, kg	864	913
1st + 2nd acceleration time, sec	38.2	41.7
2nd acceleration endpoint, rpm	1002	1140
Last acceleration time	28.9	20.9
Maximal speed, rpm	1448	1355
Total cycle time, sec	190	208
Washing		
Time after beginning acceleration, sec	50.5	25.0
Time of water supply, sec	7.8	11.9
Initial speed, rpm	1302	800
Final speed, rpm	1402	1035
Wash water supply/ charge, kg	15.8	16.6
Wash water supply, kg/100 kg massecuite	1.83	1.82
"Drying" time, sec	8.8	25.7
Screenwash		
Time, sec	4.4	6.7
Water supply, kg/charge	8.9	9.3
Water supply, kg/100 kg massecuite	1.03	1.02

For assessment of the efficiency of the centrifugals we use the following parameters:

The ratio (potassium concentration in the sugar)/(potassium concentration in the massecuite).

The ratio (colour in the sugar)/(colour in the massecuite).

Colour after membrane filtration (ICUMSA).

Colour and concentration % dry substance.

The mother liquor elimination; this is calculated from the potassium contents of the sugars and massecuites, the crystal contents of the massecuite, and the crystal yields.

The crystal loss ratio, i.e. the percentage of the crystallized sugar which goes to the syrup, either dissolved in the wash water or as fine crystals passing through the screen.

We applied different amounts of wash water and obtained the results for Factory A which are given in Table II with corresponding figures for Factory B in Table III. Figures 3 and 4 illustrate the ratios of sugar and massecuite colour and potassium, as well as the crystal loss percentage, as functions of the amounts of wash water. As explained before, we applied a logarithmic curve fitting of the ratios as a function of the amount of wash water.

From Figures 3 and 4 and the data in Table III, we may come to the following conclusions:

Table II. White centrifugals efficiency at Factory A

Wash water:			
Time, sec	6	8	12.8
Weight % massecuite	1.40	1.83	2.99
First product massecuite:			
K, g/100 Bx	0.804	0.772	0.754
ICUMSA colour	1800	1700	1810
White sugar:			
K, ppm	59.2	41.3	28.4
Colour:			
Before filtration			
420 nm	23.0	22.1	20.5
720 nm	–1.1	0.4	0.1
After filtration			
420 nm	19.1	15.1	14.1
720 nm	–2.8	–3.2	–3.0
K in sugar % K in massecuite	0.74	0.54	0.38
Mother liquor purge ratio, %	99.67	99.75	99.84
Sugar colour % massecuite colour	1.06	0.89	0.78
Crystal loss, %	7.5	9.3	16.3
Daily composite of white sugar gave a MA of 888 microns and CV of 28%			

Table III. White centrifugals efficiency at Factory B

Wash water:			
Time, sec	7	12	17
Weight % massecuite	1.07	1.83	2.59
First product massecuite:			
K, g/100 Bx	0.851	0.845	0.882
ICUMSA colour	1140	1140	1200
White sugar:			
K, ppm	90.7	46.0	40.8
Colour:			
Before filtration			
420 nm	25.3	18.7	18.1
720 nm	1.0	0.5	0.7
After filtration			
420 nm	20.6	14.8	13.6
720 nm	–1.4	–1.3	–1.6
K in sugar % K in massecuite	1.08	0.54	0.46
Mother liquor purge ratio, %	99.51	99.78	99.82
Sugar colour % massecuite colour	1.81	1.30	1.13
Crystal loss, %	8.0	13.0	20.1
Daily composite of white sugar gave a MA of 712 microns and CV of 39%			

(1) In non-optimal pan boiling, at a crystal loss ratio of 10%, we can obtain a sugar massecuite colour ratio of about 1.6%. With optimal crystallization at the same crystal loss level, this ratio is about 0.9%, so that considerable improvements of the colour of the sugar can be obtained by improved pan boiling.

(2) As far as concerns the potassium contents this improvement is about 30%.

(3) Conditions during pan boiling have more influence on the colour than on the ash contents of the sugar.

These observations have been confirmed in many other investigations.

Colour balances

As explained above, we find in our factories an almost linear relationship between the colour of the sugar and the colour of the massecuite. This refers to the situation in which the conditions at the centrifugals are optimal and the "maximal" amount of wash water is applied. Since above a certain level further wash water does not improve sugar quality (Fig. 1), we can estimate

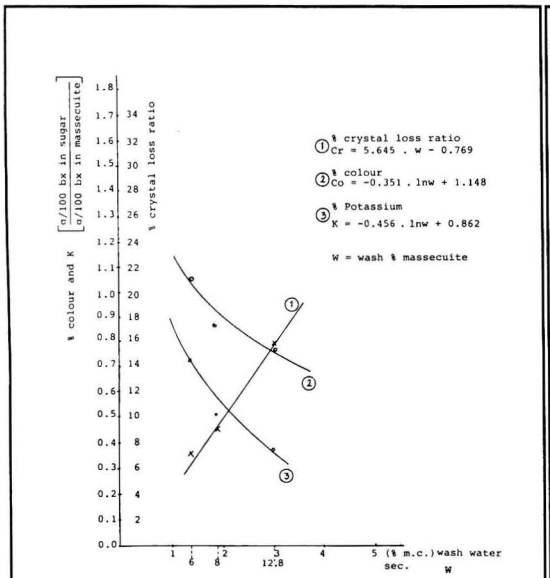

Fig. 3. Colour and potassium elimination, and crystal loss, related to volume of wash water (Factory A)

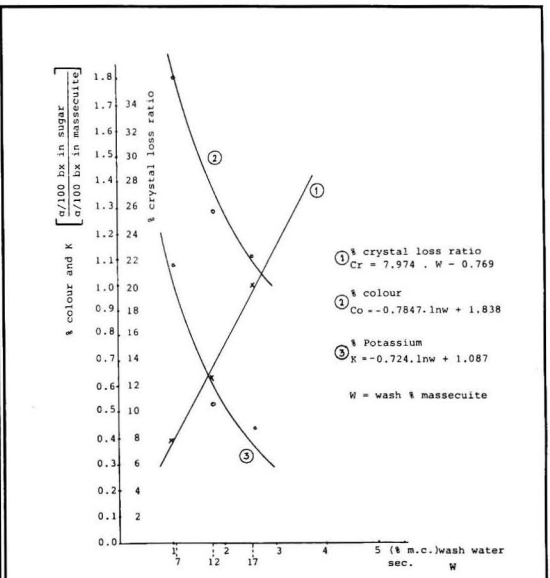

Fig. 4. Colour and potassium elimination, and crystal loss, related to volume of wash water (Factory B)

from the colour of the massecuite the minimum colour of the sugar which may be obtained by increasing the amount of wash water.

In practice, the ratio between the minimal colour of our white sugar and the colour of the massecuite is about 0.8% for white pans with stirrers, computer control and full seeding. When these conditions are not met, the ratio is about 1.2%. This indicates that there is no great influence of the nature of the colorants, which seem to behave in the same way, irrespective of their origin. Colour from thick juice does not seem easier to eliminate than colour from after-product sugar.

