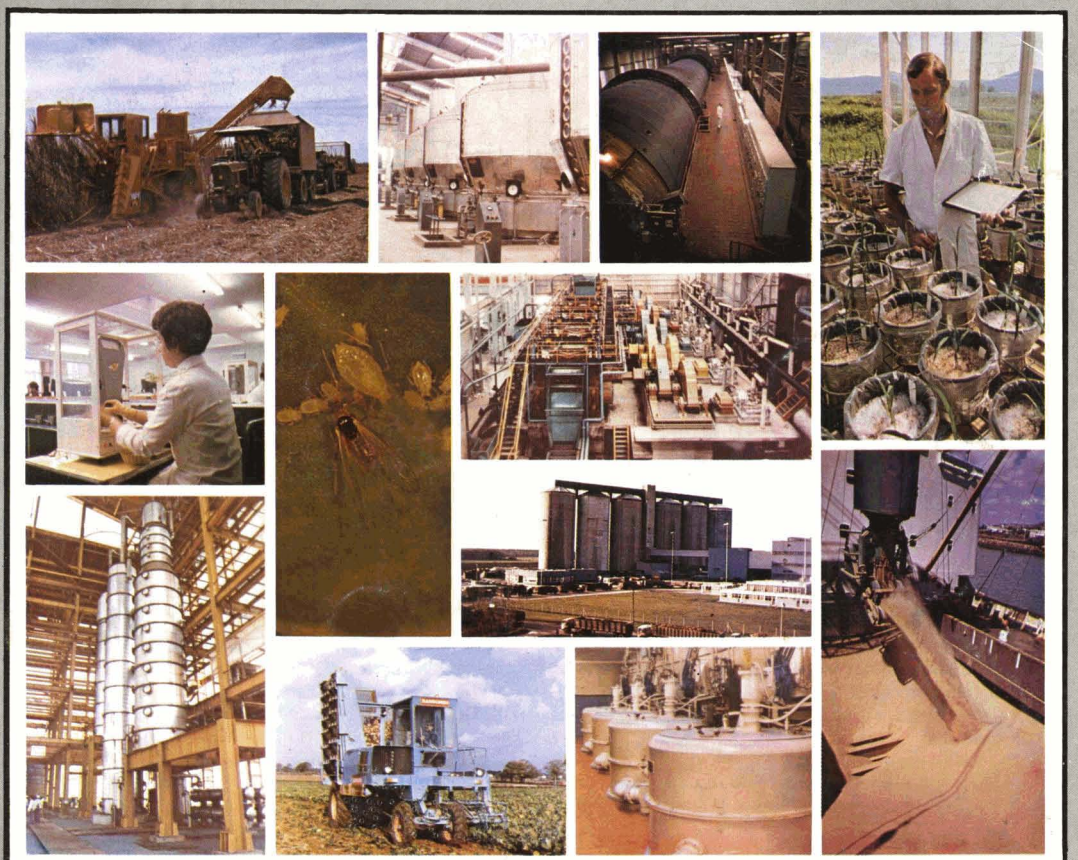
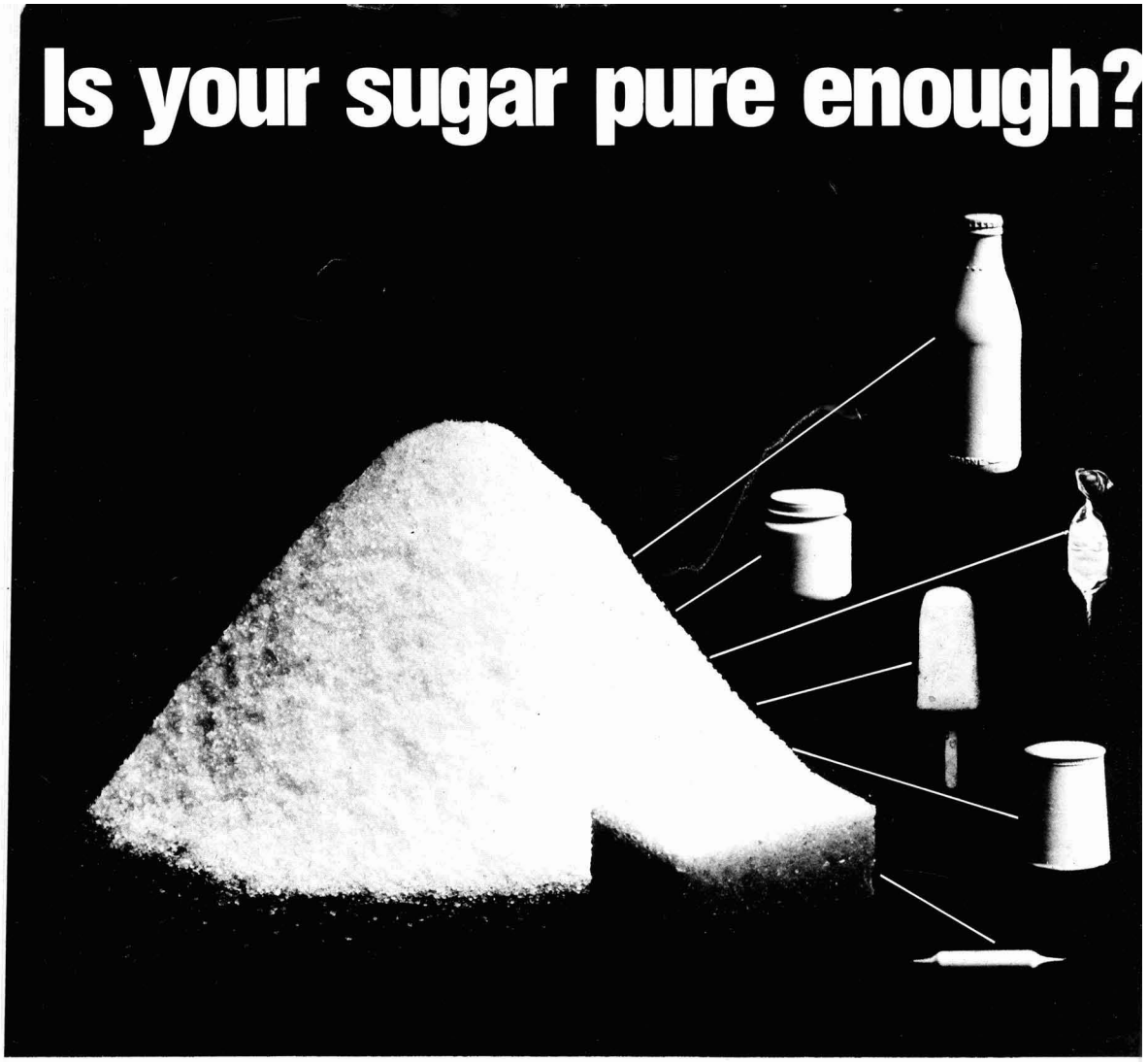
INTERNATIONAL SUGAR JOURNAL

VOLUME LXXXII
ISSUE No. 977



MAY 1980

Is your sugar pure enough?



The food and pharmaceutical industries set strict standards for purity. ANIOS can help you comply with the requirements of these important markets. Specialists in disinfection, especially in the fields of agriculture and food for over 100 years, the ANIOS laboratories are equipped with the latest research facilities.

In the sugar industry, ANIOS can deal with the treatment of the beets before the slicer, as well as the micro-biological control in the diffusers and raw juices, the preservation of the thick juices and run-offs, the sanitation of the centrifugals and the anti-algae treatment of the cooling water circuits.

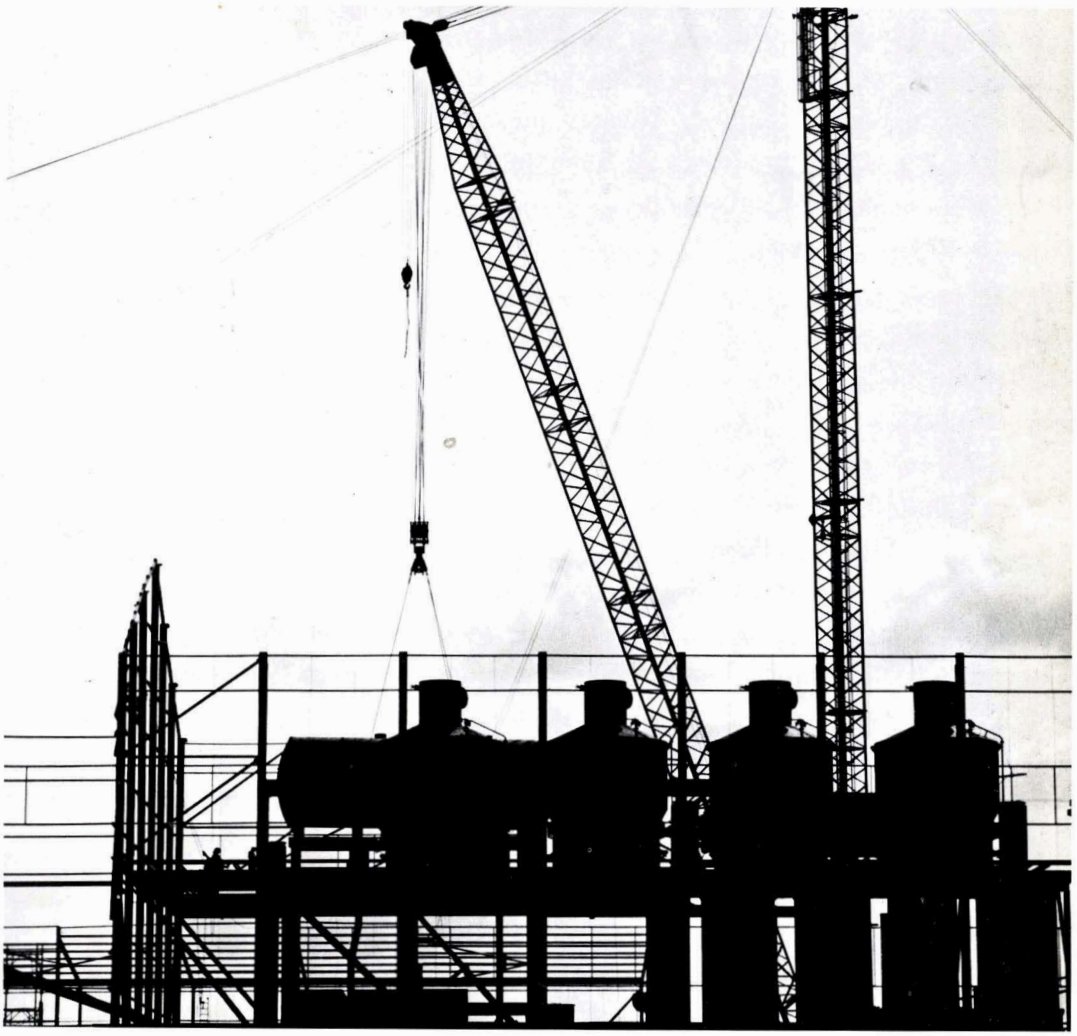
But ANIOS is, above all, another way of approaching problems with the benfit of a competent technical back-up and its ability to provide rapid service on an international scale.

princeps

ANIOS

46, rue de Soubise, 59100 Roubaix
Tel.: (20) 73.04.47. France.

There's more to it



A sugar plant is not created by design alone.
There's more to it.

There's planning and specification. Procurement, inspection and delivery.
And also civil works, erection and supervision.

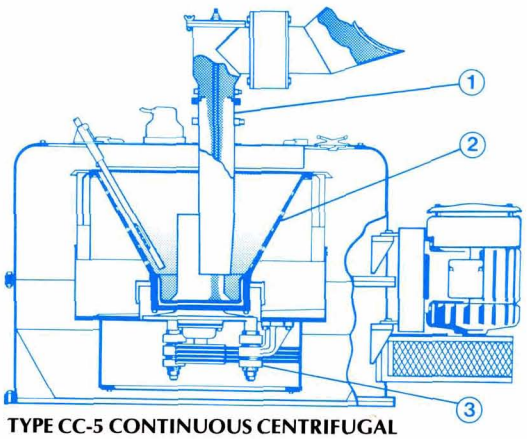
There's testing, commissioning and training of personnel.

And there's SWS to realize your plans.

STORK-WERKSPOOR SUGAR

sugar industry engineers Hengelo (Ov.) The Netherlands P.O.Box 147 Member of Vmf-Stork

Designed with high capacity in mind.



TYPE CC-5 CONTINUOUS CENTRIFUGAL

CAPACITY PLUS! It's designed and built into Western States Continuous Centrifugals.

Proven by extensive experience, the Type CC-5 feeding/pretreatment system **(1)** is the prime key to CAPACITY PLUS. The enclosed and directed feed stream insures a steady introduction of massecuite to the basket's loading bowl. The built-in arrangement for massecuite pretreatment provides the final lubricating and heating to obtain highest-quality products from even the most viscous massecuite encountered.

The Type CC-5 solid, cast stainless steel conical basket **(2)** is another key to CAPACITY PLUS. Efficient separation is the fundamental purpose of the continuous centrifugal and drainage holes from bottom to top of the CC-5 basket assure earliest possible elimination of molasses. Power input is thus more effectively used for higher production of product.

Smooth operation is provided by the tripod support system **(3)** incorporating adjustable rubber buffers for dampening vibration. This support system minimizes mechanical problems and enhances CAPACITY PLUS performance.

Get the entire money-making CAPACITY PLUS story today. Contact us or your local Western States representative and find out what the Western States Type CC-5 Continuous Centrifugal can do for you!

THE WESTERN STATES MACHINE COMPANY
Hamilton, Ohio 45012 U.S.A.
ROBERTS CENTRIFUGALS

capaci

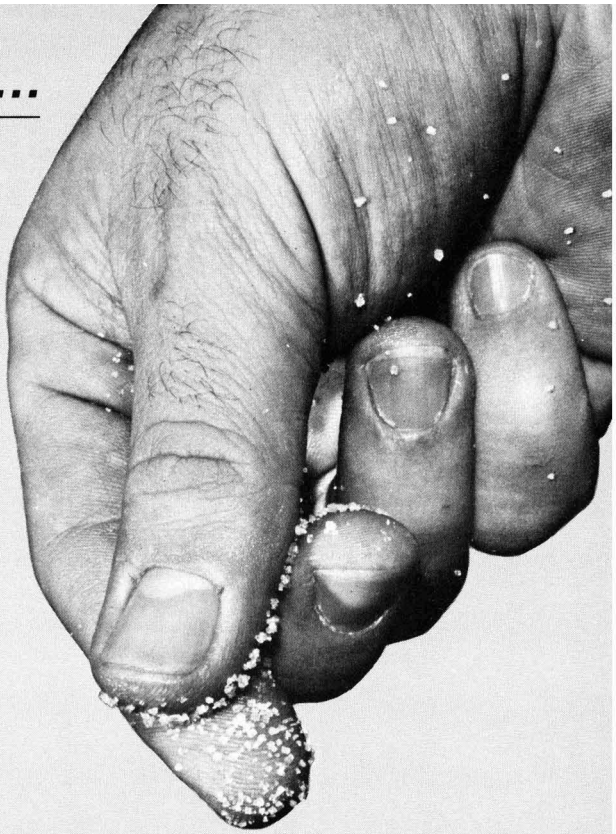
ty plus

Now More Than Ever...

Increase Sugar Recovery

Increase Pan Floor Output

With Hodag CB-6



Hodag CB-6, an easy-to-use additive, permits boiling pans to a higher brix and boiling of lower purity syrups. **Increased exhaustion of final molasses and recovery of more sugar is the result.**

A small amount of patented Hodag CB-6 makes possible greater processing capacity by increasing fluidity and circulation and reducing surface tension of syrups and massecuites.

Pan floor output is increased because boiling time is reduced—a vital improvement especially where pan or crystallizer capacity is limited.

CB-6 also helps overcome operating headaches caused by burnt, muddy, or delayed cane. It can keep your pan floor operating in spite of low purity, hard-to-boil syrups.

This product can improve the quality of your sugar—helps to achieve higher purity, lower ash, better color, and better filterability through more uniform crystal formation, better purging.

Why not benefit from the experience of factories and refineries throughout the world that use Hodag CB-6. Let a Hodag representative show you how to use CB-6 to improve your boiling house operation.

Send the coupon below for more information.

- ☐ Please have a Hodag representative contact me.
- ☐ Please send complete literature and case history data on Hodag CB-6.
- ☐ Send information on other Hodag products for the Sugar Industry.

Name _____

Title _____

Company _____

Address _____

City _____ State _____

Country _____

HODAG CHEMICAL CORPORATION / HODAG INTERNATIONAL S.A.
7247 North Central Park Ave., Skokie, Illinois 60076 U.S.A.
Telex: 72-4417

ETHREL®.

PLANT GROWTH REGULATOR

The management tool you fly on.

Get an earlier harvest. More sucrose. Increased brix and juice purity. And more.

ETHREL® plant growth regulator gives you a degree of control over your sugarcane harvest you never had before. It accelerates sugarcane ripening and increases sugar content up to 15%. It increases the sprouting of plant and ratoon cane, thereby increasing cane population and yields. And it lowers the content of reducing sugars.

By spraying some of your cane several weeks earlier than usual, you can start harvesting earlier. Then by stagger-spraying blocks of cane and harvesting in the same sequence, you can send an orderly flow of cane to the mill, reducing the mill load during peak periods. *Now, you are in charge.*

And you get a better product—improved juice purity with less molasses and better mill efficiency. More product too—more sugar per hectare.

Get the ethephon that's really a management tool. Get ETHREL ethephon plant growth regulator and take off for a better managed operation and higher profits.

ETHREL plant growth regulator should be used in accordance with label directions and only on those crops registered for use with ETHREL.

ETHREL is a registered trademark of Union Carbide Agricultural Products Company, Inc. for ethephon plant growth regulator.

Ethrel®

Helps nature help you.

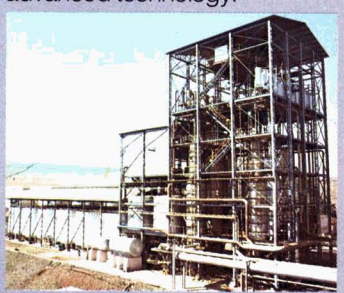
UNION CARBIDE

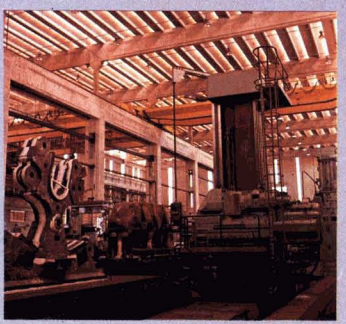
AGRICULTURAL PRODUCTS COMPANY, INC.
INTERNATIONAL DEPARTMENT
AMBLER, PA 19002 U.S.A.

SOLVE YOUR SUGAR AND ALCOHOL PROBLEMS WITH ONE WORD ONLY.

How to define the exact industrial equipment which was born from the best technology? How to solve replacement and servicing problems?