The scientific explanation for this phenomenon is not clear to us but for practical purposes we have to consider it as a fact that the colour of the massecuite determines the minimal colour of the sugar to be obtained by washing. Accepting this as fact, it becomes important to know where the colour in white sugar massecuite comes from. We have calculated balances but in these do not consider the nature of the colour substances.

Colour balances for first product massecuites

Colour in white sugar massecuites comes from the following sources: colour in thin juice, colour formation in the evaporators, colour formation in standard liquor tanks and first product pans, and colour recycling from intermediate sugars and affined after-product sugars.

An example of a colour balance in a factory is recorded in Table IV.

Course of colour components from thin juice to molasses

The figures are recorded in Table V. As a reference we give the course of the ash components. As SO_2 is an important factor in prevention of colour formation, we also give the course of SO_2 concentrations. Figure 5 records the course of the colour from thin juice to molasses; to present the data independent of crystal yields, the extinction coefficients is expressed as the ratio of colour per g ash. Figure 6 records the course of SO_2 in mg per g of ash.

Table IV. Standard liquor colour balance

Component	Quantity of dry substance	ICUMSA colour	% of standard liquor colour
Thick juice	100	1390	71
Wash syrup	2.2	1100	1.2
Intermediate sugar	26.9	1350	18.5
Affined after-product sugar	12.4	1460	9.2
Colour calculated from components		1380	
Colour measured in standard liquor		1520	
Colour in first product massecuite		1520	
White sugar		20	

Quantities refer to 100 dry substance in thick juice and are calculated from the vacuum pan house material balances

Table V. Course of colour, SO_2 and ash

Component	ICUMSA colour	SO_2, mg/100g DS	Ash, g/100g DS
Thin juice after sulphitation	1420	102.1	2.62
Evaporator juice, body 1	1470	77.6	2.45
" 2	1420	88.4	2.40
" 3	1350	101.8	2.40
" 4			
" 5	1390	93.4	2.40
Standard liquor:			
before filtration	1520	69.2	2.15
after filtration	1540	67.6	2.14
White pans intake	1520	70.0	2.14
White pans massecuite	1630	60.0	2.13
White sugar	20	0.67	0.011
Green syrup	3630	120.6	4.31
Wash syrup	1100	41.2	1.45
Intermediate:massecuite	3820	77.4	4.69
sugar	1350	10.3	1.22
syrup	8010	117.8	8.02
Affination magma	5970	55.8	4.29
Affined sugar	1460	4.0	0.949
Affination syrup	11800	83.4	7.45
After-product massecuite	13770	73.9	8.15
After-product sugar	7970	28.1	3.33
Molasses	23770	89.2	11.18

Colour inside the white sugar crystals

To determine the colour included in the sugars, we applied affination with sugar solutions of varying degrees of undersaturation. The sugar used for affination had a colour coefficient of 10 ICUMSA units and an ash content of 0.001%.

The procedure of the test is given in Appendix 1. Table VI gives some results. In this case (24.5 - 18.3)/24.5 × 100% = 25% of the colour was located on the surface of the crystals. 75% of the colour was distributed more or less evenly throughout the crystal. According to Mantovani *et al.* there is a preferential inclusion of colour on the fast-growing crystal surfaces. Observing crystal growth under the microscope (we refer to the work of Powers[5] and Mantovani *et al.*[6]), we see that irregularities in the

5 *Sugar Technol. Reviews*, 1969/70, 1, 85 - 190.
6 *Paper presented to the 23rd IGen. Meeting A.S.S.B.T.*, 1985.

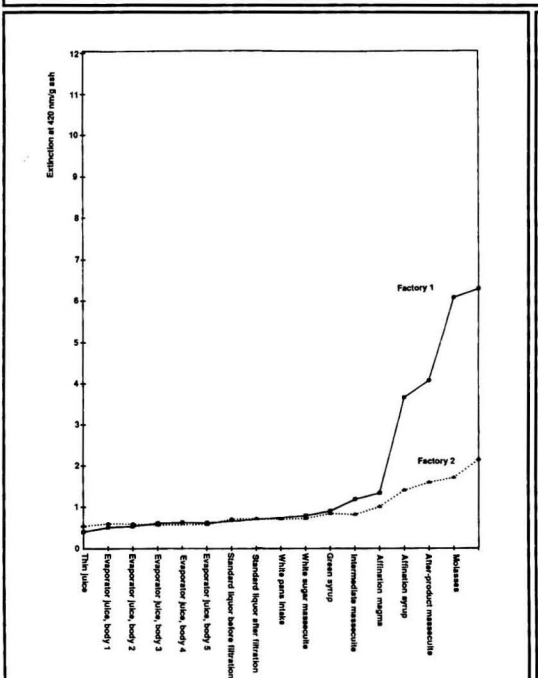

Fig. 5. Course of colour from thin juice to molasses

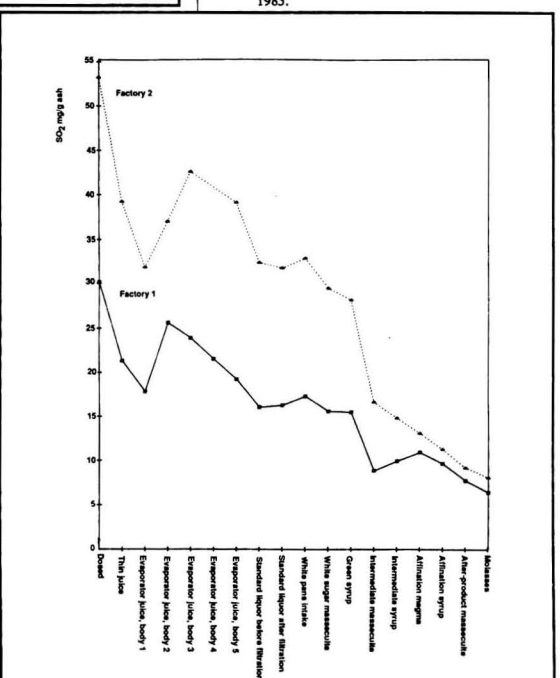

Fig. 6. Course of SO_2 from thin juice to molasses

Table VI. Location of colour and ash in the crystals

% of sugar dissolved	ICUMSA colour after affination	Ash content after affination
0 (no a	24.5	7.3×10^{-3}
0.9	18.3	3.4
70.1	19.2	2.9
96.4	28.4	3.7

crystals are covered by the crystallizing layer of sucrose. Droplets of mother liquor are captured in the crystals.

There is, however, also diffusion of non-sugars from the droplets and the surfaces of the growing crystals into the surrounding mother liquor. So it is possible that diffusion phenomena cause some selectivity in the occlusion of non-sugars. Components with relatively low mobilities are unable to leave the surfaces of the droplets before they are captured in the growing crystals. This is a possible explanation for the fact which was observed by Professor Mantovani that colour inclusions go together with high crystal growth rates. There is an increase of colour around the nucleus of the crystals, indicating occlusions incorporated in the period during or shortly after the seeding. The influence on the total colour of the sugar is not important as it relates to no more than 4% of the sugar. 53% of the ash is located on the surface. There is a slight increase in ash content around the kernel of the crystals. Figure 7 records the extinction coefficients as a function of the % dissolved sugar; it relates to a sugar with a rather high initial colour.

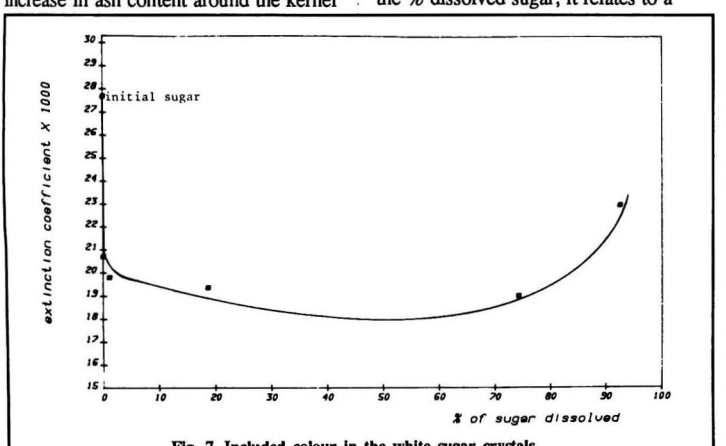

Fig. 7. Included colour in the white sugar crystals

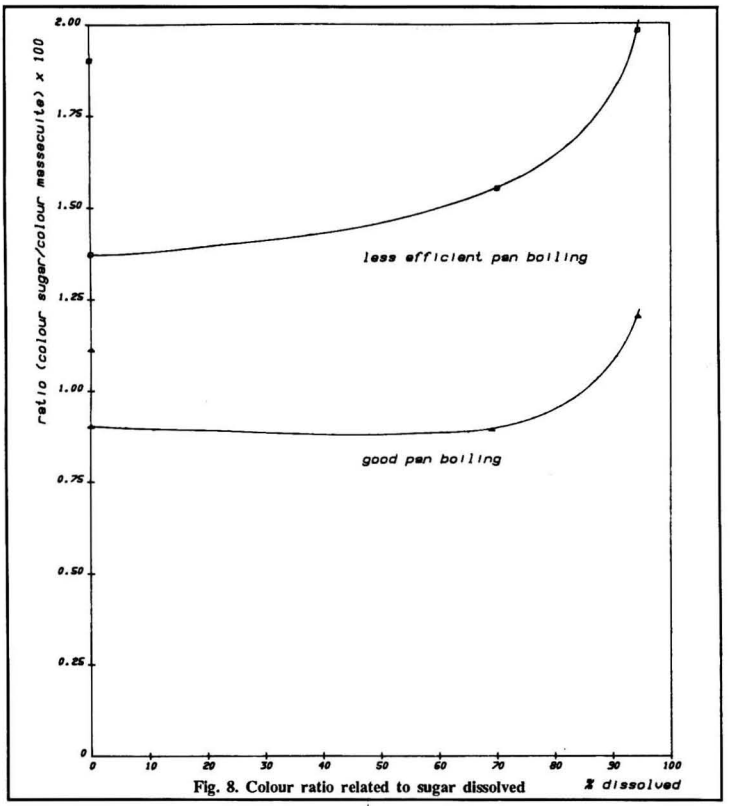

Fig. 8. Colour ratio related to sugar dissolved

Figure 8 gives the ratio of colour in sugar to colour in massecuite as a function of the percentage of sugar dissolved during the affination. We give the figures for good and less efficient pan boiling.

Colour in intermediate sugar crystals

With the same procedure as for white pans, we determined the occluded colour in intermediate sugars. We compared shock seeding and seeding with after-product sugar. Table VII records the data.

We observe as in the white sugar an increased colour in the kernel of the crystals. With the affined after-product sugar we find an increase in included colours. More than 80% of the colour is on the surface of the crystals.

Table VII. Colour in intermediate sugars

Seeding	% of sugar dissolved	ICUMSA colour
Shock seeding		
	0	640
	(no affination)	
	1.2	50
	3.6	50
	90.5	80
A. P. sugar seeding		
	0	700
	(no affination)	
	2	90
	4.1	90
	92.3	190

In Figure 9 we record the results of a series of affiniation experiments with intermediate sugar. We give the ratio (colour in sugar/colour in massecuite) × 100. With the normal shock seeding we find a ratio slightly above 1%.

In the experiments with after-product sugar as seeding material we find the seed crystals with higher colours. The colour of this seed magma relates to the colour of the after-product massecuite from which it was boiled. These experiments confirm our results in first product boiling, where we found a linear relationship between the occluded colour in the crystals and the colour of the massecuite.

Appendix 1

Occluded colour in white sugar

The sugar is dissolved in parts by affination with sugar solutions of varying degrees of undersaturation. The variation in undersaturation is obtained by dilution of a saturated solution with weighed amounts of water. Syrup and crystals are separated in a laboratory centrifugal. The sugar is dried in a dessicator and colour as well as ash are determined. The percentage of dissolved sugar is calculated from the increase in Brix of the syrup.

Procedure

Prepare approx. 3 litres of saturated sugar solution at ambient temperature. The conditions for the affination are given below.

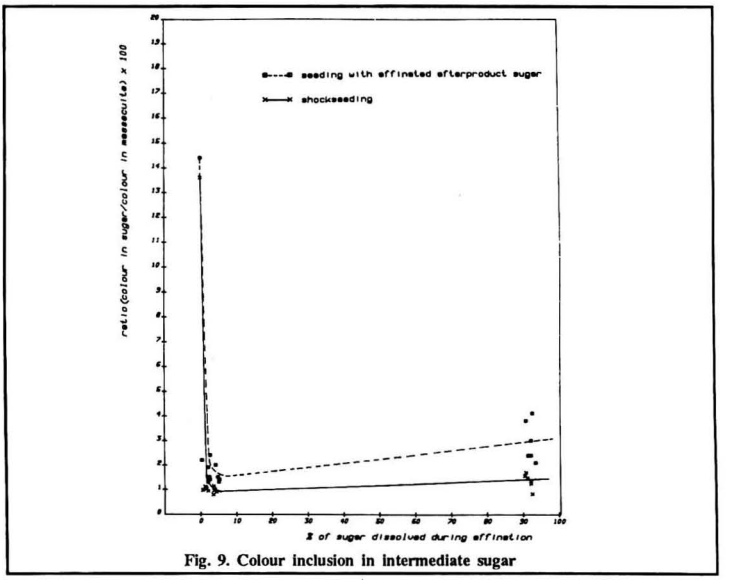

Fig. 9. Colour inclusion in intermediate sugar

grams sugar	grams saturated solution	grams water	% of crystals dissolved (approx)
0	0	0	0 (original)
50	50	0	0
50	50	0.2	0.8
50	50	0.6	2.7
50	50	4.5	18
150	50	55	73
500	50	238	95

Weigh in a 500 ml jar the desired amount of saturated sugar solution (weight C), add the given quantity of water (weight D) and, shake well to homogenize. Add the given quantity of sugar (weight B), shake for 30 minutes, and determine the refractometric Brix of the supernatant syrup (F) as well as the Brix of the saturated sugar solution (A). Separate sugar and syrup in a laboratory centrifugal, mingle the sugar once more with saturated solution, centrifuge again and dry the sugar in a dessicator. Determine the colour and conductivity ash in the sugar.