The answer is one word only: Dedini . Experience which for decades has assured expansion of the sugar and alcohol industries in Brazil, where sugar cane is planted over more than two million hectares. And always demands the most advanced technology.



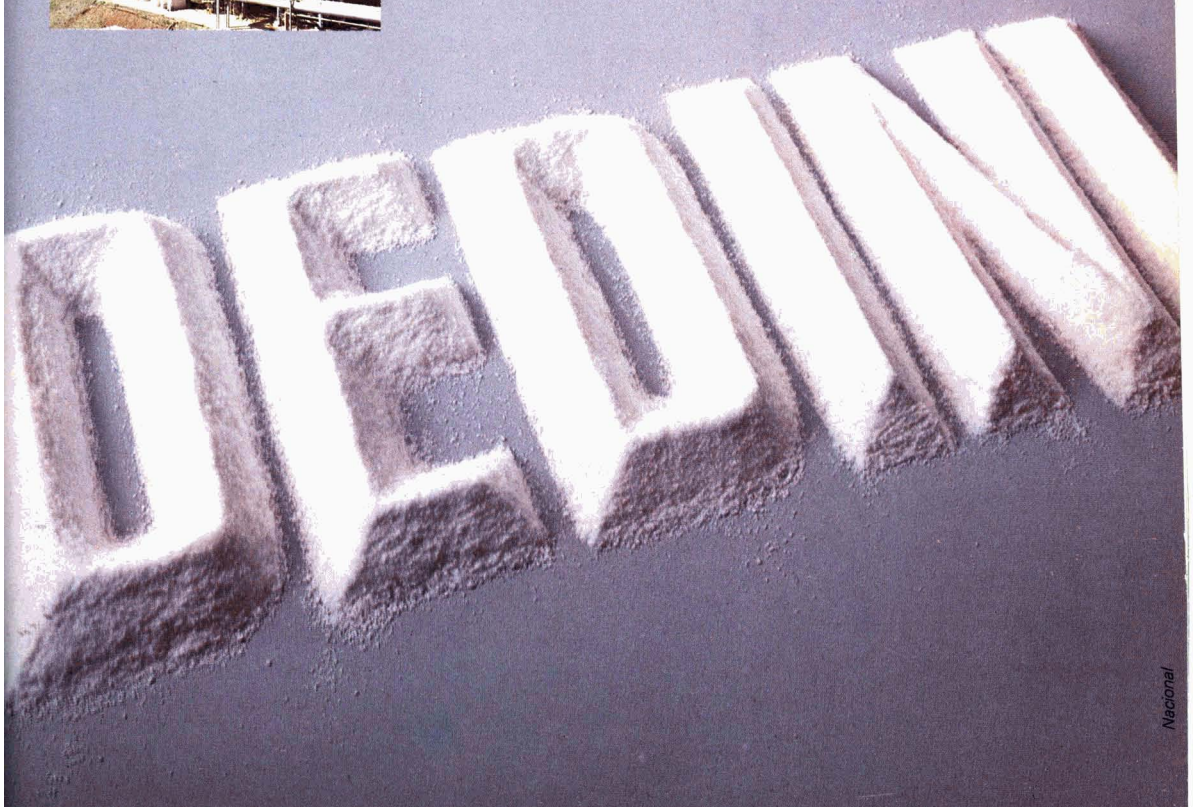


When you use Dedini experience, you obtain the last word in cane mills, steam turbines, speed reducers, boilers, heat exchangers, accessories, and a complete line for boiler shops. At the time of buying, Dedini simplifies financing procedures. When the need comes for replacement or servicing, Dedini supplies a quick answer by a specialized team.

In one word, do what most of Brazil, and an increasing number of international producers are doing: decide on Dedini. And discover the benefits of counting upon the same experience, from sugar to alcohol.

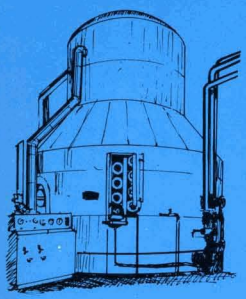
M.DEDINI S.A. METALÚRGICA

Avenida Mário Dedini, 201
Tel. (0194) 33-1122
Telex 0191032 MDMN
13.400 - Piracicaba
São Paulo - Brazil

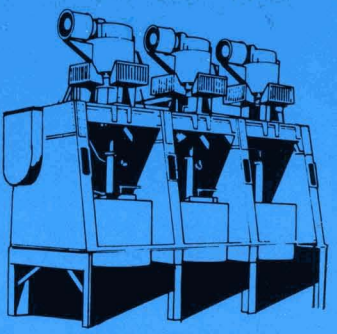


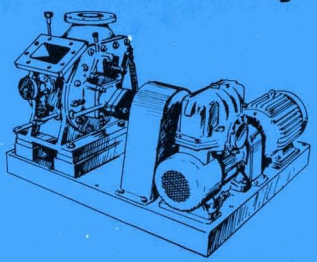
Nacional

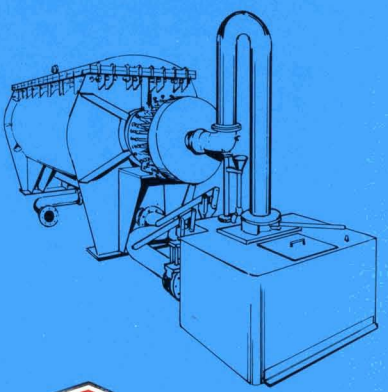
SMITH MIRRLEES



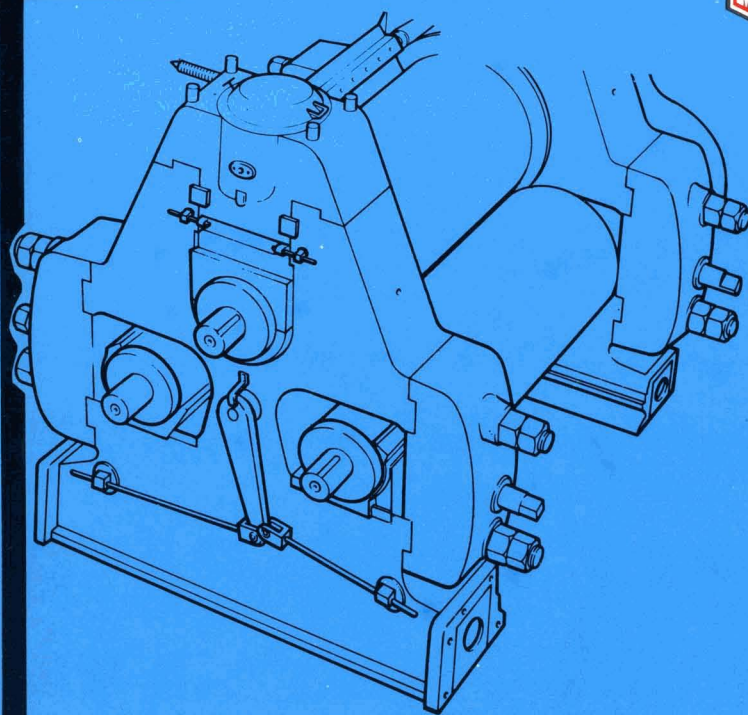
Offer you Over 140 Years' Experience in the Manufacture of Sugar Machinery







SMITH MIRRLEES

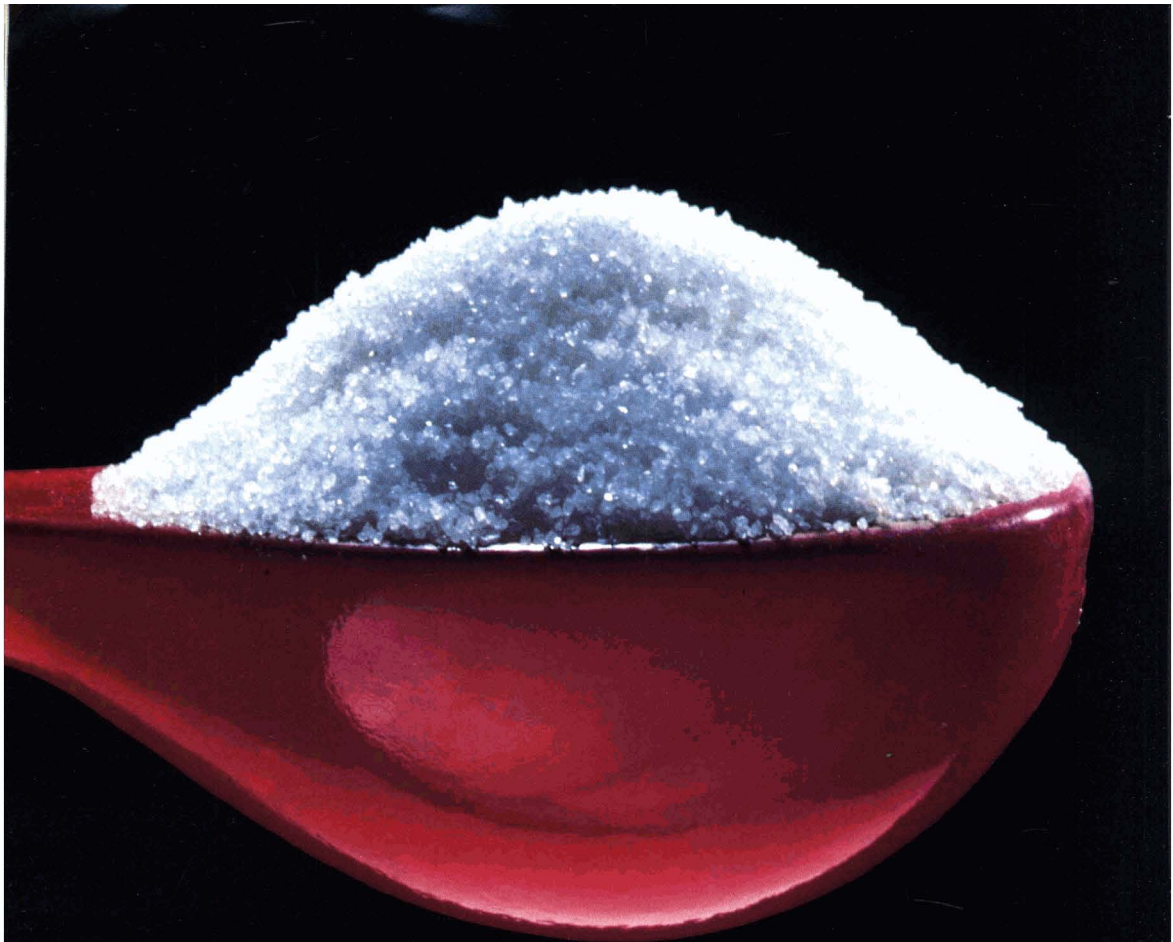


A. & W. SMITH & CO.
THE MIRRLEES WATSON CO.
No. 1 COSMOS HOUSE
BROMLEY COMMON
BROMLEY 3R2 9NA
GREAT BRITAIN
Telegrams Tecserve Bromley
Telephone 01-464 6556

Factory:
EGLINTON WORKS
COOK STREET
GLASGOW G5 8JW
Telegrams Engine Glasgow
Telephone 041-429 5441
Telex 77·137

PROGRESS THROUGH EXPERIENCE

A Division of Tate & Lyle Agribusiness Ltd.
A Member of the Tate & Lyle Group.



Johns-Manville offers seven Celite® filter aids for one good reason: 99.9% pure sugar.

For over half a century, Celite diatomite filtration of beet and cane sugar liquors has helped produce the brilliantly clear liquor needed for top-quality white sugar. With maximum flow rates over long filter cycles, Celite filtration can also bring about significant economies in cloth, labor, steam, power, and sulfur, while effecting an increased yield from the pans. And regardless of filter design, the inert Celite filter cake separates quickly and completely from the filter elements, so the filter will be ready for the next cycle.

Celite filter aids are available in a variety of diatomite grades ranging in pore size from very fine to large pores. Whichever grades you choose, you can rely on the same consistent quality, supplied promptly to meet your needs.

In addition to Celite diatomite filter aids, Johns-Manville also produces other process aids for the sugar industry such as fiber filter aids. All backed by over 50 years of filtration technology, and the largest field force of filtration specialists in the industry.

For more information on how Johns-Manville can help clear up your filtration problems, contact Johns-Manville Europe, 9/11 rue du Colonel-de-Rochebrune, 92505 Rueil-Malmaison, France, Tel. 749.13.33. Telex: Jmanvil Rueil 600089.

JM
Johns-Manville

Editor and Manager:
D. LEIGHTON, B.Sc., F.R.I.C.

Assistant Editor:
M. G. COPE, M.I.L.

Advertising Sales Manager:
JOHN V. DANCE

UK ISSN 0020-8841

Annual Subscription:
$50.00 post free

Single Copies:
$5.00 post free

Airmail charges quoted on request to

The International Sugar Journal Ltd.,
23A Easton Street, High Wycombe,
Bucks., England HP11 1NX

INTERNATIONAL SUGAR JOURNAL

Volume 82
Issue No. 977

CONTENTS May 1980

Published by
The International Sugar Journal Ltd.
23A Easton Street,
High Wycombe, Bucks.,
England HP11 1NX.
Telephone: 0494-29408 *Cable:* Sugaphilos, High Wycombe
Telex: 21792 REF 869

Inquiries regarding advertising should be addressed to the above office or to the appropriate representative:

Australia: J. J. Hindmarsh,
24–26 Kent Street, Sydney 2000.
Tel.: 241-2471. *Cable:* Hindmarshad.

France: MaG-Watt International,
6 rue des Acacias, Vert-le-Grand, 91810 Essonne.
Tel.: 492-00-15.

Holland: G. Arnold Teesing B.V.,
Prof. Tulpstraat 17, 1018 GZ Amsterdam.
Tel.: 020-263615. *Telex:* 13133.

India and South-East Asia:
J.P. Mukherji & Associates Pvt. Ltd.,
P.O. Box 915, Poona, India 411 005.
Tel.: 52696/7 *Cable:* Preproject, Poona.
Telex: 0145-367 JRMASSO.

Japan: Shinano International,
Akasaka City Plaza No. 304, 8-1 Akasaka 1-chome, Minato-ku, Tokyo 107.
Tel.: (03) 584-6420.

U.S.A.—Florida and Latin America:
Mr. Mario A. Mascaró,
7321 S.W. 82nd Street, Miami, FL, U.S.A. 33143.
Tel.: (305) 667-1724.

U.S.A.—Southern states, except Florida:
Herbert Martin Company,
2325 Old Rocky Ridge Road, Birmingham, AL 35216.
Tel.: (205) 822-7371.

U.S.A.—Western States, incl. Hawaii:
Roy McDonald Associates Inc.,
Suite 265, Baybridge Office Plaza, 5801 Christie Avenue, Emeryville, CA 94608.
Tel.: (415) 653-2122.

NOTES AND COMMENTS

International Sugar Agreement

A special session of the International Sugar Council met during March 14–April 1. It had been called to set basic export tonnages for 1980-82, the last three years of the current Agreement, in the light of requirements of the free world market, tonnages set for 1978-80, performance during the first two years of the Agreement, and other relevant factors. No agreement could be reached and, in the absence of a consensus, the formula laid down in the 1977 Agreement came into effect; this puts increasing emphasis on the performance of exporting countries in setting their BET levels.

C. Czarnikow Ltd. report[1] that, for this year, the formula is based half upon the original BET's laid down in the Agreement and half upon the relative average performance for each country during 1978 and 1979. At present quotas are inoperative and the question of market shares may appear academic. The following BET's have, however, been set under the formula for 1980 and, should quota limits be reimposed at some stage later this year, then these will form the basis for them, as well as possibly for a new Agreement after 1982.

Country	Original B.E.T.	Fallback formula B.E.T.	Expansion project increment	1980 Base levels
	tonnes, raw value			
Argentina	450,000	446,799	–	446,799
Australia	2,350,000	2,373,154	–	2,373,154
Bolivia	90,000	100,740	–	100,740
Brazil	2,350,000	2,373,174	–	2,373,174
Costa Rica	105,000	103,134	–	103,134
Cuba	2,500,000	2,522,046	–	2,522,046
Dominican Republic	1,100,000	1,200,000 †	–	1,200,000
Ecuador	80,000	70,116	–	70,116
Fiji	125,000	176,627	35,037	211,664
Guatemala	300,000	256,743	–	256,743
Guyana	145,000	151,214	–	151,214
India	825,000	832,080	–	832,080
Jamaica	130,000	130,000†	–	130,000
Mauritius	175,000	177,791	–	177,791
Mexico	75,000	70,000*	–	70,000
Mozambique	100,000	85,747	–	85,747
Nicaragua	125,000	127,051	–	127,051
Panama	90,000	131,559	2,908	134,467
Peru	350,000	330,000†		330,000
Philippines	1,400,000	1,412,611	–	1,412,611
El Salvador	145,000	164,458	8,236	172,694
South Africa	875,000	884,570	–	884,570
Swaziland	105,000	117,157	1,295	118,452
Thailand	1,200,000	1,213,341	–	1,213,341
Trinidad	85,000	70,000*	–	70,000
	15,275,000	15,520,112	47,476	15,567,588

† Decided by Council, not formula.
* Raised to minimum level 70,000 tonnes.

Under Article 69 of the Agreement there is provision for giving special consideration to countries which have been unable to maintain their full performance owing to *force majeure*. Under these provisions the Council decided to set the basic export tonnages for the Dominican Republic, Jamaica and Peru at fixed levels which, using the formula, would otherwise have been somewhat lower.

A decision was reached on the adjustment of the various price triggers in the Agreement at which economic action is taken. The Agreement specifies that the difference between the highest and the lowest trigger point must remain at 10.00c per lb and the Council increased the entire range of prices by 1.00c per lb to 12.00c to 22.00c per lb, with effect from April 1. The only economic provision which is at present affected by this adjustment is the reintroduction of the limitation upon imports of sugar from non-member countries which now operates when there has been a prevailing price below 20.00c per lb for more than five consecutive market days. Although these conditions have already been fulfilled it was decided to reimpose the limit from April 7. As with the reimposition of export quotas, contracts for non-member imports concluded while the limit was inoperative may still be performed without being charged against the limit provided that the sugar is imported within 90 days. Should prices fall further during the course of this year then there would be the option for the International Sugar Council to reimpose quotas should the prevailing price fall below 16.00c per lb while this would become mandatory with a prevailing price below 15.00c lb.

Cuba is intending to seek a further increase of at least one cent per pound in the trigger prices at the next price review in November, according to their Foreign Trade Minister[2].

One of the few raw sugar exporters which so far had not been able to join the International Sugar Agreement was Colombia, but she has now joined on the basis of a BET for 1980 of 280,000 tonnes, raw value, subject to normal adjustment under the performance formula for 1981 and 1982. It will be recalled that Colombia had suffered some poor crops at the time the 1977 ISA negotiations were taking place, which resulted in that country being offered a BET of only 75,000 tonnes. Exports by Colombia last year reached 230,000 tonnes. The status of Kenya's membership has been adjusted from an importing to an exporting country with an export entitlement under Annex II of up to 70,000 tonnes.

Consideration was given to the introduction of the Special Stock Fee at the meetings. Since the special stocks were released the financial burdens of the scheme are now much lighter and the urgency to introduce the fee has lessened somewhat. It was agreed to postpone the introduction of the fee from April 1 and it is hoped that by the time the Council next meets towards the end of May the United States will have completed the legislation necessary to implement her obligation to monitor payment of the fee on imports. Consideration may also be given at the May meetings to the level at which the fee will be introduced in the light of the much reduced outgoings of the Special Stock Fund.

Apart from the Agreement's controls over sugar supplies to the free market, adjustments were also made to a number of quantities mentioned in the Agreement connected with special arrangements. The limitation on exports by Cuba to Albania, China, North Korea, Vietnam and Yugoslavia as a group was increased from the previous level of 650,000 tonnes to 725,000 tonnes. The USSR enjoys a re-export entitlement which until now has amounted to 500,000 tonnes but the limit for this year has been reduced to half that level. In 1981 exports of 350,000 tonnes will be permitted and during 1982 up

[1] *Sugar Review*, 1980, (1486), 67-68.
[2] *Financial Times*, April 2, 1980.

to 450,000 tonnes will be allowed. East Germany will from now on enjoy an export entitlement of 100,000 tonnes, white value, as against the previous limit of 75,000 tonnes, raw value.

EEC sugar policy

Details of the EEC Commission's proposals for agricultural prices were released on February 7; the increase recommended for beet payment was 1.5% but, recognizing the substantial increase in processing costs owing to the higher price of oil fuel, the Commission proposed a 5% increase in the processing charge, to give a net 2.8% in the intervention and target prices of sugar. Proposals were made last year for reduction in the overall production quotas for sugar, and the UK's reaction had seemed lukewarm insofar as protection of imports from ACP countries under the Lomé Convention was concerned; however, a joint ACP-EEC meeting reaffirmed the obligation of the Community to import 1.3 million tonnes per year from the African, Caribbean and Pacific producers. Similar doubts had been expressed by representatives of Tate & Lyle Ltd. who feared the prospect of having to make further reductions of refining capacity in the UK if the import quotas were reduced.

There was no progress towards agreement when the Farm Ministers met to discuss the proposals on February 19, on March 3-4 and on March 26-27; during the first meeting, most Ministers called for higher increases, while the UK Minister wanted a freeze on prices of products in surplus, including sugar; during the second, discussion centred on the proposed reduction of maximum quotas to 10.5 million tonnes (against actual production of 12.2 million tonnes in 1979/80 and estimated consumption of 10.5 million tonnes) and the allocation of this amount.

On March 28 the UK Minister said he thought it unlikely that the new regime would start on July 1 as scheduled because of the impossibility of reaching agreement. Several Ministers were said to be in favour of a year's delay in starting.

The ACP countries have welcomed the proposals for reduced quotas, designed to prevent production of sugar surpluses, and have urged EEC adherence to the ISA, but European farmer and producer groups have claimed that, under present circumstances, with a deficit in world production against consumption, no quota cuts should be made. The two considerations are not related, however, since while guaranteed prices are justified for an *A*-quota to meet the difference between anticipated consumption and Lomé Convention imports and a *B*-quota to meet the contingency of poor crops, growers and sugar producers in Europe have the opportunity to produce *C*-sugar, unsubsidized by the EEC taxpayer, if they consider it to have a commercially justifiable export potential. If their judgment is wrong, and such sugar is sold at a loss, there is no reason why the taxpayer should have to pick up the bill.

European sugar beet areas, 1980

F. O. Licht GmbH recently published their first estimate of the areas to be sown to sugar beet for the 1980 crop[1] and the details are given below, with comparative figures for the previous two crops.

These initial figures are, of course, targets or intentions and may be amended as a result of weather conditions, political decisions, and the like, but the overall picture is for about the same crop area in most countries, with notable increases in a few. The beet area in Spain was reduced drastically in 1979 owing to a surplus of sugar and this year sees a step towards the former levels. Sugar production in Turkey in 1979 was insufficient to meet domestic requirements and the 10.7% increase in area should, with average yields, permit self-sufficiency. Yugoslavia has built a number of new sugar factories and the increased beet area reflects the extra tonnages of beets to supply them. Flooding in Poland reduced that country's beet area in 1979 and the increase shown marks a restoration to the 1978 level.

	1980	1979	1978
		hectares	
West Europe			
Belgium-Luxembourg	120,000	119,000	115,000
Denmark	75,000	75,000	76,000
France	525,000	515,000	523,000
Germany, West	405,000	405,000	411,000
Holland	125,000	127,000	134,000
Ireland	35,000	35,000	36,000
Italy	285,000	275,000	255,000
UK	217,000	214,000	204,000
Total EEC	*1,787,000*	*1,765,000*	*1,754,000*
Austria	52,000	44,000	44,000
Finland	33,000	32,000	30,000
Greece	45,000	45,000	46,000
Spain	190,000	163,000	230,000
Sweden	52,000	52,000	52,000
Switzerland	14,000	14,000	13,000
Turkey	299,000	270,000	277,000
Yugoslavia	177,000	137,000	126,000
Total West Europe	*2,649,000*	*2,522,000*	*2,572,000*
East Europe			
Albania	12,000	12,000	7,000
Bulgaria	85,000	85,000	78,000
Czechoslovakia	220,000	219,000	218,000
Germany, East	270,000	265,000	267,000
Hungary	106,000	111,000	122,000
Poland	530,000	470,000	523,000
Rumania	280,000	275,000	249,000
USSR	3,760,000	3,731,000	3,763,000
Total East Europe	*5,263,000*	*5,168,000*	*5,227,000*
Total Europe	7,912,000	7,690,000	7,799,000

The total area is 2.89% greater than in 1979 and this might therefore be thought to portend a similar increase in sugar production. As Licht points out, however, the 1979 area produced some 29,225,000 tonnes of sugar, raw value, while, if the average yields for the past six years were to be obtained in 1980, the higher area would give only 28,809,000 tonnes and applications of the highest and lowest individual country yields during the past six years would achieve productions of 32,869,000 and 24,785,000 tonnes, respectively. The figures thus indicate the likelihood of a somewhat smaller European sugar outturn next campaign.

US sugar legislation

On March 11 the House of Representatives passed a Bill to implement US obligations under the International Sugar Agreement. The Senate Finance Committee approved the Bill unanimously on March 25 and the full Senate approved it by a voice vote on April 2, completing Congressional action on the measure, after which it went to President Carter for signature. Under the Bill, the President can, up to 1982, limit the entry of sugar into the USA from non-members of the ISA .

Sugar cane for alcohol in Costa Rica[2]. – Central Azucarera Tempisque S.A. is to plant 4000 hectares with cane to be used for alcohol production.

[1] *International Sugar Rpt.*, 1980, **112**, 157-160.
[2] *Zuckerind.*, 1980, **105**, 291.

Factory trials of an evaporator scale inhibitor

By W. H. A. PUGH and N. D. J. LINDEMAN (Houseman (Burnham) Ltd., England),
M. SINGH and S. V. JOSHI (Godavari Sugar Mills, Ltd., India)

Introduction

Within a sugar factory the evaporators are of prime importance from the processor's point of view, since the whole of the steam economy is centred around their efficient running. During its concentration non-sugar components in the juice deposit and the heating surfaces become fouled. This accumulation of scale impairs heat transfer and eventually the process becomes impracticable and uneconomical owing to the quantity of steam required, and shut-down for cleaning is necessary.

The duration between cleaning operations and the time required for cleaning depends on various factors such as the nature of the scale and the procedure adopted. The interval varies from factory to factory while the time taken for each clean is 30 - 40 hours. This delay means loss of production, leading to lengthening of the milling season, idle labour elsewhere in the factory, delays in milling, clarification and other processes promoting disruption in house balance and loss of sugar yield.

It was considered that, in view of the cost and difficulty of maintaining efficient evaporation in face of the scaling process, it would be advantageous to find a material that would control scale deposition within the evaporator bodies but would not interfere with any subsequent processes of sugar production. Such a material must also be acceptable in terms of toxicity and be economical to use within the sugar industry.

On this basis, Miltreat S607 was developed and after successful laboratory testing was used for a full factory trial on the quadruple-effect evaporator of the Somaiya Sugar Works at Sameerwadi, India. This factory was considered particularly suitable, owing to heavy scaling problems.

At Sameerwadi the mixed juice is heated to 70°C; simultaneous liming and sulphitation then take place in a continuous reaction vessel, after which the juice is heated to 100°C and settled. The clear juice is concentrated and the resultant evaporator syrup is also sulphited to facilitate the production of plantation white sugar as the end product.

The trial was carried out during peak season and ran for 22 days.

Mechanism of scaling

The chief constituents of evaporator scale are phosphates and sulphates of calcium, magnesium, iron and aluminium, together with silica and the salts of certain organic acids. Phosphate is more prevalent in the earlier bodies of the evaporator and sulphate and silica within the later bodies. This has been confirmed by a number of workers and the figures given by Nandagopal & Ramamurthy[1] are typical of the fourth or last body.

SiO_2	20-25% of total scale
CaO	25-30% of total scale
SO_4	20% of total scale
Organic	30-40% of total scale

Solubilities of the impurities will not be affected in the first body of the evaporator and the main physical parameter that will exert effect will be high temperature. The phosphate within the juice undergoes reversion if held at temperatures in excess of 85°C for any period of time, resulting in the formation of the relatively insoluble forms of orthophosphates. At temperatures prevailing in excess of 100°C within the first body, orthophosphates of this nature will soon form as insoluble scaling material.

As concentration of the sugar juice proceeds and the temperatures fall, conditions become more and more suitable for the formation of sulphate, aconitate and silica scales. The solubilities of these compounds are exceeded in the third and fourth bodies and it is there that they form the main scale constituents.

A further deposition phenomenon taking place in the evaporator is that of coagulation at high temperatures, organic substances such as gums and protein matter being involved.

The rate of scaling has been found to be greatly affected by other factors. First, the lower the flow rate of the juice, the more scale becomes evident; this is due to the lower dispersion and retention of solids by the slower moving juice. Second, scaled or rough surfaces encourage deposition by increasing adhesion and also by creating a localized reduction in the flow of the juice. Stopping and re-starting of the evaporators also encourages scale deposition as suspended solids settle out when stagnation occurs. Further, even if the evaporator bodies are emptied on stoppage, the rate of deposition is increased owing to the laying-down of scale as the juice residues evaporate to dryness as the body cools.

There have been many endeavours to reduce the rate of scaling[2-13]. The most successful has been the replacement of calcium in clarified juice by sodium via an ion-exchange process. This method is widely used in beet sugar factories where the juice has lower calcium content owing to more extensive filtration and the carbonatation techniques employed. Problems still do occur, however, owing to calcium residuals, and, although shut-down for cleaning may not be necessary during the shorter beet campaign, efficiency of the evaporator station drops off, often quite dramatically during the season.

Some workers have employed a number of systems using electrical current to change the charge of impurities present in the colloidal state. Alginates, cellulose compounds and other colloidal solutions have also been tried. Other workers have applied solutions of phosphates or phosphoric acids in order to produce a phosphate scale that is easier to remove than these naturally occurring. Tetra-phospho-gluconate is another compound which has been investigated quite extensively. This product has the peculiar property of forming suspensoids with metallic compounds in solution, inhibiting their precipitation.

Materials and methods

Selection of the site. — After discussion between the product developers and sugar technologists concerned, it was decided that the initial trials should take place at a

1 *Indian Sugar*, 1976, **26**, 437-439.
2 Anon.: *I.S.J.*, 1949, **51**, 343, 1952, **54**, 257.
3 Anon.: *ibid.*, 1950, **52**, 23.
4 Armstrong: *ibid.*, 1948, **50**, 18.
5 Batstone: *Proc. 38th Conf. Queensland Soc. Sugar Cane Tech.*, 1971, 207-210.
6 Faith *et al.*: *I.S.J.*, 1936, **38**, 241.
7 Gaddie: *ibid.*, 1951, **53**, 193.
8 Gadhe: *Sugar Tech. Rev.*, 1976, **3**, (4), 262.
9 Hewlett: *I.S.J.*, 1948, **50**, 76.
10 Kent: *ibid.*, 1963, **65**, 153.
11 Lewis: *ibid.*, 1952, **54**, 257.
12 Wagner: *ibid.*, 1940, **42**, 327.
13 Yearwood: *ibid.*, 1948, **50**, 18.

mill with two sets of evaporators so that, in the event of disruption of the process by a shut-down for observations to be made, productivity would not suffer unduly. The mill should also be of medium throughput, have sufficient technical facility for laboratory monitoring, and the trials should commence during peak production when demands on the evaporator were at their highest.

The mill at Sameerwadi was considered to meet these demands with a quadruple- and triple-effect evaporator and a total throughput of 3500 tonnes of cane per day and with good technical facilities. Closure of the factory was necessary every 20-25 days when scaling of the evaporators reduced the efficiency of the process to a level at which it was uneconomical to continue. For a factory using the sulphitation process it might perhaps be expected that cleaning would be necessary more frequently than this; the evaporator tubes at Sameerwadi were, however, much larger than usual (3in I.D.) and so could carry more scale before efficiency was impaired to an unacceptable level. Normal cleaning operations (an alkaline boil-out followed by mechanical brushing and manual rodding) took between 30 and 40 hours.

The trial was commenced February 6, 1979, using the quadruple-effect evaporator. The triple-effect was used to back-up the quadruple both in terms of throughput and also to facilitate comparison of non-treated and treated juice. 2500 tonnes of juice per day was handled by the quadruple-effect evaporator.

Scale inhibitor. – Some polymers have been shown to interfere with scaling processes and two hypotheses have been put forward to account for this effect. First, the action has been attributed to sequestration of the scaling ions and, second, absorption of the polymer onto the crystal nuclei, leading to inhibition of crystal growth, has been given as an explanation. The sequestration mechanism was dismissed by Flesher *et al.*[14] on the basis that only a small non-stoichiometric amount of additive was required for scale inhibition. Crystal distortion was also observed by these workers and Figures 1 and 2 below show confirmation of this effect by the authors.

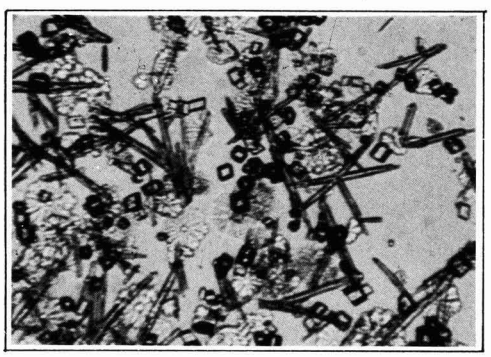


Fig. 1. Scale crystals in untreated water

The polymer would therefore appear to act by inhibiting the growth of scale particles from crystal nuclei. The crystals are maintained as small distorted masses and supersaturation of the concentrating solution is effected, resulting in prevention of scaling. Should there be settling of particles then the deposit will be soft and mobile, so that cleaning is simple. Some workers have also considered that the deposition of small amounts of polymer onto the crystal nuclei introduces antagonistic charges on these nuclei so that the particles

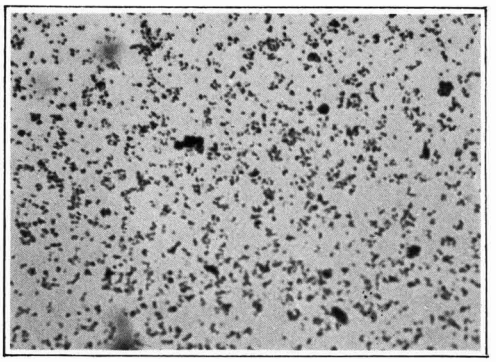


Fig. 2. Distortion of scale-forming crystals in water treated with Miltreat S607

remain non-aggregated, preventing scaling.

Flesher *et al.*[14] also showed that polymers of molecular weights between 5000 and 20,000 were the most effective scale inhibitors and that levels of approximately 5 ppm of polymer were most effective. Miltreat S607 falls into this category of molecular weight and the basis of the trial was to maintain a level of 5 ppm of polymer throughout the bodies of the evaporator.

Method of dosing. – During the trial Miltreat was added at the rate of 12 ppm to the first effect of the evaporator by gravity feed. A further booster dose was introduced at 5 ppm to the third effect to replace losses of polymer within the first two bodies and this was increased to 7.5 ppm after 7 days running. A flow rate controller was used for addition to these bodies and in both the polymer was considerably diluted to give greater addition volume and hence more accurate dosing control.

Sampling. – Samples of mixed juice, clear juice and syrup were taken every 15 minutes during the trials and these were mixed every four hours to produce a composite sample upon which were carried out Brix, purity and CaO determinations to derive calcium levels entering the evaporator set and compare these with levels in syrup. Analyses were also carried out on scale taken from the bodies prior to the cleaning before the trial and also from deposits after the trial to detect changes in scale composition and quantities. Ash levels in final sugar were also monitored for comparison of sugar from untreated and treated processes.

Visual observations were made of the deposits on the sight-glasses of the various bodies prior to and throughout the trials. Visual inspection was also made prior to, during and after the trial of the evaporator bodies and juice. Shut-down at these periods was as brief as possible to enable these inspections to be made and also to facilitate a photographic record.

Results

The evaporator was inspected after the run before the trials began. It was found to be badly scaled, particularly within the fourth body (see Figures 3 & 4). Analysis of the scale showed that phosphate was the predominant component within the first body and calcium sulphate within the fourth body (see Table I). It is interesting to note that no sulphite could be detected, in contrast to the experience of Perk[15].

Cleaning was carried out using an alkali boil-out followed by manual brushing. The first body was easy

[14] "Third International Symposium on Fresh Water from the Sea", Volume I. 1970, pp. 493-504.

[15] "The manufacture of sugar from sugar cane" (Perk, Durban) 1973, p. 85.

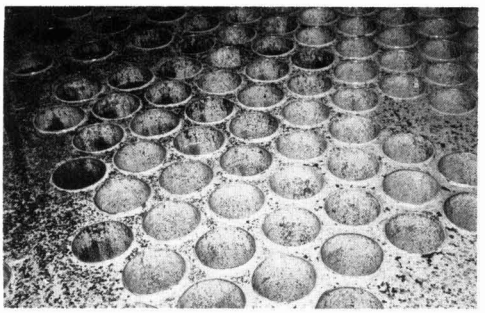


Fig. 3. Scaling of the first body prior to cleaning and before Miltreat trial

Table I Analysis of scale formed before Miltreat application

	1st Body	2nd Body	3rd Body	4th Body
			%	
Corrosion products	10.4	16.07	4.2	0.6
Hardness salts	61.1	45.4	29.1	62.1
Water solubles	13.8	2.0	36.1	0.4
Calcium phosphate	18.8	2.1	1.7	1.7
Calcium sulphate	0.4	14.6	1.3	42.7
Silica	13.8	27.2	27.8	13.4

Fig. 4. Scaling of fourth body prior to cleaning and before Miltreat trials

to clean but the scale in the third and fourth bodies was particularly resistant and despite subsequent extensive mechanical and manual activity considerable scale remained.