Calculations

(A × C) /(C + D) = Brix of the solution before affination (G).
If the amount of sugar dissolved = X, the balance becomes:
(C + D + X) F = (C + D) G + 100X
(C + D) (F - G) = (100 - F)X
X = (C + D) (F - G) / (100 - F), and
100X/B = % of sugar dissolved.

Summary

Colour elimination in the centrifugals depends on the amount of wash water and the quality of the crystals. On application of a maximal amount of wash water we find for each factory a relationship between the colour of white sugar and the colour of massecuite. The ratio (colour in sugar/colour in massecuite) × 100 is about 0.8% for good quality crystals. Colour balances are presented for first product massecuites as well as the course of "colour" and SO_2 throughout the factory from thin juice to molasses. To determine colour inside the crystals, an affination test was developed in which a part of the sugar is dissolved. 25% of the colour was located at the surface of the white sugar crystals and there is a greater amount of colour in the final 5% of the sugar. Intermediate sugar boiled on after-product sugar as seeding material showed more included colour by comparison with sugar boiled by shock seeding.

CITS 18th General Assembly, 1987

During the 18th General Assembly of the Commission International Technique de Sucrerie, to be held in Ferrara, Italy, during June 8 - 12, 1987, the following papers are to be presented and discussed. There will be simultaneous interpretation in the three languages of the Commission.

1. Cronewitz: "Eigenschaften der Gerüstsubstanz der Schnitzel bei der mechanischen Entwässerung und daraus resultierende Möglichkeiten zur Weiterentwicklung von Schnitzelpressen"

2. Valentin: "Die thermische Entwässerung von Schnitzeln in einem grosstechnischen Dampftrockner"

3. Witte: "Wärmedurchgang Verweilzeitverhalten und Farbbildung in Verdampferanlagen"

4. Genie: "Analogue computer simulation of diffusion – Conclusions"

5. Jensen, Borreskov, Dinesen and Madsen: "Beet pulp drying in superheated steam under pressure"

6. Clarke, Tsang, Roberts and Godshall: "Cane sugar colorants in processing operations"

7. Maurandi, Mantovani, Vaccari and Rossi: "Kinetics and technology of low boiling massecuites exhaustion"

8. Lescure and Bourlet: "Incidence des adjuvants de surpressage sur le bilan ionique de la sucrerie"

9. Giorgi and Giraud: "Automatisation de l'évaporation"

10. Hangyal, Paradi and Bara: "Einfluss einiger Parameter auf die Zuckerzerstörung und Farbbildung im Zuckerhaus"

11. Bara, Hangyal and Vukov: "Adsorptive Entfernung einiger Farbstoffe mittels Kalziumkarbonat im Zuckerhaus"

12. Hangyal, Gryllus and Bara: "Neuere Untersuchungen über die Wirkung der Zusammensetzung von Extraktionswasser auf die Zuckerausbeute"

13. Pollach and Hollaus: "Versuche zur Stimulierung monosaccharidabbauender Infektionen in der Extraktion zwecks Verbesserung der Schnitzelabpressung"

14. Klaushofer: "*Clostridium thermohydrosulfuricum*, ehemals bekämpft, bald genutzt"

15. Schoenrock: "The development and application of continuous ion exclusion"

16. de Bruijn, Kieboom, van Bekkum and van der Poel: "Reactions of monosaccharides in aqueous alkaline solutions"

17. Schliephake: "Kristallaggregatbildung aus voragglomerierten Strukturen"

18. Huisman, Peters, de Nie and van der Poel: "Odour emission and control in the Dutch sugar industry"

19. Degeest and Debroux: "Historiques du contrôle de l'état sanitaire de la diffusion RT"

20. Austmeyer: "Ueber die verfahrenstechnischen Grundlagen der mechanischen Schnitzelentwässerung"

21. Buchholz: "Alternative Verwertung extrahierter Rübenschnitzel – Entwicklungsarbeiten zur Biogasgewinnung im technischen Massstab"

22. Vukov and Barta: "Zuckerhirse als Zuckerrohstoff in Ungarn"

23. Vaccari, Mantovani and Sgualdino: "Bisulphites in diffusion plants as sterilizers, pulp pressing aids and decolorizing agents"

24. Mantovani, Vaccari and Sgualdino: "Sucrose crystallization and colour inclusions"

25. Accorsi *et al.*: "Einfluss verschiedener Zusatzstoffe auf die Farbbildung"

26. Accorsi *et al.*: "Presshilfsmittel bei Vorauslaugungsanlagen"

27. Broughton, Sargent, Houghton and Sissons: "The inclusion of colour and ash components in UK beet white sugars"

28. Christodoulou, Hadjantoniou and Zountsas: "The influence of alpha-amino-nitrogen, K and Na on colour formation in thin juice from Greek sugar beets"

29. Tjebbes: "Process influences on the properties of exhausted cossettes"

30. Sapronov, Tuzhilkin, Sorokin and Lysyuk: "Optimisation des procédés de cristallisation de masse-cuite au cours de refroidissement"

31. Sapronov and Karagodin: "Optimization of the sugar crystallization process in vacuum pans on the basis of the mathematical model-using computer technique"

32. Pouillaude, Ternynck and Boymarcotte: "Séchage de la pulpe de betterave à la vapeur surchauffée avec recompression mécanique de vapeur. Procédé Bertin G.T.S.-Béghin Say"

33. Pouillaude and Vetter: "Hyperpressage des cossettes de betteraves"

34. Zaorska: "Corrected sugar content of beets remaining in soil some days after topping"

35. Salgado, Lebert, Guerin and Plever: "Drying and sorption isotherms of sugar beet pulp"

A special program is arranged for the ladies, including a visit to Venice and Bologna, while on Friday June 12, the program includes a visit to a modern Italian beet sugar factory. There is no registration fee for either participants or their guests, but those intending to take part in the Assembly should write to CITS Ferrara 1987, c/o A.N.T.Z.A., Via Tito Speri 5, I-44100 Ferrara, Italy. Requests for hotel accomodation should be made through CTV/CIT Centro Turismo Viaggi, Via Borgo dei Leoni 33/35, I-44100 Ferrara, Italy.