The deposits, mainly in the fourth effect, were measured and found to be up to 2 mm in thickness in places. Measurement was by microscope using a micrometer eye-piece previously calibrated against a graduated slide and by using reflected light from above the substage of the microscope when examining the scale samples. By this technique layering of new scale on old could easily be seen. The cleaning of the third and fourth bodies took 41 hours and it was decided that the trial should commence despite the fact that they were not completely scale-free (see Figures 5 and 6).

The trial with chemical dosing commenced on February 6, 1979 and after 7 days continuous running it was seen that the sight-glasses were very clean indeed. Slight scaling was evident on the fourth body sight-glass but that of the third body was quite clear. It was therefore decided to increase the dosing into the third body to 7.5 ppm to improve carry-over of the treatment to the fourth body. The sight-glass of the third body of the triple-effect showed a much higher level of scaling at this time, being totally obscured.

After 11 days continuous running the evaporators

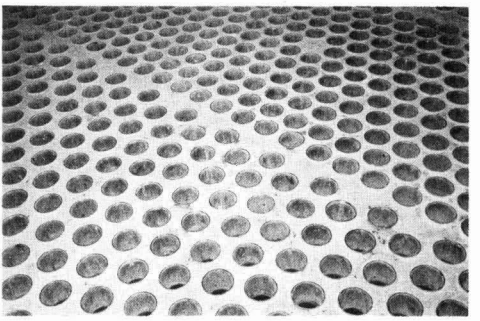


Fig. 5. The first effect after cleaning

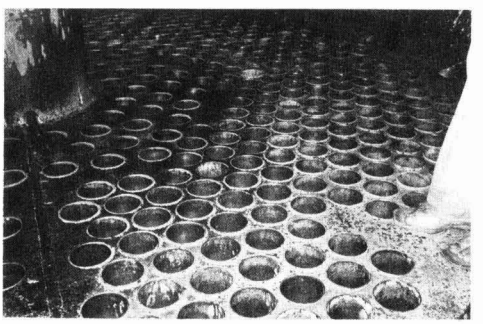


Fig. 6. The fourth effect after cleaning

were stopped and the bodies inspected. No scale was apparent in the first body and the fourth body was still in good condition with a very thick layer of scale in the lower parts of the tubes. This scale was of a different nature to that normally seen, being greyish as opposed to white-brown. It was also of a much finer texture, and had formed as a layer on top of the previous scale deposit which had not been removed by cleaning. The thickness of this layer, measured by microscope, was 0.12 mm.

After 17 days of running, it was decided to put the whole juice load from 3500 tcd through the quadruple-effect for 6 hours. If scaling had occurred within the evaporator, it would not be able to handle this full load and build-up would occur in the clarifiers, plus loss of vacuum and erratic boiling and foaming in the effects. None of these became apparent while the evaporator bodies showed the following pressure/vacua:

Body No. 1 – 2 psi pressure
Body No. 2 – 6 in Hg
Body No. 3 – 14 in Hg
Body No. 4 – 24 in Hg

Dosing of Miltreat was increased during this experiment to allow for the extra loading.

On the eighteenth day the evaporator was closed down for general inspection. Observations were that the first body was still very clean indeed. Within the fourth body the level of scaling was now seen to be 0.15 mm, generally at the base of the tubes.

After 22 days the trial was stopped, by previous agreement between co-participants in the trial and not of necessity, and the final inspection carried out. Samples of scale were taken from Bodies 1 and 4 for analysis and the results of these are seen below under Table II. The

deposit in the first body was predominantly composed of corrosion products (mainly iron oxide). Calcium phosphate and calcium sulphate levels were now in equal proportions. The analysis of scale from the fourth body showed the deposits to be predominantly calcium sulphate.

Table II. Analysis of scale formed during trial

	1st Body	4th Body
	%	
Corrosion products	51.6	0.2
Hardness salts	26.6	68.3
Water solubles	0.2	0.2
Calcium phosphate	12.3	1.2
Calcium sulphate	11.8	64.9
Silica	6.6	18.6

Visual inspection of the first body from above and also from below the tubes showed that there was virtually no scaling (Fig. 7); only very slight scaling of a soft nature, which could be removed by rubbing, was seen at the tops of the tubes. Inspection of the fourth body showed that scaling was minimal at the tops of the tubes and still of wafer thinness, shown by microscopic examination to be now 0.17 mm, at the bottom (Fig. 8).

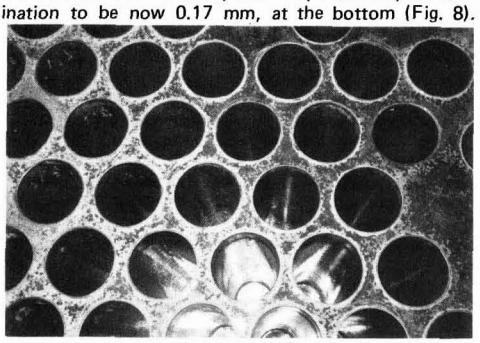


Fig. 7. Tubes in the first effect after 22 days of treatment

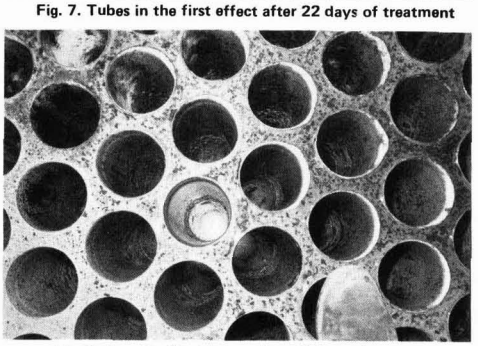


Fig. 8. Fourth effect tubes after 22 days of treatment

Results of calcium determinations in composite juice and syrup samples, carried out during the trial period, are summarized in the graph below (Fig. 9) and, as will be seen, the levels, expressed as CaO, relate closely throughout the trial showing that deposition was minimal.

Analyses were also carried out on sugar from the untreated process before the trial and of the resultant sugar during the trial. All other factors – boiling technique, strike purity, etc. – were the same.

Table III. Comparative analyses of sugar before and after evaporator treatment

	Sugar No treatment	Sugar from treated juice
Silica	0.003%	0.002%
Iron oxide	0.002%	0.001%
Calcium sulphate	0.055%	0.030%
Calcium phosphate	0.021%	0.019%
Magnesium hydroxide	0.002%	0.001%
Sodium sulphate	0.005%	0.006%
Loss on ignition	99.9%	99.9%
Ash	0.0635%	0.0506%

Analytical records, based on 4-hour composite mixtures of samples taken every 15 minutes, were also kept of Brix and purity determinations. The purity of the syrup was maintained between 80 and 84 throughout the trial, being over 83 at the shut-down for inspection (Fig. 10). Similarly, Brix values in the syrup were maintained at over 60° during the trial (Fig. 11).

Discussion

Scaling was seen to be reduced considerably in all bodies during the trial and, as the photographs show, quite dramatic results were seen in the earlier bodies. At the first shut-down after 11 days results were excellent with scaling only showing in areas where old deposits had been left. After 18 days more general scaling on the lower parts of the tubes was apparent and it would seem that the shut-down for inspection on the eleventh day had increased the overall scaling potential of the evaporators. This phenomenon is consistent with the findings of other workers and also with the mechanism postulated for the effect of the scale inhibitor. Any reduction or cessation of flow will allow particles to settle from suspension and commence the formation of a deposit.

At the finish of the trial, *viz.* 22 days, scaling was certainly more pronounced on surfaces already scaled at the commencement of the trial. There was indication that some of the lighter scaled areas were in fact cleaner than at the commencement (see photographs). In terms of scale thickness in the fourth body, measurements showed this to be at 0.12 mm, 0.15 mm and 0.17 mm respectively at the 11, 18 and 22-day stages. These figures imply that the scaling rate was greater during the first part of the trial, in contrast to the findings of other workers. However, when also examining the distribution of scale, an entirely different picture emerges. The 0.12 mm measurement was of new scale laid on old and the general situation was of spasmodic scale deposition, with the majority of the tube surface still in clean condition. The scale distribution at 18 and 22 days was more generalized at the bottom of the tubes and of maximum thicknesses of 0.15 mm and 0.17 mm respectively. The top ends of the tubes were apparently cleaner than at the commencement of the trial.

In summary, the inspection at 11 days showed the evaporator to be in a generally clean condition by contrast with that normally found when no treatment is used. After shut-down and restart the scaling rate was increased with more generalized deposits seen at later inspections. The dynamics of the heated juice within the tubes plus treatment are responsible for localized cleaning action at the upper tube areas and this interesting phenomenon will require further investigation at subsequent trials.

The monitoring of calcium levels within the evaporator during the trial showed a close correlation between calcium levels entering and leaving the

evaporator set, indicating that no gross scaling was taking place. Ash figures on the final sugar were indicative of an improved sugar. The sugar was whiter in colour during the trial and analysis showed a 36! reduction in ash content compared with sugar produced without evaporator treatment.

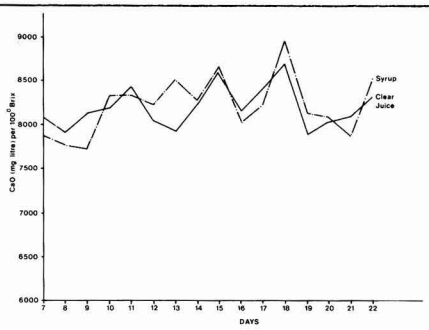


Fig. 9. Relationship between calcium levels in clear juice and syrup

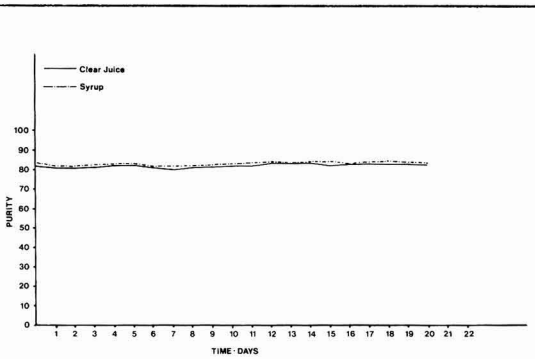


Fig. 10. Purity values of clear juice and syrup during trial

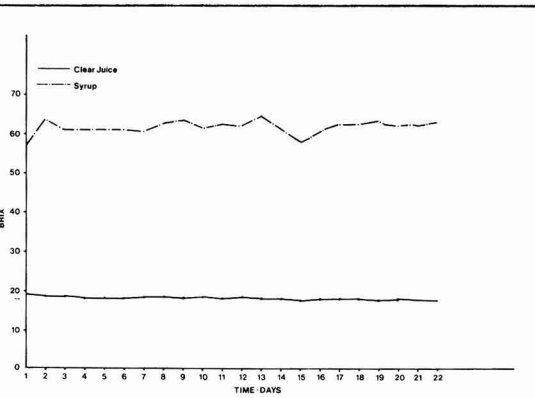


Fig. 11. Brix values of clear juice and syrup during trial

Analysis of deposits after the trial as compared with that of deposits usually seen (*i.e.* without Miltreat) showed no really significant change in their compositions. This was considered satisfactory because it had been feared that, by use of a scale inhibitor which could have been expected to have more affinity for calcium salts, a scale of predominantly silica and silicates might be deposited which, although smaller in quantity, would have been far more difficult to remove.

During the trial it was evident that the dosing method was not satisfactory, with frequent blockages of the fine ports of the flow rate controllers. Even with the ready supervision available there were periods when no treatment was being administered to the bodies, either because of repair and cleaning of the controllers or when blockages occurred at night and went unnoticed. With scaling inhibitors continuous accurate dosing is essential for maximum effect and subsequent to the trial the HM 19 Miltreat automatic dosing module has been developed. This equipment, which monitors the dosing process, indicates by audible and visual alarm any break-down in any of the dosing sets used. Electrical failure of dosing equipment, exhaustion of treatment tanks and pressure build up from blockage of treatment delivery lines all activate alarms, ensuring that any cessation of dosing is immediately apparent and can be quickly put right. Dosing pumps are incorporated with the HM 19 unit as are specially designed valves suitable for injection into lines under both positive and reduced pressure. The HM 19 unit has subsequently been successfully tested both on the bench and under mill conditions.

The trial showed that after 22 days of continuous treatment with Miltreat the evaporator bodies were much improved in terms of scale deposition and efficiency over the situation that would normally prevail after the same period without treatment. It was considered, therefore, that a much longer period between cleans could be effected by using Miltreat S607. At least half of the eight cleaning operations usually carried out during the 160 - 180 day season could be saved, particularly if the evaporators were cleaner initially, if running was continuous and if reliable automatic dosing equipment was used.

The saving of four cleans would shorten the season by 6-8 days, with savings as follows:

(a) *Direct costs*
1. Factory wage bill for 6-8 days,
2. Cost of additional hands employed for cleaning,
3. Chemicals used,
4. Cost of steam for boiling during cleans,
5. Power used for cleaning,
6. Cost of brushes and cutters consumed,
7. Interest, depreciation, repairs of cleaning equipment, including workshop and direct labour cost for equipment upkeep,
8. Loss of tube life owing to damage during cleaning,
9. Cost of replacement of jointing and packing resulting from opening of vessels, and
10. Cost of water used.

(b) *Indirect costs*
1. Sugar lost from normal stock of boiling house products, by retention during cleaning,
2. Deterioration of harvested cane in transit or awaiting milling, and

3. Loss due to increased duration of season caused by cleaning shut-downs, calculated as 490 tonnes*

Further there is the loss due to the decline in crushing capacity caused by progressive scaling of the evaporator during runs and also the re-start pick-up time.

All these various costs were calculated at Sameerwadi and the economic benefit of eliminating four cleans was found to be very significant. Obviously the savings will vary with the mill, for which individual costings must be made. At Sameerwadi, however, there is ample justification for the use of the scale inhibitor at the mill on the basis of increased outturn alone. Add to this the other direct and indirect cost savings and considerable advantage is seen.

Conclusions

(1) Miltreat S607 is an effective scale inhibitor in cane juice evaporators.
(2) Scale deposition in an evaporator is greater on already scaled surfaces and under low flow conditions.
(3) The successful use of Miltreat scale inhibitor in the evaporator station is enhanced by continuous accurate dosing by automatic control equipment such as the HM19 module.
(4) Cleaning operations can be reduced by the use of an effective scale inhibitor and resultant cost savings, are considerable.

This trial was planned to obtain more information about scaling processes within sugar evaporators and to commence to evaluate a polymeric scale inhibitor specifically selected because of its affinity in controlling the scaling components of these systems. The trial was also carried out to obtain information relating to the correct route and method of introducing a scale inhibitor to evaporators to optimise its effectiveness.

It was considered that these objectives were realized and in consequence further trials were planned during the 1978-79 and 1979-80 campaigns both in India and elsewhere to evaluate the product and the scale inhibition process further. The basis of these trials will be to: (a) test the product at factories where shut-down is necessary after shorter periods, such as 7 days and 2-3 days, and (b) test the product at factories where the load is heavier such as those with a crush of 7000 and 14,000 tonnes per day, respectively. The trials will be run to determine the extension period possible over the normal run between cleans and also to investigate and document any subsequent "spin-off" advantages to the vacuum pan, crystallization and centrifugal operations resulting from more efficient evaporation brought about by Miltreat S607. The results of these further trials and the completed evaluation of Miltreat S607 will be published at a later date.

Acknowledgements

The authors wish to record their thanks to the managers and staff of Godavari Sugar Mills Ltd. for making this trial possible and wish to acknowledge the contribution made to the trial work and formulation of the paper of Messrs. V. G. Bahulekat, I. B. Adarakatti and P. Probhanjan.

Summary

The first of a planned series of trials with Miltreat S607, a scale inhibitor based on a polymeric compound, was carried out at Somaiya Sugar Mill, India, which uses a sulphitation process to produce plantation white sugar. The evaporator used for the trial was a quadruple-effect unit receiving 2500 tonnes juice per day, and observations were made after 11, 18 and 22 days. Scaling was dramatically reduced and the time between cleaning could be significantly lengthened. It is calculated that adoption of the treatment would give considerable savings to the mill over the season and figures are included to substantiate this conclusion. The sugar produced contained no polymer and had a lower ash content than sugar produced without the treatment.

Essais dans une sucrerie avec un inhibiteur d'incrustation d'évaporateur

Le premier test dans une série projetée avec Miltreat S607, inhibiteur d'incrustation basé sur un composé polymérique, a été fait à la sucrerie Somaiya (l'Inde) où la sulfitation est employée pour production du sucre blanc "plantation". L'évaporateur employé dans les tests était un appareil à quadruple effet recevant 2500 t jus par jour, et on a fait des observations après 11, 18 et 22 jours. La formation d'incrustation fut étonnamment réduite et le temps entre les nettoyages pouvait être significativement prolongé. On calcule que l'adoption du traitement permettrait à la sucrerie de faire des economies considérables à la saison, et des chiffres sont donnés pour confirmer cette conclusion. Le sucre produit ne contenait pas de polymer et avait une teneur en cendres plus basse que sucre produit sans le traitement.

Zuckerfabrikversuche mit einem Belagverhinderer für Verdampfer

Der erste, in einer geplanten Serie Versuch mit Miltreat S607 einem auf Polymerverbindung basierten Belagverhinderer, wurde in Zfb. Somaiya (Indien) durchgeführt, wo das Sulfitationsverfahren zur Herstellung von "Plantagen"-Weisszucker angewendet wird. Der in den Untersuchungen angewandte Verdampfapparat war eine Mehrkörperanlage, die 2500 t Saft pro Tag behandelte; Beobachtungen wurden nach 11, 18 und 22 Tagen gemacht. Die Krustenbildung wurde ausserordentlich vermindert, und die Zeit zwischen Reinigungen konnte erheblich verlängert werden. Man rechnet, dass Anwendung des Verfahrens beträchtliche Ersparnisse in der Zfb. pro Saison ermöglichen würde, und Werte zur Bestätigung dieser Schlussfolgerung werden gegeben. Der hergestellte Zucker war polymerfrei und hatte einen niederen Aschengehalt als bei Zucker, der ohne das Verfahren erzeugt wurde.

Ensayos en un ingenio de un inhibidor de incrustación en un evaporador

El primero de un serie de ensayos con Miltreat S607, un inhibidor de incrustación basado en un compuesto polimerico, se ha realizado en Somaiya Sugar Mill en la India, donde se utiliza un proceso de sulfitación para producir un azúcar blanco directo. El evaporador empleado en el ensayo es un cuadruple-efecto que recibe 2500 toneladas de jugo por día, y observaciones se han hecho después de 11, 18 y 22 días. Incrustación se ha disminuido dramáticamente y el intervalo entre limpiezas pudo prolongarse significantemente. Los autores calculan que adopción del tratamiento daría beneficios notables al ingenio durante la zafra, y incluyen cifras para justificar esta conclusión. El azúcar producido no contiene polimer y tiene menos de ceniza que azúcar producido sin el tratamiento.