Facts and figures

New ISO Executive Director

The Executive Committee of the International Sugar Organization has agreed to propose to members a new Executive Director, whose appointment, by a postal vote, is considered to be foregone conclusion. He is Sr. Alfredo Ricart, Ambassador of the Dominican Republic to the United Nations Conference on Trade and Development, and he is likely to take up the new appointment with effect from April 15.

Honduras alcohol project[1]

Honduran sugar producers are considering construction of two plants for the manufacture of alcohol to be used as motor fuel. The cost of the plants would be around $5 million each and the project, prompted by the difficulties sugar producers encounter in placing their output in the international market, has met with government interest because it would allow the reduction of Honduras' energy expenditures.

Fiji sugar production, 1986[2]

The Fiji Sugar Corporation completed its 1986 crushing season with a record sugar output of 501,800 tonnes, tel quel, from a cane harvest of 4,109,000 tonnes. The previous highest output was 486,679 tonnes of sugar achieved in 1982.

1 *Amerop-Westway Newsletter*, 1987, (158), 12.
2 *Czarnikow Sugar Review*, 1987, (1757), 13.

US sugar imports and exports, 1986[3]

	tonnes
IMPORTS	
Raw sugar	
Argentina	51,242
Australia	98,048
Belize	51,192
Bolivia	6,142
Brazil	203,908
China	18,681
Colombia	116,313
Costa Rica	65,145
Dominican Republic	282,385
Ecuador	17,223
Fiji	14,490
Guatemala	120,215
Guyana	18,684
Honduras	28,985
Ivory Coast	11,247
Jamaica	5,258
Madagascar	11,282
Mauritius	27,447
Mexico	103,566
Mozambique	20,131
Panama	33,562
Papua New Guinea	11,157
Paraguay	10,574
Peru	52,246
Philippines	212,969
St. Kitts	2,981
El Salvador	42,849
South Africa	35,124
Swaziland	25,057
Thailand	21,793
Trinidad	11,460
Uruguay	11,074
Zimbabwe	18,676
Other countries	71,276
Total raw sugar	1,832,382
White sugar	
Canada	12,078
Dominican Republic	4,748
Other countries	1,207
Total white sugar	18,033
EXPORTS	
Raw sugar	
Canada	781
Other countries	518
Total raw sugar	1,299
White sugar	
Bahamas	7,807
Canada	69,736
Chile	6,245
Dutch West Indies	5,000
Haiti	20,630
Iraq	86,213
Jamaica	32,425
Jordan	11,000
Peru	114,816
Saudi Arabia	1,315
Somalia	11,500
Turkey	41,524
Other countries	49,373
Total white sugar	457,584

SIT Annual Meeting, 1987

The 46th Annual Technical Meeting of Sugar Industry Technologists Inc. is to be held during May 10 - 13, 1987, in Sydney, Australia. A pre-conference tour has been arranged for May 4 - 10 which includes visits to Meringa Sugar Experiment Station, the Mourilyan bulk sugar terminal, cane breeding facilities at Macknade Mill, a cane planting demonstration, the Lucinda Point bulk sugar terminal, Victoria Mill, and relaxation at Great Barrier Reef Island resort. A shorter post-conference tour includes visits to the Meringa Station and Mourilyan bulk terminal and a one night stay at the resort. CSR Ltd., hosts for the Meeting, will show members over the Pyrmont refinery in Sydney and have also arranged transportation to their Chelsea refinery in Auckland, New Zealand, although this is not part of the official program.

For reservations and further details, write or telephone the Executive Director of SIT, Mr. R. Stuart Patterson, at P.O. Box 2067, Martinez, California 94553, USA (Phone: +1-415-682-4646).

International sugar technology conference in Poland

The Association of Sugar Industry Technicians in Poland has announced that an international techno-scientific sugar industry conference is to be held during May 21 - 23, 1987 in Warsaw. It will be devoted to improvements in beet sugar production and the main themes will be improvement of sugar production process technology, modern sugar factory equipment design, and rationalization of sugar factory thermal economics. The address of the Association is H. Dabrowski Place 3, 00-057 Warsaw, Poland (Telephone 26-98-27; Telex 813676 pl).

Pakistan bagasse paper factory

On February 5, the President of Pakistan laid the foundation stone for the third paper project to be incorporated with a sugar factory. The new plant is Kamalia Paper Mills Ltd., a sister concern of Kamalia Sugar Mills Ltd., Kamalia, and is expected to produce 66,000 tonnes a year of writing and printing paper. 90% of the raw material will be bagasse from Kamalia sugar factory and from Pattoki Sugar Mills Ltd. which is also owned by the Punjab Industrial Development Board, of Lahore. Pakistan currently produces about 34,000 tonnes of paper against an actual requirement of 80,000 tonnes/annum so that the new project should make the country self-sufficient.

Finland sugar production, 1986/87[4]

The three beet sugar factories in Finland sliced a total of 609,140 tonnes of beet during a 59-day campaign to yield 63,993 tonnes of white sugar and 20,802 tonnes of raw sugar.

Drought in Australia[5]

The 1987 cane crop in Australia is under severe stress owing to lack of rain since early December along almost the entire Queensland coast. Unseasonable light rain fell in the last week of January but soil moisture is still inadequate for normal growth.

Jamaica bulk loading facility[6]

It is reported that construction of a new bulk loading port at Rocky Point, south of Monymusk, is in the contracting phase. The West German government conducted the feasibility study for the port facility. Storage capacity at the site is projected to be 85,000 tonnes. The facility is expected to begin receiving sugar during the 1988 harvest from the New Yarmouth, Monymusk, Worthy Park and Frome sugar factories.

ISO Council meeting on its budget

A special session of the International Sugar Council has been called by the USSR, backed by East Germany, over the ISO administrative budget for 1987. This followed the notification by the USA that it intended to reduce its contribution to the budget by 44% from $160,000 to nearly $90,000. The USSR is reported to have proposed a restructuring of all budget contributions. According to some industry observers[7], the reduction by the US is another action which undermines the United States' credibility as a concerned participant in the world sugar market. Yet other observers believe such international commodity agreements inevitably fail, so why waste time and money on them? This view would, of course, be a rationale for scrapping the contribution and membership of the ISO altogether, but not of reducing it partially.

French record white sugar store[8]

The largest white sugar store in the world went into operation at Sillery sugar factory in November last. It has a capacity of 120,000 tonnes, including 80,000 tonnes from the Sillery factory and further 40,000 tonnes which will come from another Beghin-Say factory at Châlons-sur-Marne, 30 km away. The store cost 46 million francs (£5 million) and was completed within a year.

Dutch sugar factory closure[9]

Owing to restriction of sugar production in Holland, CSM Suiker B.V. is to close its factory at Sas van Gent, near the Belgian border.

3 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, S72 - S73.
4 *Zuckerind.*, 1987, **112**, 79.
5 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 70.
6 *Amerop-Westway Newsletter*, 1987, (158), 13.
7 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 38 - 39.
8 *Zuckerind.*, 1987, **112**, 80.
9 F. O. Licht, *Int. Sugar Rpt.*, 1987, **119**, 53.

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Please help us by answering questions in one of the four languages provided. Send by **air mail** to P.O. Box 26, Port Talbot, United Kingdom. Every reply received by August 15, 1987 will take part in a prize draw. The winner will receive a voucher for $300 exchangeable at any time for books from our Book Department or subscriptions to any of our publications.

Thank you for your time — it will help us give you a better magazine.

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2. Do you read ISJ every month ☐ often ☐ sometimes ☐ never ☐

3. How many other sugar magazines do you read regularly ☐

4. List these magazines and score each magazine, including ISJ, 0 - 10 for their importance. (0 - low, 10 - high).

Magazine	Score	Magazine	Score
1. International Sugar Journal		4.	
2.		5.	
3.		6.	

5. How useful (0 - 10) is ISJ to you as a source of information about:
   (a) science and technology ☐
   (b) new equipment ☐
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6. Do you keep old copies of ISJ for reference? (yes/no) ☐

7. How many people, including yourself, read your copy of ISJ? ☐

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Eg. Automobiles: Ford, Toyota, Sony, Fiat, Boeing, Volkswagen.

(1) Process chemicals: AC Biotechnics/Buckman/Dorr-Oliver/Hodag/Mazer/Miles Laboratories/Tate & Lyle
(ii) Centrifugals: ASEA/BMA/Broadbent/Hein Lehmann/Pieralisi/Silver Engineering/Walkers/Western States
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(vi) Conveyors: Ewart/Link-Belt/Renold/Rexnord/Salzgitter/Tate & Lyle/Webster
(vii) Steam turbines: DDS/Dresser-Rand/Elliot/KKK/Murray/Siemens/Terry
(viii) Valves: Amri/Omel/Saunders/Siemens/Silver/Stockham
(ix) Pulp presses: BMA/Fletcher & Stewart/Krupp/Salzgitter/Smith Mirrlees/Stord/Stork-Werkspoor
(x) Beet slicing equipment: AC Biotechnics/Bosco/Cocksedge/DDS/Maguin/Putsch
(xi) Cane mills: Dedini/Fives Cail Babcock/Goninan/Hitachi/Industria del Hierro/Smith Mirrlees
(xii) Gears/Drives: Falk/Flender/Fletcher &Stewart/Lufkin/Philadelphia Gear/Precision Chain
(xiii) Screens: Akzo/Balco/Buckbee Mears/Ferguson/Fontaine/Krieg & Zivy/Veco
(xiv) Chains: Ewart/Koch/Link-Belt/Renold/Rexnord/Sedis/Webster

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Merci — ceci nous permettra de vous presenter une meilleure revue.

1. Depuis combien d'années êtes vous lecteur de ISJ? ☐

2. Lisez vous ISJ chaque mois ☐ souvent ☐ quelques fois ☐ jamais ☐

3. Combien d'autre revues sucrières lisez vous regulièrement ☐

4. Citez ces revues, et notez chaque revue y compris ISJ de 0 - 10 par importance (0 bas, 10 haut).

Revue	Importance	Revue	Importance
1. International Sugar Journal		4.	
2.		5.	
3.		6.	

5. De quelle utilité (0 - 10) est ISJ pour vous en ce qui concerne l'information et les renseignements pour:
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   Exemple: Automobiles; Ford, Toyota, Sony, Fiat, Boeing, Volkswagen.

(i) Chimiques de procès: AC Biotechnics/Buckman/Dorr-Oliver/Hodag/Mazer/Miles Laboratories/Tate & Lyle
(ii) Essoreuses: ASEA/BMA/Broadbent/Hein Lehmann/Pieralisi/Silver Engineering/Walkers/Western States
(iii) Pompes: Alfa Laval/Crane Deming/Fabcon/Netzsch/Pompes Delasco/Sigmund/Sulzer Delta
(iv) Filtres: Alfa Laval/CECA/Chemviron/Dorr Oliver/Larox/Manville/Sparkler
(v) Matériaux pour échange d'ions/décolorisantes: Abay/Akzo/Calgon/Dow/Graver/Illinois Water/Norit/Purolite
(vi) Transporteurs: Ewart/Link-Belt/Renold/Rexnord/Salzgitter/Tate & Lyle/Webster
(vii) Turbines à vapeur: DDS/Dresser-Rand/Elliott/KKK/Murray/Siemens/Terry
(viii) Robinetterie: Amri/Omel/Saunders/Siemens/Silver/Stockham
(ix) Presses à pulpe: BMA/Fletcher & Stewart/Krupp/Salzgitter/Smith Mirrlees/Stord/Stork-Werkspoor
(x) Coupe-racines: AC Biotechnics/Bosco/Cocksedge/DDS/Maguin/Putsch
(xi) Moulins à canne: Dedini/Fives Cail Babcock/Goninan/Hitachi/Industria del Hierro/Smith Mirrlees
(xii) Engrenages: Falk/Flender/Fletcher & Stewart/Lufkin/Philadelphia Gear/Precision Chain
(xiii) Tamis: Akzo/Balco/Buckbee Mears/Ferguson/Fontaine/Krieg & Zivy/Veco
(xiv) Chaines: Ewart/Koch/Link-Belt/Renold/Rexnord/Sedis/Webster

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Adresse: .....

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Premio de $300

ISJ Examen de Lectores

Por favor ayudenos dandanos las respuestas en las preguntas que les damos en una de cuatro linguas. Por favor retorne las contestaciones *por aereo* a P.O. Box 26, Port Talbot, Gran Bretaña. Cada contestación recibida antes de el 15 de agosto 1987, se pondrá en parte de una rifa. El ganador recibirá un billete por $300 que lo puede usar cuando quiere en cambio de libros en nuestra libreria o subscripciones en cualquier de nuestras revistas.

Gracias por su tiempo — que nos ayudara en darle una mejor revista.

1. ¿ Cuantos años a estado leyendo ISJ? ☐

2. Usted lee ISJ cada mes ☐ frecuente ☐ a veces ☐ nunca ☐

3. ¿ Cuantas otras revistas azucareras usted lee frecuente?

4. Liste estas revistas y dele una marca a cada una incluyendo ISJ 0 - 10 por su importancia (0 bajo, 10 alto).

Revista	Marca	Revista	Marca
1. International Sugar Journal		4.	
2.		5.	
3.		6.	