* Number of cleaning shut-down days = 6-8 days (say 7 days)
Cane crushed during 7 days = 24,500 tonnes
Average recovery per day over the season = 10.5%
Recovery that would be obtained during the extended season = 8.5%
Sugar that can be saved by avoiding 4 cleans = 24,500 x (10.5 - 8.5)% = 490 tonnes.

High pressure liquid chromatography for the analysis of sugar cane saccharides*

By J. WONG-CHONG and F. A. MARTIN
(Louisiana Agricultural Experiment Station, Louisiana State University, Baton Rouge, La. 70803, USA)

Introduction

Polarimetric analysis is the technique traditionally employed to determine the sucrose content of juice samples in the cane sugar industry. Although this technique is adequate under ideal conditions, it may have serious limitations under circumstances where optically-active substances other than sucrose are present[1]. Under such circumstances more accurate methods of sucrose analysis are desirable[2,3]. These include enzymatic methods, gas-liquid chromatography with prior derivatization, paper chromatography and liquid chromatography. However, considerations of cost, time of analysis per sample and the complexities involved in these techniques have deferred the acceptance of these methods by cane sugar industries.

The separation of carbohydrates by liquid chromatography is not a new technique. Early liquid chromatographic systems utilizing glass columns were long and tedious processes. Because the solvent delivery systems employed were by gravity-feed, the separations often required more than 60 hours[4,5]. Resolution was incomplete in many cases so that the technique was inapplicable to most routine carbohydrate analyses.

Recent developments in the area of pressurized liquid chromatography (HPLC) have made possible the rapid analysis of sugar mixtures with minimum sample preparation[6]. The possibility of getting accurate estimates of sucrose, reducing sugars and deterioration products in a single analysis arouses one's interest[7]. Better estimates of cane quality for cane payment purposes and improved quality control of factory operations would obviously be an attracting advantage to the cane sugar industry[2,3]. As a minimum, such technology would prove to be extremely useful for research. The objective of the research described below was to explore the possibility of using HPLC for the analysis of sugar cane saccharides.

The basis of chromatographic analysis

Chromatography is a method of analysis in which the flow of a solvent or gas promotes the separation of substances by differential migration from a narrow initial zone in a porous sorptive medium[8]. It consists of a mobile phase in which the components of interest are carried and a stationary phase with which the components interact. Each component in a mixture interacts with its environment differently from all other components under the same conditions.

Dr. F. A. Martin

As the name implies, in liquid chromatography the mobile phase is a liquid which can range from a polar to a non-polar solvent depending upon the separation to be accomplished. In liquid chromatography, the sample is passed through a column packed with solid particles. With the proper solvent and operating conditions, some components in the sample will travel through the column more slowly than others. The differential migration phenomenon thus results in the desired separation.

A typical chromatographic analysis can be divided into three steps. The first is sample preparation, which involves getting it ready for introduction into the chromatographic system. This may involve removing suspended particle matter, adjusting some parameter of the original solvent, or partitioning the constituents of interest into a more compatible solvent.

The actual chromatographic separation is the second step of the analysis. In this the components of interest are spacially separated on the basis of their adsorption, partition, ion-exchange and molecular interactions with the stationary phase in the column.

Finally, after separation in the column, the eluting fractions of interest must be analysed. The analysis can range from specific chemical analysis of discrete fractions collected, to direct monitoring of the eluting stream. Such monitoring is usually accomplished by use of monochromatic absorption (usually in the ultraviolet spectrum) or by refractive index. In such monitoring of the eluting stream, the identification is accomplished by comparing retention times (time from injection to detection) of the components with those of known standards. Quantification is accomplished by comparing the magnitude of detector response with a calibration curve obtained using the known standards.

High pressure liquid chromatography system

The components of a HPLC system are indicated in the flow-schematic diagram, Fig. 1. The carrier solvent is pumped from a reservoir through a sample injecting device, which can be a fixed-volume sample loop or a variable-volume injector. The injecting devices may be manually operated or automatically controlled by microprocessors. The solvent then flows through a high pressure rated stainless steel column packed with an appropriate stationary phase. It is in the column that the actual spatial separation of solutes contained in the sample occurs. As the flow goes through the detector an electronic output proportional to the amount of solute detected is monitored by a recording or integrating

* *Paper presented to the 17th Congress ISSCT,* 1980.

1 Meade-Chen: "Cane sugar handbook", 10th Edn. (Wiley, New York) 1977.
2 Brokensha *et al.: Proc. 52nd Congr. S. African Sugar Tech. Assoc.*, 1978, 54-58.
3 Schaffler & Smith: *ibid.*, 59-63.
4 Khym & Zill: *J. Amer. Chem. Soc.*, 1951, **73**, 2399.
5 Idem: *ibid.*, 1952, **74**, 2090.
6 Conrad & Palmer: *Food Technol.*, 1976, **30**, (10), 84-92.
7 Wong-Chong & Martin: *Papers submitted for publication in J. Agric. Food Chem.*, 1979.
8 Heftmann: "Chromatography: A laboratory handbook of chromatography and electrophoretic methods", 3rd Edn. (Van Nostrand Reinhold, New York) 1975.

device. The effluent from the detector can either be collected or allowed to go to waste.

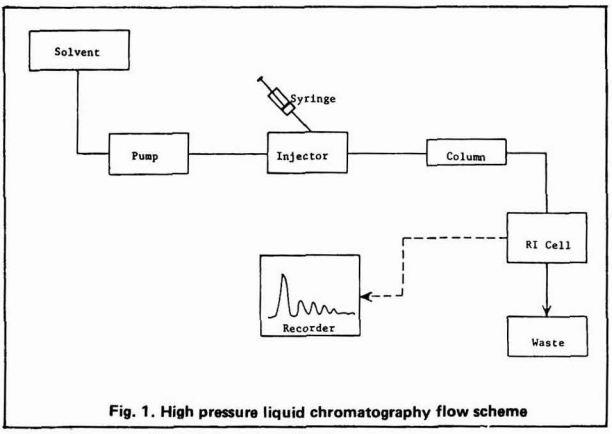


Fig. 1. High pressure liquid chromatography flow scheme

Materials and methods

The equipment used in this study consisted of:

1. Waters Associates Liquid Chromatograph equipped with:
   a. Solvent delivery system
   b. Differential refractometer
   c. Syringe injection
   d. Solvent programmer
2. Sargent-Welch Recorder, Model SRG
3. Hewlett-Packard 3385A, Reporting Graphic Integrator
4. Constant temperature circulating water-bath

Prepacked μBondapak/carbohydrate (8-12 microns particle size) column of 4 mm ID x 30 cm L, obtained from Waters Associates, and prepacked Aminex-Carbohydrate HPX87 column of 8 mm x 30 cm, available from BioRad Laboratories, were used as such. Aminex Q150S resin, obtained from BioRad Laboratories, was slurried and treated in the manner described below, before packing into the column.

Column packing

The procedure described by Scobell *et al.*[9] for resin preparation was followed. The Aminex Q150S resin was slurried in deionized-distilled water in a ratio of 4:1 water:resin, and degassed for one hour with water aspirator vacuum. It was then transferred to a 20 mm ID x 400 mm L glass column and a tenfold excess of 2N solution of the potassium ion was allowed to percolate through the bed. The resin was washed with three bed volumes of water, reslurried in two litres of water, transferred to a 2-litre graduated cylinder and checked for fines. If fines were observed, the resin was allowed to settle and the upper layer decanted. This was repeated until a clear boundary was obtained.

The following procedure was used to pack the column at room temperature. The empty column was clamped in a vertical position. An end fitting was attached to the bottom end of the column and an open-ended vessel to the top of the column. The assembly was filled with degassed, deionized-distilled water to about one-third of the vessel. A vacuum line was attached to the bottom end and the treated resin was poured into the open-ended vessel. Suction was applied until the level of resin in the open vessel was constant. The vessel was removed, and an end fitting was then attached to the top of the column.

A water-jacket was constructed to elevate the column temperature of the Aminex resin.

Juice sample preparation

Originally, the following procedure was adopted to clarify the juices: Celite was added to the juice sample and centrifuged at 10,000 *g* for 10 minutes. The clear supernatant was taken to make a 1:10 v/v dilution (syrups and molasses samples were diluted before centrifugation). To 10 cm^3 of the diluted sample, 0.2 g of Amberlite MB1 was added in order to deionize the sample. The solution was gently shaken for 10 minutes in a swirling motion and then filtered through a 0.22 micron millipore filter.

Later in the study, it was found that the Amberlite and millipore filtration could be replaced by use of a small precolumn to remove particulate materials still present after centrifugation. The diluted supernatants were injected into the LC system without any further treatment.

Criteria of performance

On the onset of this study it was decided that the minimum criteria of acceptable performance would be to separate a clean sucrose peak in a total run time of 10 minutes or less. Also, a long-lived column without a need of regeneration was desired.

Results and discussion

A. *Adsorption chromatography with μBondapak/carbohydrate resin.*

Using acetonitrile:water in the ratio of 80:20 as the eluting solvent through a Waters μBondapak/carbohydrate column at the rate of 2.0 $cm^3.min^{-1}$ a mixture of fructose, glucose and sucrose was separated in less than 10 minutes (Fig. 2). Raffinose was included in the standard mixture to assure that sucrose would be separated from higher order oligosaccharides. As seen in

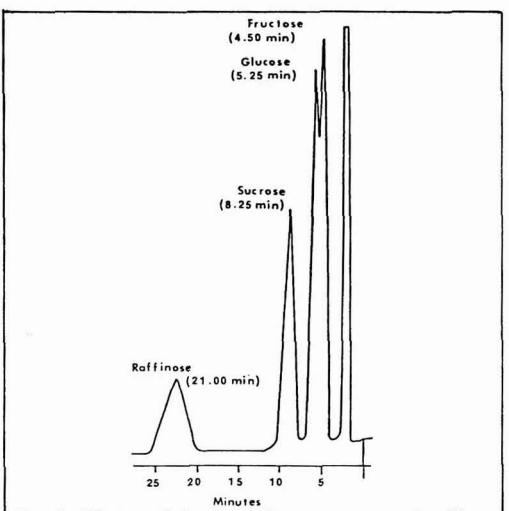


Fig. 2. Mixture of fructose, glucose, sucrose and raffinose chromatographed on μBondapak/carbohydrate column, using 80:20 acetonitrile:water as solvent at 2.0 $cm^3.min^{-1}$

Figure 2, the elution of the trisaccharide raffinose took 21 minutes with this system. Increasing the flow-rate and increasing the polarity of the acetonitrile:water mixture both decreased the run time, but resulted in an unacceptable loss of resolution between fructose and glucose. The use of flow-programming was introduced for this reason[7]. By increasing the flow rate during a run through the use of a solvent programmer, the separation of glucose, fructose, sucrose and raffinose was achieved within 10 minutes (Fig. 3).

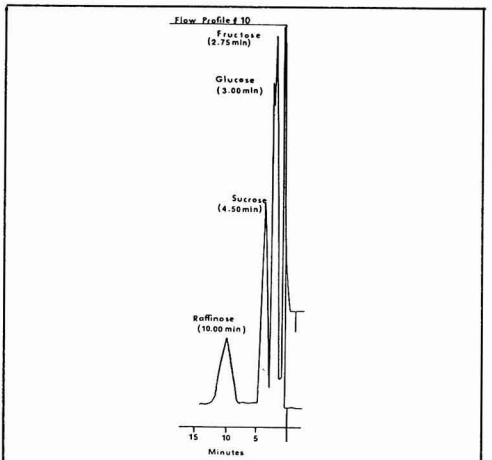


Fig. 3. Chromatographic separation of sugars on μBondapak/carbohydrate column with a program run of 1 minute using 80:20 acetonitrile:water as solvent at an initial rate of 2.0 $cm^3.min^{-1}$ and a final rate of 4.0 $cm^3.min^{-1}$

Diluted cane juice samples were analysed using the flow-programmed scheme. Elution times and separation of fructose, glucose, and sucrose were identical to those obtained with the standards.

B. *Ion-exchange resins.*

Based on the results of some recent studies[9,10] a series of column systems using Aminex resins for HPLC was tested for cane juice analysis. Aminex Q150S, a cation exchange resin converted to the potassium form, was found to be the best packing material examined. Maximum speed of separation and maximum resolution was attained with Aminex Q150S (K^+) in a 7 mm ID x 61 cm column kept at a constant temperature of 60°C. Degassed, deionized-distilled water was the only solvent used. Figure 4 gives a typical chromatogram of a fresh cane juice separated on this system with a solvent flow rate of 2.5 $cm^3.min^{-1}$. The elution times obtained for a standard mixture containing sucrose, glucose and fructose were 5.40, 6.89 and 7.44 minutes respectively.

Although insignificant amounts of polysaccharides are normally in fresh cane juice, conditions that result in increased polysaccharide content may prevail. The presence of dextran in deteriorated cane juices is of practical importance since it presents serious problems in juice clarification and the crystallization process of the boiling house[11]. It would therefore be a desirable advantage to be able to identify these deterioration products on the same column and the same sample run as used for mono- and oligosaccharides.

It was found that dextran could be separated from sucrose, glucose and fructose with the Aminex Q150S (K^+) system described above. Figure 5 illustrates a typical chromatographic separation of dextran from

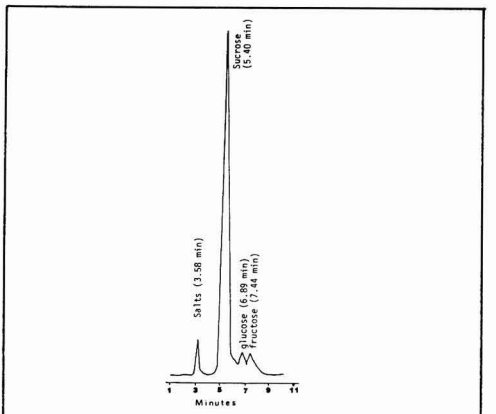


Fig. 4. Separation of fresh cane juice sample on Aminex Q150S (K^+) with solvent flow rate of 2.5 $cm^3.min^{-1}$

other sugars. The column, of 7 mm i.d. x 61 cm, was operated at 60°C and eluant flow rate was 2.5 $cm^3.min^{-1}$.

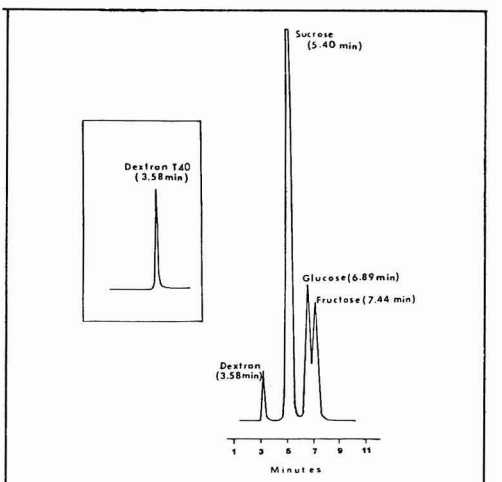


Fig. 5. Separation of standard mixture containing sucrose, glucose, fructose and dextran on Aminex Q150S (K^+)

Of the known products of sugar cane deterioration, lactic acid and dextran were found to emerge together at 3.58 minutes. The relative retention times obtained for a mixture containing sugars, inorganic salts and deterioration products are given in Table I.

Because other polysaccharides, salts and lactic acid all emerge under the dextran peak, the peak ascribed to dextran would be more accurately labelled as salts and degradation products. But, nevertheless, these products of deterioration are well separated from sucrose, without any interference with the "clean" sucrose peak. A typical chromatogram of a badly deteriorated juice sample is shown in Figure 6.

[9] *Cereal Chem.*, 1977, **54**, (4), 905-917.
[10] Palmer & Brandes: *J. Agric. Food Chem.*, 1974, **22**, 709.
[11] Kamoda *et al.: Proc. 13th Congr. ISSCT*, 1968, 362-373.
[12] M.S.Thesis, Louisiana State University, Baton Rouge, 1978.

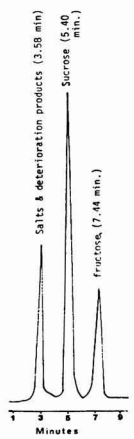


Fig. 6. Typical chromatogram of a badly deteriorated juice sample separated on Aminex Q150S (K^+) with a flow rate of 2.5 $cm^3.min^{-1}$

Table I. Relative retention times for sugars, inorganic salts, and known deterioration products run on an Aminex Q150S (K^+) column

	Rel. Retention Time
Inorganic salts	0.53
Dextran	0.53
Lactic Acid	0.57
Acetic Acid	0.62
Sucrose	0.78
Mannitol	0.93
Glucose	1.00
Fructose	1.08
Ethanol	1.15

The results obtained from Aminex A5 and Aminex Q15S were reported by Wong-Chong[13]. These two resins were found to be reliable for the separation of sucrose, glucose and fructose in fresh juice samples. However, when deterioration products were run on these columns, high molecular weight polysaccharides like dextran were found to interfere with the sucrose peak owing to overlapping[7,12]. The separation of sugars was also tested on Aminex-Carbohydrate HPX87, a prepacked column of 8 mm ID x 30 cm. The retention times of sugars resolved are given in Figure 7. In fresh juice samples, this type of resin would provide an adequate system of sucrose, glucose and fructose quantification. A clean peak of sucrose was obtained. However, in badly deteriorated juices and products of low purities, lactic acid gave rise to two peaks. The second peak from lactic acid started to emerge at 6 min and peaked at 10.50 min. This tailing would clearly interfere with both the sucrose and glucose peaks. This, therefore, is the main objection to this system.

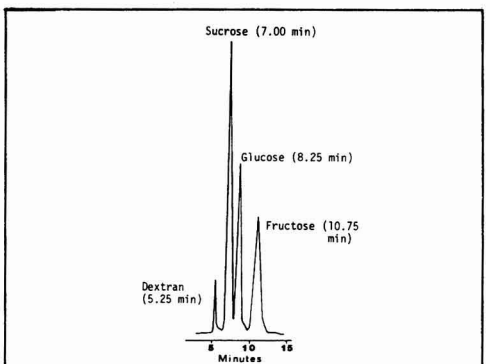


Fig. 7. Separation of sugars and dextran on Aminex carbohydrate HPX87 at 85°C with deionized distilled water at 0.8 $cm^3.min^{-1}$

Comparison between polarimetric and liquid-chromatographic techniques of sucrose analysis

The results of the liquid chromatography (Q150S) and polarimetric analysis for fresh, moderately deteriorated and badly deteriorated juice were compared. The correlation coefficients between the two methods ranged from 0.989 for fresh juices to only 0.460 for badly deteriorated juices (Figures 8a & 8b).

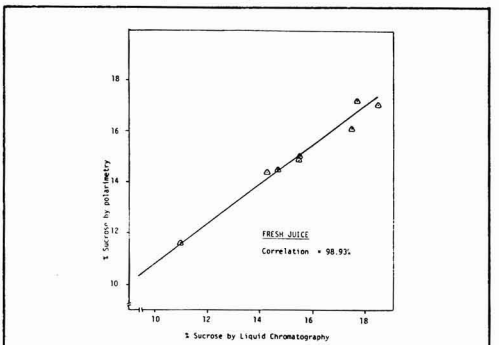


Fig. 8a. Scatter diagram relating sucrose % fresh juice determined by polarimetry *vs.* liquid chromatography

From these results it was concluded that liquid chromatography is much superior to polarimetric analysis during periods when false pol values may be experienced. Such periods usually follow a severe stalk-damaging freeze in Louisiana. The fact that HPLC measures deterioration products in the same run as the sucrose analysis should make it particularly attractive in a post-freeze period. However, it is unlikely that a HPLC unit would be purchased for use only after a

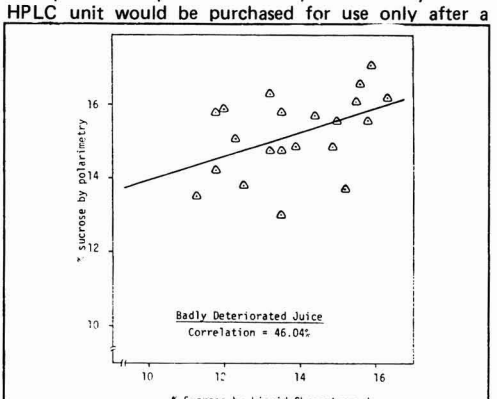


Fig. 8b. Scatter diagram relating sucrose % badly deteriorated juice determined by polarimetry *vs.* liquid chromatography

severe stalk-damaging freeze. Serious consideration of HPLC would more likely be over the entire harvesting season. Therefore, for the last 27 days of the 1978 harvest at the St. Martinville Sugar Coop., HPLC analysis was run on duplicates of pol analysis samples. The objectives were again to compare HPLC analysis with polarimetric analysis, and to study the feasibility of using HPLC in a Louisiana sugar factory. Comparison of HPLC sucrose and pol sucrose ranged from 0.9700 correlation on the day of best agreement to 0.7566 correlation for the day of poorest agreement (Figures 9a & 9b). The overall correlation for the 27-day period was 0.9094. This relatively high agreement was to be expected under the ideal harvesting conditions experienced in 1978. Under the conditions tested, 8 to 10 samples per hour could be run with HPLC. We have found that this column system has a very long life. Over 6000 samples have been analysed using the Aminex Q150S system lasting over a 7-month period.

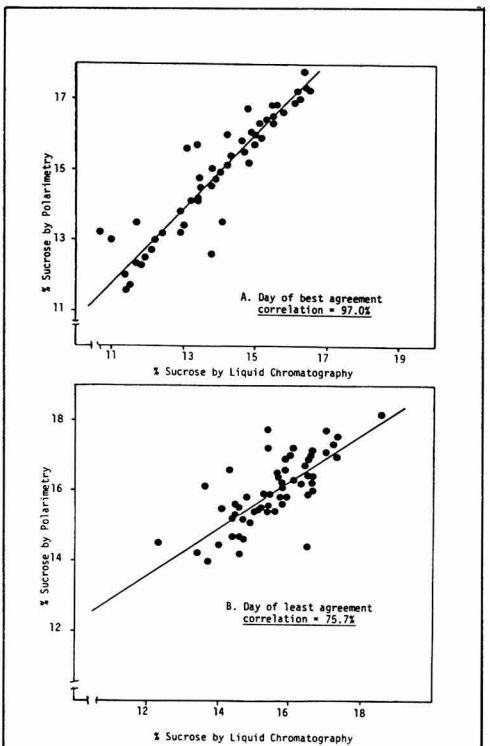


Fig. 9. Scatter diagrams relating sucrose determined by polarimetry *vs.* L.C. for (a) a day of best agreement and (b) a day of poorest agreement

Comparison of HPLC and polarimetric analysis was also made at sampling points in the mill. Analysis of these data reveals greatest disagreement in results for products of least purity. The discrepancies in the results were greatest for molasses samples where LC and pol estimates typically differed by 10! sucrose. Typical chromatograms of molasses, raw sugar and sucrose after acid inversion are given in Figures 10a, 10b and 10c respectively. Significant variations between pol and sucrose (as analysed by gas chromatography) were also reported by Brokensha *et al.*[2] and Schäffler *et al.*[3]. These discrepancies were attributed to the inaccuracy of direct pol as a measure of sucrose. All samples currently run in a sugar factory (filter cake, juices, syrups, massecuites, etc.) can be run by liquid chromatography on the Aminex Q150S (K^+) column after appropriate clarification.

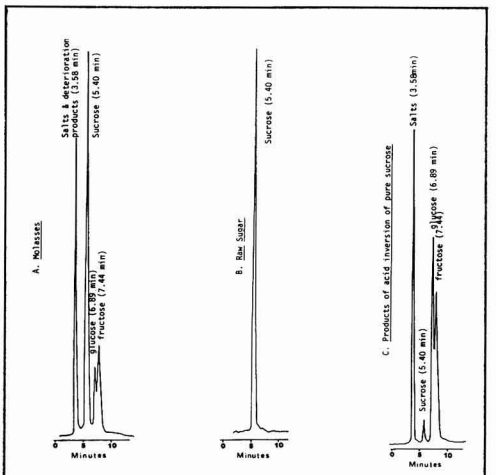


Fig. 10. Chromatographic separation of sugar products on Aminex Q150S (K^+) at 2.5 $cm^3.min^{-1}$

Conclusions

Although the μBondapak/carbohydrate system provides good resolution and reproducibility of results, there is, however, a serious consideration about the system in that the presence of slower eluting compounds, e.g. raffinose and higher molecular weight compounds such as dextran, which would be on the column indefinitely, makes it difficult to know when the last peak in a sample is eluted. Also, if left for some time on the shelf, the column requires frequent recalibration when put back into use. These considerations would render the μBondapak system unsuitable for routine laboratory analysis.

Aminex-Carbohydrate HPX87 column can achieve the desired separation of sucrose, glucose and fructose. However, the presence of deterioration products such as lactic acid presents a serious objection to this system.

Of the resins tested, Aminex Q150S showed greatest potential as the method for analysing juice samples. Its superiority resides in the fact that it can be used for the rapid fractionation of juice samples that have undergone some degree of deterioration. Although the Aminex Q150S resin system is not the ultimate answer in achieving complete juice analysis with high pressure liquid chromatography, this system clearly has superior accuracy when measuring sucrose, glucose and fructose.

When analysing materials of high purity with no "false pol" content, HPLC sucrose estimates are virtually no better than polarimetric sucrose estimates. However, for those materials of low purity, HPLC is clearly a more accurate, and superior method. HPLC is a dependable, rapid and accurate method of measuring sucrose, glucose, fructose and degradation products of sugar cane.

Acknowledgements

The authors wish to express their appreciation to the management and staff of St. Martinville Sugar Cooperative, who have assisted in gathering data during the 1978

harvest season. Thanks are also due to Hewlett-Packard for their Reporting Graphic Integrator, Hewlett-Packard 3385A.

Summary

This paper is an introduction to the application of high pressure liquid chromatography for the analysis of sugar cane saccharides. A rapid method for the determination of sucrose, glucose and fructose in cane juice by adsorption chromatography on a Waters Associates μBondapak/carbohydrate column is described. With flow-programming complete analysis is achieved in less than 12 minutes with an acetonitrile:water mixture as the eluting solvent. However, the technique is unsuitable for routine analysis because of the prolonged time of elution of higher polysaccharides occasionally present in juice samples. Of the ion-exchange resins tested, Aminex Q150S (K^+) gives the best results. Using this resin, a high correlation was obtained between liquid chromatography and saccharimetry in the analysis of fresh juice samples. The lack of agreement of these two techniques with deteriorated samples or samples of low purity is attributed to false polarimeter readings. The usefulness of HPLC in the analysis of products of low purities in cane sugar factories is emphasized.

La chromatographie liquid à haute pression pour l'analyse des saccharides dans la canne à sucre

Cet article est une introduction à l'emploi de la chromatographie liquide à haute pression pour l'analyse des saccharides dans la canne à sucre. On décrit une méthode rapide pour la détermination de la saccharose, glucose et fructose dans le jus de canne par la chromatographie à adsorption sur une colonne μBondapak/hydrate de carbone de Waters Associates. Avec la programmation de flux, on accomplit une complète analyse dans moins de 12 minutes en employant comme dissolvant élutriant une mixture acétonitrile:eau. Cependant, la technique ne convient pas à l'analyse routinière à cause du temps prolongé d'élution des plus hauts polysaccharides de temps en temps présents dans des échantillons de jus. Entre les résines d'échange d'ions testées, Aminex Q150S (K^+) donne les meilleurs résultats. Avec cette résine, on a obtenu une haute corrélation entre la chromatographie liquide et la saccharimétrie dans l'analyse d'échantillons de jus frais. On attribue la manque d'accord entre les deux techniques dans le cas d'échantillons détériorés ou de pureté basse à les mesures polarimétriques fausses. On souligne l'utilité de la CLHP pour l'analyse de produits de pureté basse à sucreries de canne.

Hochdruckflüssigkeitschromatographie für die Analyse von Zuckerrohrsacchariden

Dieser Aufsatz ist eine Einführung zu die Anwendung der Hochdruckflüssigkeitschromatographie für die Analyse von Zuckerrohrsacchariden. Es wird eine Schnellmethode zur Bestimmung von Saccharose, Glukose und Fructose in Rohrsaft beschrieben, welche die Adsorptionschromatographie auf eine μBondapak/Kohlenhydratkolonne von Waters Associates anwendet. Mittels Fliessprogrammieren wird Vollanalyse in wenigen als 12 Minuten mit einem Acetonitrilwasser-Gemisch als Elutrierlösungsmittel fertiggebracht. Jedoch die Technik eignet sich nicht für gewohnheitsmässige Analysen wegen der langen Zeit beim Elutrieren von zu Zeiten in Saftproben answesenden hohen Polysacchariden. Unter den untersuchten Ionenaustauschharzen, gibt Aminex Q150S (K^+) die besten Ergebnisse. Mittels dieses Harzes, erhielt man einen hohen Zusammenhang zwischen Flüssigkeitschromatographie und Saccharimetrie bei der Analyse von Frischsaftproben. Der Mangel an Übereinstimmung zwischen die beiden Verfahren im Falle zersetzter Proben oder Proben von Niederreinheit wird irrigen Polarimetermessungen zugeschrieben. Man betont die Anwendbarkeit von HDFC für die Analyse von Niederreinheitsprodukten in Rohrzuckerfabriken.

Cromatografía liquida de alta presión para el análisis de sacaridos de la caña de azúcar

El presente trabajo es una introducción a la aplicación de cromatografía líquida de alta presión para el análisis de sacaridos en la caña de azúcar. Se describe un método rápido para la determinación de sacarosa, glucosa y fructosa en el jugo de caña por cromatografía de adsorción sobre una columna μBondapak/carbohidrato de la firma Waters Associates. Con la ayuda de programación del flujo, el análisis completo se puede hacer en menos de 12 minutos utilizando como solvente de elución una mezcla de acetonitrilo y agua. Sin embargo, la técnica no es apropriada para análisis de rutina debido al tiempo prolongado requerido para la elución de los polisacaridos mayores ocasionalmente presentes en las muestras de jugo. De las resinas intercambiadores de iones probados la que mejores resultados da es la Aminex Q150S (K^+). Utilizando esta resina, se obtuvo una muy buena correlación entre la cromatografía líquida y la sacarimetría para el análisis de muestras de jugo fresco. La diferencia en los resultados obtenidos con las dos técnicas en muestras de jugo deteriorado o de baja pureza se atribuye a errores en la lectura del polarimetro. Se hace hincapié en la gran utilidad de la CLAP para el análisis de productos de baja pureza en los ingenios azucareros.

The World's oldest cultivated ratoon cane?

By TIAN SANG

It is reported that sugar cane plants grown two and a half centuries ago are still producing vigorous progenies every year on a small plot in the East China province of Fujian. Locally dubbed "longevous canes", they have been growing year after year without replanting on a plot in Wanqian Village occupying two-thirds of an acre. After harvesting of the stalks, new shoots spring up from the stubble and grow into sturdy stalks reaching a height of 1.6 metres. This is probably the world's oldest sugar cane plot.

The Vice-President of Fujian Agricultural College, Professor Zhou Keyong, was sceptical when he read about the "longevous canes" in a newspaper some years ago. He sent a group of ten scientists and agro-technicians to Wanqian Village to find their true age. When interviewed, almost every elder in the village said: "My father told me that the canes were planted as 'auspicious plants' on the day our village was founded". The scientists studied the Village's Annals, in which it is clearly written that Wanqian Village was founded in the fourth year of the reign of Emperor Yongzheng in the Qing Dynasty, *i.e.* 1727 A.D.

Several villagers assigned to look after the old cane plot periodically apply manure to the land, loosen the soil and cull new shoots growing outside the rows.

Alcohol in Brazil[1]

By E. ANDERSON

When Brazil set up its widely publicized national alcohol programme (ProAlcool) in November 1975, its primary concern was to reduce the nation's dependence on imported oil. About 36% of Brazil's primary energy supply comes from imported crude which cost about $5000 million per year before the price increases of summer 1979. Almost one-third of Brazil's export earnings went to pay for this imported oil.

Few people realise that the original ProAlcool decree contained a commitment to increase alcohol output for chemicals as well as fuels. It also established a subsidized price for alcohol (tied to the price of petrochemical ethylene) when the alcohol is used to replace products derived from petrochemicals. What the original decree did not contain were quantitative goals, either for fuel alcohol or for chemical alcohol. Most published estimates pegging future alcohol production in Brazil are based on assumptions, the basic one being that, by 1985, the "average" fuel used by Brazilian motorists will be a blend of 80% petrol and 20% alcohol.

On that basis, most experts calculate that Brazil will be producing about 1320 million gallons of alcohol by 1985. To appreciate just how much alcohol this is, consider that only 187 million gallons of synthetic alcohol were produced in the USA in 1978. Recently, however, the Minister of Industry & Commerce announced quantitative targets for ProAlcool, the 1985 goal being set at 2800 million gallons of alcohol. To reach this, Brazil will have to invest about $5000 million over the next five years.

The huge increase is attributed to Brazil's new emphasis on cars that will operate on 100% alcohol fuel. Eventually, Brazil hopes to have 1,700,000 cars operating on an all-alcohol fuel. Most of these cars will be built by major motor manufacturers in the country. Although no quantitative targets have been set for chemicals, much of that huge alcohol volume will no doubt be available to make chemicals. If it is, Brazil's alcohol-based chemical industry will become much larger than it has been.

In the 1976/77 crop year, for instance, Brazil produced about 175 million gallons of alcohol. Of that, only 21,000,000 gallons went into turning out 61,000 tonnes of chemical derivatives. This is only a small fraction of the 4,500,000 tonnes of petrochemical products that were produced in Brazil that year. However, another 70 million gallons of alcohol were used to produce a variety of solvents for the pharmaceutical and cosmetics industries. Only 84 million gallons, or 48% of the total, went into petrol-blended fuel.

In contrast to Brazil's world-scale petrochemical complexes, today's fermentation alcohol producers operate under an economic handicap. Most alcohol distilleries are tied into sugar operations; facilities are relatively small and technology outdated. Were it not for a government subsidy, alcohol-based chemicals would be even less of a factor than they are. If, for example, petrochemical ethylene costs $0.40 per kg, the subsidized price of ethanol is $0.14 per litre or about $0.53 per gallon. The National Petroleum Council and the Sugar & Alcohol Institute grant quotas and control the flow of subsidized alcohol. They buy it at market prices, sell to chemical users at the subsidized price, and absorb the loss.

How fast and how far a Brazilian alcohol-based chemicals industry is able to climb depends on political, technological and economic factors, and it is thought that these will favour alcohol. Before Brazil set a definite goal of 2800 million gallons of alcohol for 1985 and 1300 million gallons was still a reasonable estimate, Victor Yang, an alcohol expert with Centro Tecnologia Promon, estimated that chemicals would consume about 20% of the total, or about 264 million gallons — more than ten times the volume that went into chemicals in 1977/78. Cosmetics and pharmaceuticals would have accounted for another 7% or 92 million gallons. Now that the quantitative goal for 1985 is twice as high as the original estimates, even more alcohol will probably be earmarked for chemicals. In Brazil, economic conditions favour developing as big a market as possible for alcohol, including chemicals, in order to stabilize the sugar industry when prices are low. Alcohol-based chemicals can also help to balance the market for various petrochemical products in Brazil, since it can provide for the higher growth in demand for ethylene (17% per annum) than that in demand for aromatics (13%). Ever-increasing costs of imported crude oil indicate that alcohol-based chemicals will become more competitive with petrochemicals in Brazil since the price of alcohol-derived ethylene rises only a fraction of the increase in the cost of ethylene based on crude oil.

Even inflation favours fermentation alcohol; compared with petrochemical units, alcohol distilleries are small, take less time to build and, as a result, the impact of inflation on capital costs is likely to be smaller. But a bright future in Brazil for an alcohol-based chemical industry will not be assured until it is able to compete with petrochemicals without a subsidy. This will take better economics — in the agricultural sector, in the distilleries and in downstream units.

Summary

An account is given of alcohol production in Brazil, with particular reference to the establishment and possible future expansion of an alcohol-based chemicals industry.

Alcool au Brésil

On rapporte sur la production d'alcool au Brésil, avec référence particulière à l'établissement et expansion possible à l'avenir d'une industrie chimique basée sur l'alcool.

Alkohol in Brasilien

Man berichtet über Alkoholherstellung in Brasilien, mit besonderem Erwähnen der Gründung und möglichen zukünftigen Erweiterung einer auf Alkolhol basierten Chemikalienindustrie.

Alcohol en Brasil

Se describe producción de alcohol en Brasil, con referencia especial a la fundación y posibilidad de expansión en el futuro de una industria química, basado en alcohol.

US beet sugar factory closure[2]. — Holly Sugar Corporation plans to close its 2000 tonnes per day factory at Worland, Wyoming. The beet growers are interested in taking over the factory since, with only two other small factories in the state, at Lovell and Torrington, the beet cultivation potential would be reduced considerably by closure of the plant.

Bulk sugar terminal in Iraq[3]. — A contract worth $33.9 million to build a bulk sugar terminal at Basra is to be announced soon. West German, French and Japanese companies are bidders to the terminal, which will enable bulk sugar to be imported instead of costlier bagged sugar.

[1] *C & E. News*, 1979, **57**, (32), 15-16.
[2] *Zuckerind.*, 1980, **105**, 190.
[3] *Middle East Economic Digest*, January 25, 1980.

SUGAR CANE AGRONOMY

Chemical weed control in spring planted sugar cane. G. Singh and P. P. Singh. *Indian J. Sugarcane Tech.*, 1978, **1**, 23-28. – Weed competition reduces cane yield significantly, by 14-75% according to the literature, and trials were carried out on the chemical control of weeds at Pantnagar. On unweeded plots, broad-leafed weeds and annual grasses constituted 44.2 and 42.4% of the total weed population, respectively, the principal species being *Physalis minima* and *Dactyloctenium aegypticum* grasses. Pre-emergence application of Simazine and Diuron at 2 kg a.i. per ha gave good control and produced cane yields statistically the same as recorded under weed-free conditions.