5. ¿ Cuanto utíl (0 - 10) le es ISJ para usted como fuente de informacion sobre:
   (a) la ciencia y tecnología? ☐
   (b) el nuevo equipo? ☐
   (c) las conferencias y reuniónes? ☐
   (d) El comercio azucarero mundial en general? ☐

6. Guarda usted copias viejas de ISJ para referencia? ☐

7. Cuantas personas, incluyendo usted, leen su copia de ISJ? ☐

8. Cuantas personas son:
   Tecnólogos de fábrica/refinería ☐ Gerentes de fábrica/refinería ☐ Investigadorescientíficos ☐
   Consultantes ☐ Personal universitarío ☐ Personal de gobierno ☐ Otros ☐

9. Mire esta lista de equipos y nombres de suministradores. Usando *solo su memoria* subraya (en cada categoria) de nombres cuales entre esas en la lista usted considere los más importantes suministradores para la industria azucarera. También circule los nombres *hasta dos* de otros suministradores importantes (no más de dos). No mencione otros nombres, aunque usted crea que hay otros suministradores más importantes que en la lista.
   e.g. automoviles: Ford, Toyota, Sony, Fiat, Boeing, Volkswagen

   (i) Químicos para proceso: AC Biotechnics/Buckman/Dorr-Oliver/Hodag/Mazer/Miles Laboratories/Tate & Lyle
   (ii) Centrífugas: ASEA/BMA/Broadbent/Hein Lehmann/Pieralisi/Silver Engineering/Walkers/Western States
   (iii) Bombas: Alfa Laval/Crane Deming/Fabcon/Netzsch/Pompes Delasco/Sigmund/Sulzer Delta
   (iv) Filtros: Alfa Laval/CECA/Chemviron/Dorr Oliver/Larox/Manville/Sparkler
   (v) Materias para cambio de iones/descolorizantes: Abay/Akzo/Calgon/Dow/Graver/Illinois Water/Norit/Purolite
   (vi) Transportadores: Ewart/Link-Belt/Renold/Rexnord/Salzgitter/Tate & Lyle/Webster
   (vii) Turbinas a vapor: DDS/Dresser-Rand/Elliott/KKK/Murrray/Siemens/Terry
   (viii) Válvulas: Amri/Omel/Saunders/Siemens/Silver/Stockham
   (ix) Prensas a pulpa: BMA/Fletcher & Stewart/Krupp/Salzgitter/Smith Mirrlees/Stord/Stork-Werkspoor
   (x) Máquinas para obtener cosetas: AC Biotechnics/Bosco/Cocksedge/DDS/Maguin/Putsch
   (xi) Molinos: Dedini/Fives Cail Babcock/Goninan/Hitachi/Industria del Hierro/Smith Mirrlees
   (xii) Engranajes, Accionamientos: Falk/Flender/Fletcher & Stewart/Lufkin/Philadelphia Gear/Precision Chain
   (xiii) Tamices: Akzo/Balco/Buckbee Mears/Ferguson/Fontaine/Krieg & Zivy/Veco
   (xiv) Cadenas: Ewart/Koch/Link-Belt/Renold/Rexnord/Sedis/Webster

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Umfrage über ISJ-Leserschaft

Bitte hilfen Sie uns durch Beantworten einiger Fragen in einer der gegebenen vier Sprachen und schicken Sie Ihre Antworten *mit Luftpost*, an: P.O. Box 26, Port Talbot, West Glamorgan SA13 1NX, U.K. Jeder ausgefüllte, bis zum 15. August 1987 empfangene Fragenbogen wird an einer Ziehung teilnehmen. Der Gewinner wird einen Gutschein bekommen, den er jederzeit gegen Bücher in Wert von $300 aus unserer Buchabteilung oder gegen Abonnemente irgendeiner unserer Veröffentlichungen austauschen kann.

Vielen Dank für Ihre Zeit – Ihre Mühe wird uns helfen, Ihnen eine bessere Zeitschrift zu geben.

1. Wieviel Jahre lesen Sie die ISJ? ☐

2. Lesen Sie die ISJ monatlich ☐ häufig ☐ manchmal ☐ nie ☐

3. Wieviel andere Zuckerzeitschriften lesen Sie regelmässig ☐

4. Geben Sie eine Liste dieser Zeitschriften und schätzen Sie die Wichtigkeit jeder Zeitschrift (einschliesslich die ISJ) im Bereich 0 - 10 (0 gering, 10 - hoch) ein.

Zeitschrift	Wichtigheit	Zeitschrift	Wichtigheit
1. International Sugar Journal		4.	
2.		5.	
3.		6.	

5. Wie nützlich (0 - 10) finden Sie die ISJ als Informationsquelle über:
   (a) Wissenschaft und Technologie ☐
   (b) neue Einrichtungen ☐
   (c) Konferenzen und Tagungen ☐
   (d) Weltzuckerhandel im allgemeinen ☐

6. Bewahren Sie alte Nummern der ISJ als Nachschlagewerke? (Ja/Nein) ☐

7. Wieviel Leute, mit Ihnen, lessen Ihr Exemplar der ISJ ☐

8. Wieviel aus dieser Leute sind:
   Fabrik- bzw. Raffinerietechnologen ☐ Fabrik- bzw. Raffinerieleiter ☐ Forscher ☐
   Berater ☐ Universitätspersonal ☐ Regierungsangestellte ☐ andere ☐

9. Schauen Sie an diese Liste von Einrichtungen und lieferanten. *Aus nur Ihrem eigenen Gedächtnis* unterstreichen Sie (in jeder Klasse) den Namen des Lieferants and die Zuckerindustrie (unter den eingeschriebenen), den Sie für den wichtigsten halten. Auch machen Sie einen Kreis um die Namen von *bis zu zwei* (aber nicht mehr) anderen wichtigen Lieferanten. Bitte schreiben Sie nicht Namen ein, auch wenn Sie glauben, dass es einen anderen Lieferant gibt, der mehr wichtig ist als die gegebenen.
   zB. Autos: Ford, (Toyota) Sony, Fiat, Boeing, (Volkswagen)

(i) Verfahrenschemikalien: AC Biotechnics/Buckman/Dorr-Oliver/Hodag/Mazer/Miles Laboratories/Tate & Lyle
(ii) Zentrifugen: ASEA/BMA/Broadbent/Hein Lehmann/Pieralisi/Silver Engineering/Walkers/Western States
(iii) Pumpen: Alfa Laval/Crane Deming/Fabcon/Netzsch/Pompes Delasco/Sigmund/Sulzer Delta
(iv) Filter: Alfa Laval/CECA/Chemviron/Dorr Oliver/Larox/Manville/Sparkler
(v) Ionenaustauschharze/Entfärber: Abay/Akzo/Calgon/Dow/Graver/Illinois Water/Norit/Purolite
(vi) Förderer: Ewart/Link-Belt/Renold/Rexnord/Salzgitter/Tate & Lyle/Webster
(vii) Dampfturbinen: DDS/Dresser-Rand/Elliott/KKK/Murray/Siemens/Terry
(viii) Ventile: Amri/Omel/Saunders/Siemens/Silver/Stockham
(ix) Schnitzelpressen: BMA/Fletcher & Stewart/Krupp/Salzgitter/Smith Mirrlees/Stord/Stork-Werkspoor
(x) Rübenschneider: AC Biotechnics/Bosco/Cocksedge/DDS/Maguin/Putsch
(xi) Zuckerrohrmuhlen: Dedini/Fives Cail Babcock/Goninan/Hitachi/Industria del Hierro/Smith Mirrlees
(xii) Getriebe/Antriebe: Falk/Flender/Fletcher & Stewart/Lufkin/Philadelphia Gear/Precision Chain
(xiii) Siebe: Akzo/Balco/Buckbee Mears/Ferguson/Fontaine/Krieg & Zivy/Veco
(xiv) Ketten: Ewart/Koch/Link-Belt/Renold/Rexnord/Sedis/Webster