Studies on intercropping with sugar cane. R. S. Sachan, R. G. Menon and M. Singh. *Indian J. Sugarcane Tech.*, 1978, **1**, 29-32. – Intercropping trials in 1974/75 and 1975/76 showed that all three intercrops gave a significantly increased return per unit area per unit time than a pure crop of cane. With groundnut and mung there was a marginal decrease in the yield of cane, but with onion there was a marginal increase.

Sugar cane response to various rates of NPK fertilizers in artificially developed fertility. S. M. H. Jafri, S. C. Srivastava and M. Alam. *Indian J. Sugarcane Tech.*, 1978, **1**, 33-37. – An account is given of fertilizer trials with Co 1148 plant and ratoon crops. The response to fertilizers was greater on soils of low nutrient content than on high. The output:input ratio in the case of the plant crop was greatest with a N-P-K combination of 200-50-75 kg.ha^{-1} while, for the ratoon crop, there was increased response from increase in fertilizer application, but the highest return was with a N-P-K combination of 200-100-150 kg.ha^{-1}; the highest output:input ratio in low-fertility soil was obtained with a N-P-K combination of 150-50-70 kg.ha^{-1}.

Reduce your sett cutting costs by using an IISR sugar cane sett cutting machine. N. S. L. Srivastava and M. P. Sharma. *Indian Sugar Crops J.*, 1978, **5**, 53-56. – The design and capacity of a sett cutting machine designed at the Indian Institute of Sugarcane Research are described. The machine has two saw blades, and bundles of cane are pushed towards these, one end being located by a wooden stopper. This produces two bundles of setts which fall down a sloping platform into a tank holding fungicidal solution from which they are removed for planting. The unit can be carried easily by tractor from place to place, and a 4-man team can produce up to 16,000 setts per hour against 250-300 per man cutting by hand.

Testing the fertility status of Aira sugar factory zone, Dist. Lakhimpur, Uttar Pradesh. A. C. Shukla, A. K. Gupta and R. N. Srivastav. *Indian Sugar Crops J.*, 1978, **5**, 66-70. – A total of 1465 soil samples were taken from an area of about 49,130 ha and soil fertility assessed. A soil map was prepared showing the status of the various areas within the factory zone. On the basis of Nutrient Index values, the soils are poor in organic carbon and medium-to-low in P and K.

A study into the possible effects of the phenomenon of heavy tasselling of sugar cane on its quality. D. G. Dakshindas and G. C. Shaligram. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 9-19. Profuse flowering of cane occurred during the 1975/76 season in the Kopargaon sugar factory area of Maharashtra, probably owing to unusual climatic conditions, but fears that it would affect the milling quality of the cane proved unfounded.

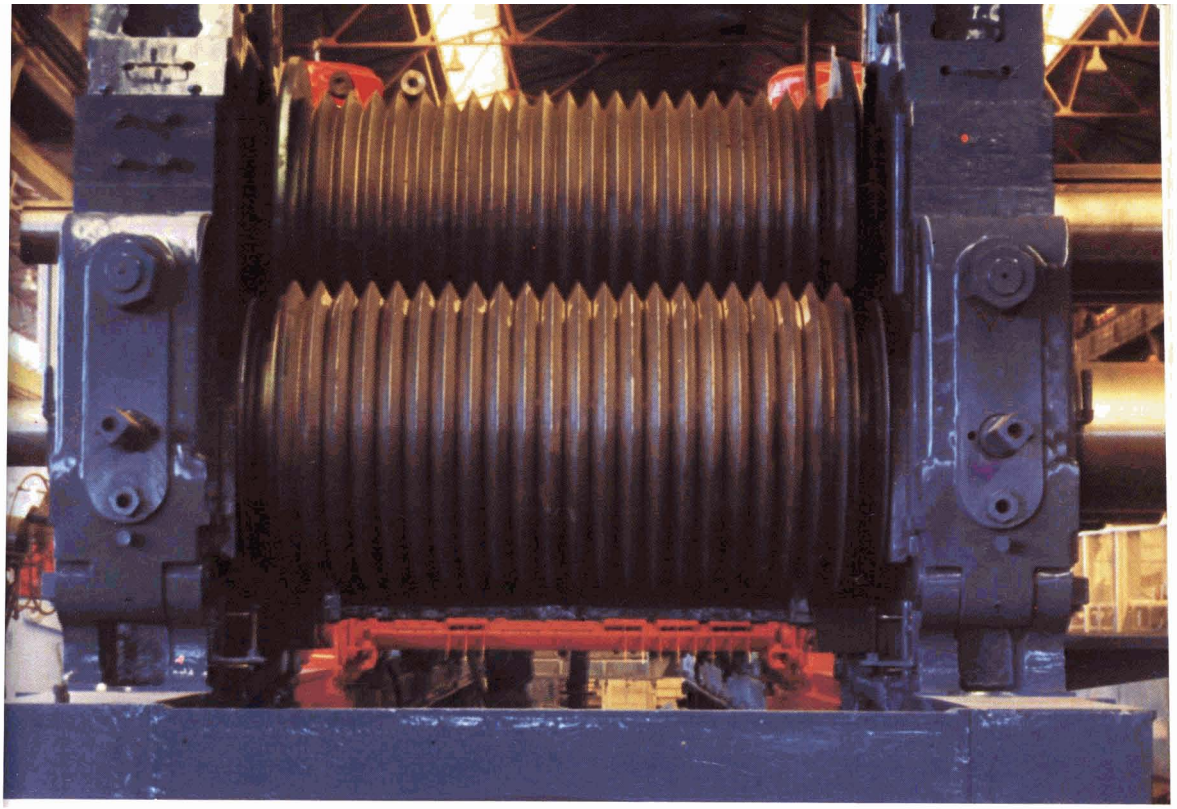
Sugar cane development in sugar factory zones of Andhra Pradesh. M. Lakshmikantham. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 20-27. – A series of recommendations are made in regard to sugar cane cultivation and cover land selection and cultivation, cane planting, seed material, sett length, use of immature tops as setts, seed nurseries, sett heat treatment, seed cane fertilization, irrigation and drainage, protection against early shoot borer, time of planting and age at harvest, varietal scheduling to provide mature cane at different parts of the season, weed control, crop fertilization, protection against pests and diseases, and ratooning.

Sugar cane is not harvested in succession of maturity in spite of multiple advantages – why? K. S. Thirumalaisamy. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 28-33. – Planting of cane so as to reach maturity progressively through the crushing season would bring great benefits to both millers and growers as is explained. Reasons for non-adoption of the system are advanced and it is considered that a combination of factory extension staff and farmer education and incentives should be employed to promote its adoption.

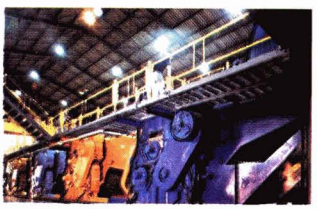
Production and distribution of disease-free sugar cane. A review of work done at Sakharwadi. R. S. Sachan and V. Vaidya. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 34-38. – When Somaiya Sugar Works was established in 1972, 80% of the 12,000 acres of its area was under Co 419 cane and the rest under Co 740. Crop condition was poor and yields were as low as 15-18 tonnes.acre^{-1}. Steps have since been taken to reduce the dependence on one variety, to improve crop health and to raise average yields to 25 tonnes.acre^{-1}. The area under cane has also been doubled.

Physiological studies in shortening of internodes in sugar cane variety Co 740. G. R. Naik, G. V. Joshi and J. D. Nimbalkar. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 39-46. – Experimental studies in which internode shortening was induced by conditions similar to those when the disorder occurs naturally, *i.e.* waterlogging of soil combined with excessive N fertilization, were carried out to determine physiological effects. Radio-isotope studies showed that the rate of CO_2 fixation is higher and that chlorophyll content and photosynthesis and activity of the enzyme PEPCase are stimulated. Less photosynthate is transferred from the leaves to the stalk, however. There is an imbalance in the activities of peroxidase and indole acetic acid oxidase, which are responsible for controlling the auxin level. Nitrogen metabolism is adversely affected.

The effect of urea *vs.* ammonium sulphate on juice composition and jaggery quality in sugar cane. S. Asokan, E. Lalitha, S. Thangavelu and K. C. Rao. *Proc. 18th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978,



Trapiches Zanini, el dulce sabor del suceso.

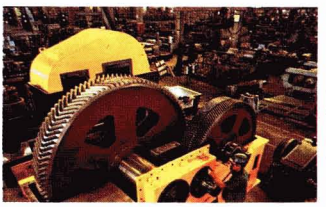


La tecnología Farrel incorporada a los equipos Zanini está presente en los mayores centrales azucareros del mundo. Los trapiches Zanini - Farrel ya demostraron su eficiencia y rentabilidad en el Brasil, Argentina, México, Estados Unidos, Venezuela, República Dominicana, Colombia y otros países.

Fabricados con la técnica más avanzada y un profundo estudio del proyecto, los trapiches Zanini - Farrel pasan siempre por un riguroso control de la calidad, lo que garantiza la gran eficiencia que los centrales azucareros modernos requieren.

CARACTERÍSTICAS DE LOS TRAPICHES ZANINI:

- Mayor capacidad de molienda.
- Gran facilidad de operación.
- Extraordinaria rapidez y facilidad de mantenimiento.



- Gran resistencia, mínimo desgaste.

Su central azucarero merece los trapiches cuyos desempeños ya fueron probados y comprobados en las más diferentes regiones del mundo. Verifique y verá que detrás del suceso de los mayores centrales azucareros del mundo, está siempre la tecnología de Farrel. Y la calidad de Zanini.

DIMENSIONES DEL EQUIPO (en pulgadas):

30" x 54"	36" x 72"	43" x 90"
30" x 60"	37" x 78"	44" x 96"
34" x 66"	42" x 84"	

A pedido, Zanini también puede fabricar trapiches de otras dimensiones.

GARANTÍA:

Los Trapiches Zanini ofrecen una garantía por dos (2) años contra cualquier defecto de fabricación, asegurando así la total tranquilidad del cliente.

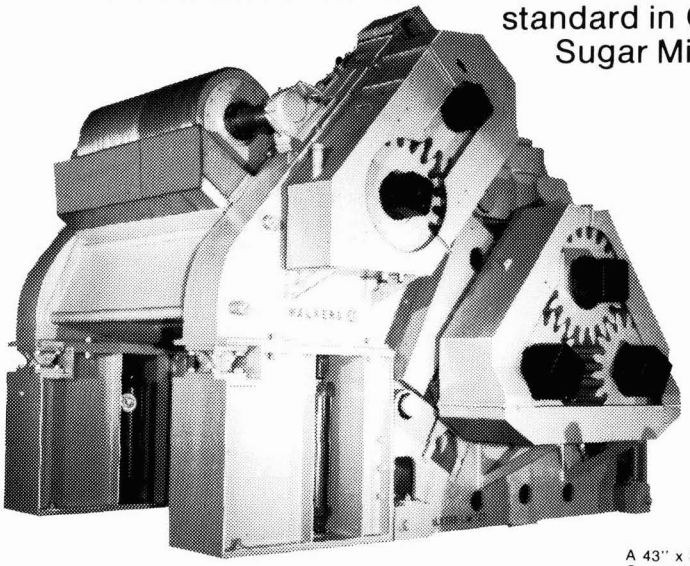
zanini s/a
equipamentos pesados

Fábrica: Km 4 da Rodovia Armando de Salles Oliveira
Caixa Postal, 139 - 14160 Sertãozinho - SP - Brasil
Teléfono: (0166) 42.2255
Telex: 0166.315 - ZANI BR
Oficina Central: Avenida Paulista, 460 - 18° andar
01310 São Paulo - SP - Brasil
Teléfono: (011) 285.5122
Telex: 011.22901 ZANI BR - 011.21550 ZANI BR

A new standard in milling

It isn't easy to remain one of the world leaders in cane milling equipment supply — but we manage.

Perhaps our 100 years experience makes the difference, or could it be our close touch with the end user, or our continuous pursuit of improved milling efficiency; or whatever the reason we intend remaining at the top and feel quietly confident that the Walkers S.R.B. series mills will set the new world standard in Cane Sugar Milling.



A 43" x 84" S.R.B. Mill for a Queensland Sugar Company

Consider the advantages of:

5 roll milling performance permanently lubricated roller bearings.

Grease and oil-free operation simplified access and maintenance, reduced friction losses.

For further information contact the specialists

Walkers Limited

MARYBOROUGH — QUEENSLAND — AUSTRALIA
Telex 49718 — Cable "Itolzak" — P.O. Box 211

WALKERS
MARYBOROUGH QUEENSLAND

RENOWNED ENGINEERING EXPERIENCE SINCE 1864

(I), 47-52. – Comparative trials showed no differences between juice composition or jaggery quality for cane grown with N fertilization in the form of urea and ammonium sulphate.

Studies on intercropping in sugar cane with blackgram. K. K. Prasadarao, M. Radhamohanrao, B. Gopalam, H. Paparao, J. S. N. Raju and B. Jaganmohanarao. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 71-80. – Blackgram grown as an intercrop over a period of five seasons was shown to be profitable and to have a minimum adverse effect on cane yield.

Visit to the Colombian sugar industry, Nov. 1978. G. D. Thompson. *S. African Sugar J.*, 1978, **62**, 624-625, 629, 631. – A survey is presented of the Colombian sugar industry, covering sugar production and prospects, climate, cane yields, varieties and diseases, cultural methods, soils and nutrition, irrigation and drainage, harvesting, insect pests, alternate crops and research.

Raising of a sugar cane seed crop in the Punjab. P. S. Dhillon and N. Singh. *Indian Sugar Crops J.*, 1978, **5**, 43-44. – Guidance is given on measures to produce healthy crops of seed cane, young and immature for spring-planted cane and well-grown cane for the autumn-planted crop. The seed should be heat-treated for disease control, and the cane should be examined carefully at regular intervals to ensure it is free of pests and diseases. Frequent irrigation in December and January should be applied to save the crop from frost damage and it should be tied in August-September to prevent lodging.

Study of correlations between cane yield and different attributing characters. H. V. L. Bathla. *Indian Sugar Crops J.*, 1978, **5**, 45-46. – Four varieties were studied and cane weight found to have a high positive correlation with stalk length, thickness and number of internodes. There was a positive correlation between cane length and number of internodes and a negative one between cane thickness and leaf length.

Enhancing cane yield in regur soils by improving soil structure. P. N. Rao, K. K. P. Rao, B. R. Rao, C. S. Lingam, P. C. Reddy and B. A. Rao. *Indian Sugar Crops J.*, 1978, **5**, 47-49, 51. – In the black or regur soils of Nizamabad district of Andhra Pradesh, the root systems of sugar cane crops are often found to be shallow owing to soil compaction below 22.5 cm depth. This leads to lodging of the crop and ill effects when the soil water table is below the compacted level. Soil bulk density is high and infiltration rates are low. By ripping or deep ploughing to a depth of 45 cm, the hard pan is opened up, infiltration rates are trebled and root weight, number and penetration increased with a consequently higher cane yield.

Nitrogen and sugar cane. XVIII. Nitrogen uptake in relation to its availability from soil and crop efficiency for utilization. U. S. Singh. *Indian Sugar*, 1978, **28**, 319-322. – Investigations showed that N uptake by cane declined with the age of the crop, the maximum being during tillering and minimum during sugar accumulation. Over two years, 58.7% of total N uptake occurred during tillering, 32.2% during elongation and only 9.1% during the sugar accumulation phase of growth. The availability of N from the soil similarly declined during crop growth, and the crop utilized declining proportions of that available to it during the period. There was no confirmation of a positive correlation between soil availability and N uptake, however, and the latter might be due to increased efficiency of utilization by the crop which should therefore be another factor given due importance in a cane breeding programme.

Effect of intercropping of wheat varieties on the growth and yield of sugar cane. S. S. Narwal and K. L. Behl. *Indian Sugar*, 1978, **28**, 323-327. – Cane tiller and stalk numbers were reduced by intercropping with wheat, the effect differing with variety of wheat. Cane row spacing also affected yield, wider rows giving lower yields. The highest net profit was given by 75 cm spacing and intercropping with Hira (HD 1941) triple gene dwarf wheat variety.

A new tool for sugar management. D. Smith. *Sugar y Azúcar*, 1978, **73**, (12), 23-25. – A survey is presented of the history and application of cane ripening chemicals, particularly Monsanto's Polaris, for increasing the sucrose content of cane at harvest.

Production functions and nitrogen optima for sugar cane in different agro-climatic conditions of India. R. L. Yadav and J. Lal. *Indian J. Sugarcane Tech.*, 1978, **1**, 102-106. – An account is given of fertilizer trials at five different sites in India. Statistical examination showed the most appropriate methods of relating yields to treatments, and optimum economic applications are calculated for each region on a basis of the response and the cost of the fertilizer.

Simulating lime-induced chlorosis in sugar cane. IIa. Effect of bicarbonate on elemental compositions. D. K. Tandon and S. C. Srivastava. *Indian J. Sugarcane Tech.*, 1978, **1**, 107-114. – A sand culture experiment with three levels of bicarbonate (5, 10 and 20 meq.litre^{-1}) was conducted to observe its effect on causing chlorosis in cane. Dry matter production tended to decrease with increasing bicarbonate levels, although chlorosis was observed at the highest level. Chemical analysis showed that plants grown in sand with the higher bicarbonate levels absorbed smaller quantities of nutrients, although contents of a few nutrients in some parts were higher than in the control treated with NaCl. The Fe content and Fe:Mn ratio of bicarbonate-treated plants were higher.

Rapid method of leaf area measurement during grand growth period of sugar cane. R. L. Yadav and R. K. Sharma. *Indian J. Sugarcane Tech.*, 1978, **1**, 115-118. Measurements showed that there was a high correlation (r ñ 0.6983) between the area of the tenth leaf from the top of the plant and the total leaf area. The average leaf area per plant when cane enters its major growth period (185 days after planting) may be obtained by measuring the length and width of the tenth leaf, calculating the area and multiplying by 8.9032.

Land levelling by laser beam. Anon. *Australian Sugar J.*, 1978, **80**, 487-488. – A system of land grading or levelling is described which employs a laser generator, the beam from which is received by both a large drag scraper and a fine levelling scraper. These carry a mast which receives the laser beam and can either indicate to the operator if the blade is higher, level or lower than required to give the correct grading. In an alternative form the signal can be used to raise or lower the blade automatically to level or grade the land as required.