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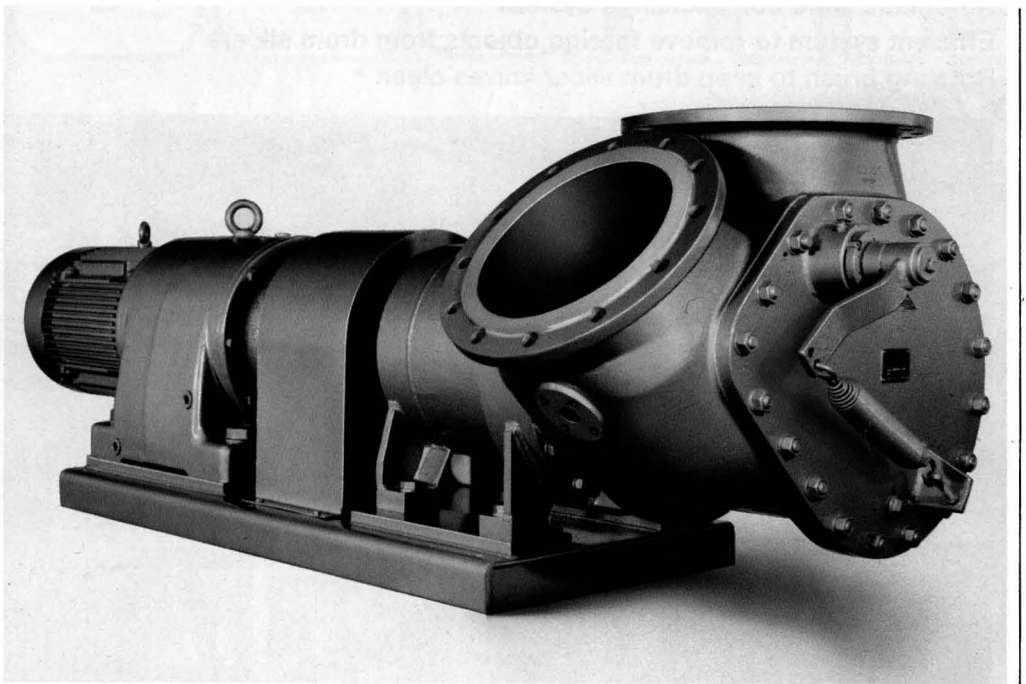
New magma pump for high throughputs



Our new magma pump F 800 F, supplemented by the F 500 F and the F 350 F for smaller capacities, has in a short period of time proven to be extremely successful.

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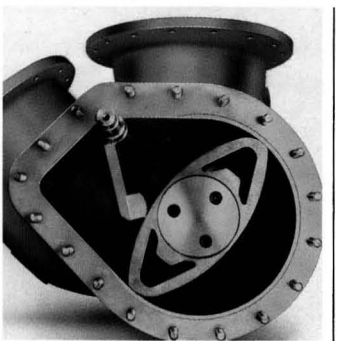

- ✳ clearance between seal and antifriction bearing housing protects the bearings and facilitates inspection
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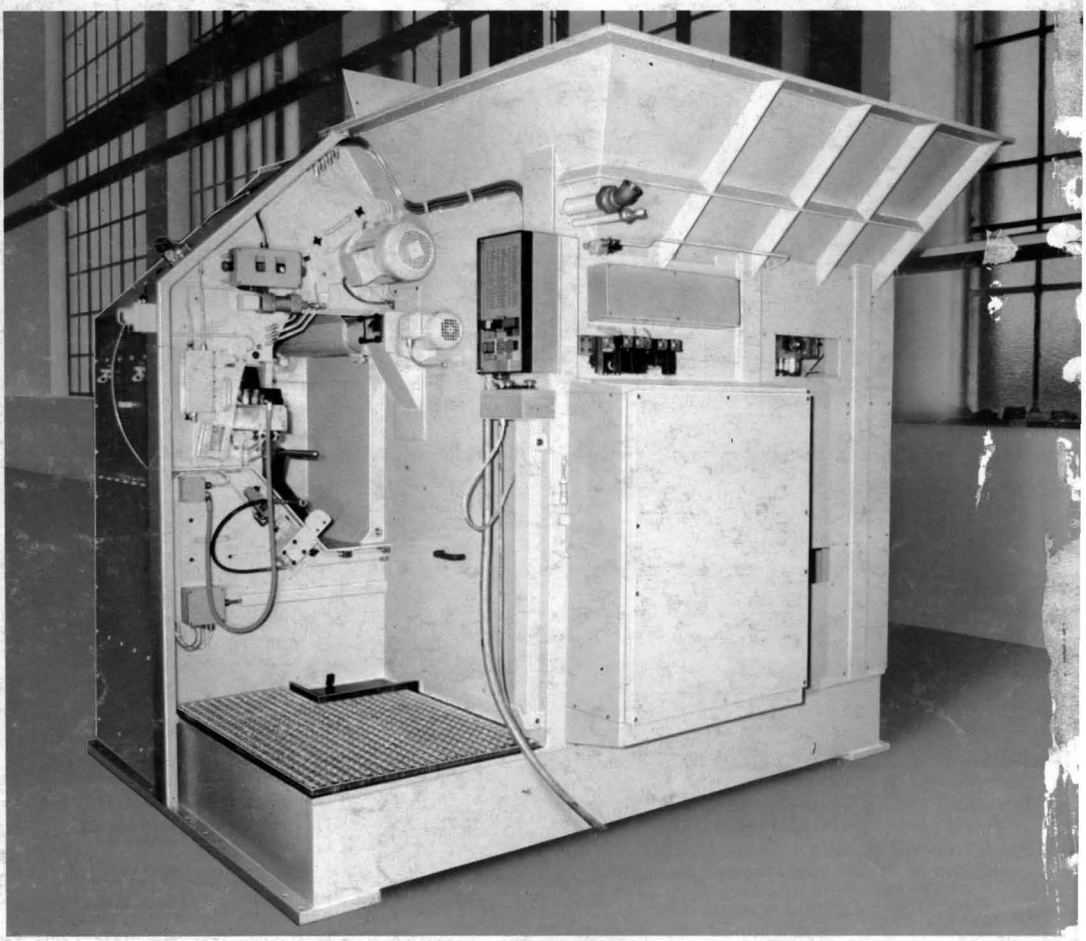

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