SUGAR CANE MECHANIZATION

Economic and productivity analysis of mechanical harvesting at CARPA (Cia. Agropecuária Rio Pardo), 77/78 season. A.R. Tanno. *Brasil Açuc.*, 1978, **92**, 69-72 *(Portuguese)*. –An account is given of the first season of operation of seven Santal Model S-115 cane harvesters at Usina da Pedra in 1977, when 137,956 tonnes of cane were cut mechanically. Data are tabulated for each month between May and November and as totals. The machines were operated initially for 12 hours per day but later for 9 hours. Despite the inexperience of the operators and other personnel, the total costs amounted to 36.46 cruzeiros per tonne against 35.04 cruzeiros per tonne for manual cutting and loading, and the system has advantages where labour availability is variable. However, it cannot be used where furrows are very deep, where cane is completely lodged, after torrential rain or where there are large numbers of rocks or tree stumps.

Land use on steep slopes on an estate on the south coast of Natal. O.P. Landrey. *S. African Sugar J.*, 1978, **62**, 454-459. – See *I.S.J.*, 1980, **82**, 16.

Update on the Stubenberg S-75 short cane harvester at Laupahoehoe Sugar Company. J. R. Marshall. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 39-41. – Details are given of modifications to the Stubenberg S-75 chopper-harvester which have been incorporated in Phase II of the machine. Instead of chains used to pick up the cane in the original version, the modified machine has a bottom feed roll with lower paddles very close to the ground which pick up cane from the basecutter discs; the outer sides of the basecutter feed drums have contoured shields which are within ? inch of the base-cutter paddle teeth tips, so that cane is not thrown outwards. While the pick-up system has worked very well, some chopped cane was dropped on its way from the chopper to the storage bin; however, an inclined rubber belt conveyor installed in place of the secondary chain-and-slat elevator has reduced cane losses. A swinging guillotine knife has proved better for cane chopping than the earlier knife, which tended to mash the billet ends and cause high juice losses. The Phase II machine seems to pick up more dirt than the Phase I harvester, while the basecutter knife speed is considered too low, so that stools are "bulldozed" and the resultant ratoon stands are poor. Further changes are being made in an attempt to remedy this.

Rome wheel tractors in agriculture. J. W. Ray. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.*, 1977, 42. – A brief note is given on rubber-tyred and crawler tractors offered by Rome International Corp., which supplies 50% of its international sales volume to the sugar cane industry for tillage and cultivation. The crawler type operates best at 0-5 mph and is the more suitable type for initial ripping where soil penetration is down to a depth of 35 inches; the 4-wheel-drive, rubber-tyred tractor works best at 4-9 mph.

Brake linkage system is automatic. A. V. Rudd. *Cane Growers' Quarterly Bull.*, 1978, **42**, 50. – The automatic brake linkage attachment described is particularly suitable for cane trailers regularly detached from a towing vehicle, *e.g.* harvesting units using rear delivery. The system is activated by a lever adjacent to the driving position through a mechanical linkage (incorporating a quick hitch) with the trailer hydraulic system. It connects or disconnects itself as the trailer is being hitched or unhitched without the tractor driver needing to leave his seat. The efficiency of the system is not affected by the angle of the trailer to the tractor and it can be fitted easily to existing quick hitches and trailers.

What price combine harvesting? C. H. Burleigh. *Sugar J.*, 1978, **41**, (5), 10-11. – The economic desirability of combine harvesting in developing countries, with fully mechanized cutting, chopping and loading, is questioned and studies quoted which indicate that the increased losses of cane in the field can outweigh the savings in labour costs. It is suggested that complete economic analysis be made in any particular conditions to determine the true costs involved and that this might show that it could be preferable to increase labour recruiting efforts or even to abandon cane cultivation entirely.

Comparative study on the transport costs of chopped and whole-stalk sugar cane. A. B. Santos. *Brasil Acuc.*, 1978, **92**, 150-152 *(Portuguese)*. – Experience at Usina Barcelos in Campos (RJ), is quoted which shows that the total cost per tonne of cutting and loading chopped cane is lower (Cr.36.05 *vs.* Cr.39.93 per tonne) than for manual cutting and mechanical loading, while the higher density of the chopped cane reduces transport costs below those for whole-stalk cane, the reduction being greater for longer journeys to the mill.

Infield cane transport costs. Anon. *Producers' Rev.*, 1978, **68**, (12), 21-22. – The cost of cane transport to the sugar factory is said to amount to about half the cost of producing the crop and determines the profitability of the operation. Mr. H. Poole is quoted on his views of transport systems used in Australia, and his own company's system is described. This employs a method of weight transfer from a trailer through a gooseneck hitch to the tractor and improves the traction of the latter so that a smaller and more economical model can be used to haul the same weight of cane that would require a larger tractor if it were in a conventional trailer unit.

Hydraulics improve the performance of our cane harvesters. D. Gaillard. *Producers' Rev.*, 1978, **68**, (12), 43-44. – The author comments on the increasing application of oil hydraulic machinery in the sugar industry as in the use of hydrostatic drives for cane harvesters. Factors in the choice of such machinery are discussed.

The maximum economical distance to transport sugar cane for milling. L. V. Gentil, E. S. Ometto and H. C. Arruda. *Sugarland*, 1978, **15**, (4), 6-7, 19. – See *I.S.J.*, 1978, **80**, 202-204.

Growers' innovations streamline trash planting operation. J. Wright. *Cane Growers' Quarterly Bull.*, 1979, **42**, 72-74. – An illustrated description is given of modifications to Toft J 150 harvesters for cutting and loading trash planting material. Trials are also reported which showed that no significant difference in yield occurred between trashed and non-trashed planting material.

CANE PESTS AND DISEASES

Rats present in sugar cane cultivation in north-east Argentina. M. A. Costilla and H. Izquierdo. *Rev. Ind. Agríc. Tucumán*, 1978, **55**, (1), 45-49 *(Spanish)*. – See *I.S.J.*, 1980, **82**,117.

Latest report on Eldana borer infestation. G. D. Thompson. *S. African Sugar J.*, 1978, **62**, 581, 583. – An account is given of facilities established in South Africa for monitoring and providing information on the Eldana borer and its control. A coordinated project has been developed for control purposes which includes experimentation on pesticides (Carbofuran and Monocrotophos are the most effective so far) and their application (by fixed-wing aircraft and helicopter as well as by ground spraying at high and low volume), the influence of trashing and burning, and use of biological control with a number of predators (none so far successfully established). Other projects in progress or to be developed are listed.

Studies on smut disease (*Ustilago scitaminea* Syd.) of sugar cane: longevity and viability of teliospores. K. C. Alexander and K. Ramakrishnan. *Indian J. Sugarcane Tech.*, 1978, **1**, 47-49. – Longevity and viability of 58 collections, all from within India, were tested by the method of Alexander & Srinivasan. Longevity ranged from 640 to 1210 days, while in eight collections the teliospores were viable for more than 11 years.

A method for mass rearing of *Isotima javensis* Rohw. P. N. Avasthy and N. K. Tiwari. *Indian Sugar Crops J.*, 1978, **5**, 57-59. – *I. javensis* is a specific parasite of the top borer, *Tryporyza nivella* Fabr. An improved cage has been designed at the Indian Institute of Sugarcane Research for mass rearing of the wasp; it allows a 70-80% recovery of the parasite, as against 30-34% for the earlier design and 50-60% for the muslin method.

Weighted average of the percentage of sugar cane stools infected with mosaic in the state of São Paulo. S. S. Mello. *Brasil Açuc.*, 1978, **92**, 241-243 *(Portuguese)*. An assessment was made of the incidence of mosaic disease in 13 cane varieties grown in various areas of São Paulo by sampling 1% of the area for the chosen variety and selecting at random 100 stools containing 10 stalks each and noting the numbers infected. On this basis, the varieties were classified as resistant (CB 40-69, CB 40-70, CB 41-76, CB 47-355, CB 53-98, IAC 48/65, IAC 52/150, IAC 52/326 and IAC 58/480), intermediate (NA 56-79 and Co 413) and susceptible (CB 40-13 and Co 740).

Laboratory behaviour and biology of *Sturmiopsis parasitica* Curran, an exotic parasite of moth borers of sugar cane. A. N. Kalra and J. Chandra. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 1-4. – The fly, *S. parasitica*, was reared in the laboratory up to 8 generations and tested for parasitization against different borer species found in India. This reached 38.3% with the maize borer, *Chilo partellus*, 23.4% with the stalk borer, *C. auricilius*, 19.1% with the shoot borer, *C. infuscatellus*, 18.9% with the pink borer, *Sesamia inferens*, and 12.2% with the top borer, *Tryporyza nivella*.

Warding off termite attack in sugar cane through cultural practices. A. N. Kalra, R. R. Panje, C. P. Dutta and D. K. Banerji. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 61-64. – Termite damage is usually to setts before germination, and a technique to prevent damage is to transplant germinated setts. This is not usually possible because of the high water requirement and high mortality, but a new technique proved successful. Three-budded setts were planted under translucent polyethylene film and transplanted into watered trenches when all three buds had germinated and 7-cm tall shoots were evident. No difficulty was experienced with transplanting, and termite attack was reduced to 27.2% against 85.2% for the control and 57.6% for setts dipped in an Aretan-Gammexane mixture.

Sexual response and mating behaviour in moths of the top borer, *Tryporyza nivella* Fabr. (Pyrillidae:Lepidoptera), a major pest of sugar cane. A. N. Kalra, A. K. Mehrotra, H. David and J. Chandra. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 65-70. – Control of the top borer is mostly by chemical means but, in view of the hazards involved, the mating habits of the borer have been studied with a view to developing biological control methods. Solvent extracts from virgin females produced a response from males in the laboratory, but were not successful for attracting them in traps in the field.

A new disease on Co 62175 – is it pokkah boeng? D. G. Dakshindas and D. M. Sawant. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 91-93. During a visit to Kopargaon in July 1977, some Co 62175 cane plants were seen which exhibited symptoms similar to those of pokkah boeng. This variety includes in its parentage the variety POJ 2878 which has always been considered very susceptible to the disease, and it is suggested that a close watch should be kept on fields of Co 62175 for occurrence of the symptoms, which include the formation of chlorotic areas on the basal portions of leaves as they emerge from the spindle and also on the leaf sheaths.

Control of parasitic nematodes with Counter, Furadan and Temik and their effect on sugar cane yield. C. H. Hu and T. K. Tsai. *Rpt. Taiwan Sugar Research Inst.*, 1978, (81), 25-34 *(Chinese)*. – The effects of the three title nematicides and Nemacur were compared with those of Terracur P and Thimet over a three-year period. Incidence of the root-knot nematode *Meloidogyne incognita* Chitwood ranged from 5 to 35% against 75% in the untreated controls, with resultant increases in cane size and weight. The most effective material was Counter, followed by Temik and Furadan. Application of Counter 10% G at 30 $kg.ha^{-1}$ resulted in 12.0-18.2% and 32.3-140.9% increases in the yields of autumn and spring cane. Furadan 3% G at 60-75 $kg.ha^{-1}$ raised autumn cane yield by 21.2% and 13.3% in two years, but gave no increase in the third. In the spring crop, the yield increased in all three years, by 24.2-127%. Temik 10% G also raised yields but by less than Terracur P and Thimet, both of which gave a consistent increase in yield over untreated controls. Borer damage also decreased with application of nematicide. Studies with Nemacur are still in progress.

CANE BREEDING AND VARIETIES

Studies on fibre characteristics in relation to anatomical features in sugar cane. S. Rita, S. S. Narayanan and K. C. Rao. *Indian Sugar,* 1978, **28,** 77-80.—The fibre content and the physical properties of the individual fibres were determined for each of six cane varieties (including two clones of *Saccharum barberi*); anatomical studies were also carried out on each variety. The tabulated data are discussed. The three Co varieties studied had comparatively low fibre contents as a result of breeding for this effect. The number of vascular bundles found in each variety did not appear to correlate with fibre content, fibre strength or fibre elongation. Although the three Co canes had smaller juice cells, association of this feature with a high sucrose content[1] requires confirmation by further studies.

Study of the behaviour of some cane varieties (*Saccharum* spp.) submitted to low temperatures under laboratory conditions. O. Brinholi and E.C. Ferraz. *Brasil Açuc.,* 1978, **92,** 20-23 *(Portuguese).* — Ten varieties grown in Brazil were subjected to temperatures of 0°, −3° and −6°C for 1, 6 and 12 hours. Formation of banded chlorosis occurred with all treatments at 0° and −3° except for the 1-hour treatment at 0°. None of the varieties survived treatment at −6°.

Development of basic sugar cane breeding lines in Louisiana. Anon. *Sugar Bull.,* 1978, **56,** (24), 11-14. Information is given on the 1977 series of basic crosses made with new breeding lines at the U.S. Sugarcane Field Laboratory, Houma, Louisiana, including details of the parental material, flowering, crossing and true seed production.

Current status of the varietal development programme. T. L. Tew and D. J. Heinz. *Rpts. 36th Ann. Conf. Hawaiian Sugar Tech.,* 1977, 74-75. — It is stated that when smut was first discovered in Hawaii in 1971, about 75! of the varieties in the selection programme were susceptible to the disease. In 1976, another strain of smut occurred, and 35! of the varieties resistant to the first strain, A, proved susceptible to the second, B. However, this reduction in susceptibility indicated that some genes giving resistance to strain A were also providing resistance to strain B, thus giving a general rather than a specific resistance to smut. The rate of recovery from the effects of smut have been encouraging. Details are given of some of the more promising varieties in each of the five cane areas of Hawaii, including data on the six most promising, *viz.* H 58-8255, H 61-1721, H 62-4671, H 65-2209, H 68-1158 and H 69-9103.

Sugar cane variety trials in Texas, 1977-78 season. S. A. Reeves. *Tech. Rpt. Research Center* (Texas Agric. Expt.Sta.), 1978, (78-4), 67 pp. — Some 50 cane varieties were evaluated in 12 trials, and details are tabulated. In terms of yield, the best varieties (in descending order) were: Co 421 > N:Co 376 > N:Co 310 > Mex 57-473. However, despite their excellent performances, all but N:Co 310 were of such poor juice quality that they could not be recommended for commercial release. In terms of sugar yield, the leading varieties were (in descending order): CP 65-357 > N:Co 310 > CP 66-315 > L 61-49, the last two being experimental varieties. Overall evaluation showed that N:Co 310 continues to be the leading late-maturing variety, CP 65-357 and L 61-49 are the best early-maturing varieties, while CP 66-315 is the best for mid-season harvesting. Cane carried over from the previous season showed such high sugar losses (in some cases as a result of rat damage and lodging) and generally poor juice quality that the practice of carrying-over is to be avoided, even if it means destroying cane which cannot be harvested at the normal time.

Commercial evaluation of new varieties. E. A. Pembroke. *Cane Growers' Quarterly Bull.,* 1978, **42,** 53-54. — The system used by the Bureau of Sugar Experiment Stations in commercial evaluation of new cane varieties is described.

Investigations on clonal selection of sugar cane (*Saccharum* spp.) in the Argentine Republic. Revision of experimental results. J. A. Mariotti. *Rev. Ind. Agríc. Tucumán,* 1978, **55,** (1), 27-43 *(Spanish).* — Critical problems of clonal selection encountered during the past 10 years included very high selection pressure in the early stages, extremely subjective criteria for selection, especially in Stage I, very narrow variability for important traits in original progenies, and a high frequency of genotype x environmental interaction interferences. The degree of genetic determination appears to be acceptable for most traits from Stage II on. A conditional environmental component of variation, which affects the efficiency of the genetic parameters estimated, was detected for diameter and number of stalks, with very definite trends. Association studies show that the number of stalks is the most conspicuous cane yield component. A non-linear type of association was detected between number of stalks and diameter, which might explain some of the interactions found between this relationship and environment. Alternative or joint selection for cane yield and quality may be done readily without secondary effects. These characteristics were found to be independent under the conditions of the programme. From selection experiments carried out in varying environments it may be concluded that the environmental treatment strongly influences the selection of genotypes with specific adaptability which might affect the efficiency of the process.

Variability in sub-clones obtained from sugar cane tissue cultures. L. D. Ploper and J. A. Mariotti. *Rev. Ind. Agríc. Tucumán,* 1978, **55,** (1), 59-64 *(Spanish).* — Sub-clones were obtained by tissue culture from three varieties, and the degree of variability in these progenies was examined in relation to several yield and quality components. A residual variation which could be interpreted as genetic appears in respect of cane yield, stalk weight and juice quality. Possible explanations are discussed as well as prospects for their utilization in breeding.

Production and introduction of sugar cane varieties. V. González R. and C. Uzcátegui L. *Bol. Est. Exp. Occidente* (Venezuela), 1972, (95), 1-18 *(Spanish).* During 1970/71 a total of 56 biparental crosses and 3 multiple crosses were made and 15,000 seedlings produced, of which 5000 were brought to field testing

[1] Oworu *et al.:* Ann. Bot., 1977, **41,** 393-399.

for mosaic resistance. Of the 1969 seedlings, 260 selections were subjected to a first comparative trial, while 179 of the 1968 selections were advanced for a second trial. Results of earlier selections are recorded, of which nine 1964 varieties have gone for regional assessment. A record is also presented of trials with varieties imported from Jamaica, Barbados, USA and Puerto Rico in the period.

Sugar cane variety tests. O. Lozada V. and J. Panza. *Bol. Est. Exp. Occidente* (Venezuela), 1972, (96), 29-51 *(Spanish)*. – Comparative trials were carried out with locally bred varieties as well as varieties imported from Barbados and Puerto Rico. Best results were obtained with different varieties in separate areas having different soils.

Production and introduction of sugar cane varieties. V. González R., C. Uzcátegui L. and A. Manzano Ch. *Bol. Est. Exp. Occidente* (Venezuela), 1973, (98), 3-30 *(Spanish)*. – An account is given of crossing and selection activities in 1973. From 10 biparental crosses and 2 groups of multiple crosses, a total of 36,264 seedlings were raised, of which 9930 were sent for field testing. Selection of earlier produced crosses continued, and four of the 1965 series were judged comparable to the four best control varieties. A total of 143 varieties of the B 70 and B 71 series were introduced from Barbados, 35 from the world collection, including some commercial varieties and clones of *Saccharum officinarum* and *S. spontaneum*. Testing of varieties imported earlier continued and PR 1117 was chosen for replicated yield testing.

Sugar cane variety trial in the centre-western region of Venezuela. O. Lozada V. and J. D. Panza. *Bol. Est. Exp. Occidente* (Venezuela), 1973, (100), 3-14 *(Spanish)*. A record is presented of trials in a number of areas, and the best varieties from the 1964 series and imported varieties determined for each area in terms of yield and recoverable sugar content (TCTS).

Production and introduction of sugar cane varieties. V. González R., C. Uzcátegui L. and A. Manzano Ch. *Bol. Est. Exp. Occidente* (Venezuela), 1974, (101), 1-24 *(Spanish)*. – An account is given of seedling production and selection in 1973, and of the importation of varieties from Barbados and the world collection in the same year.

Sugar cane variety trial in the cane areas of the centre and west of Venezuela. O. Lozada V., J. D. Panza and C. Rincones. *Bol. Est. Exp. Occidente* (Venezuela), 23-29 *(Spanish)*. – Trials were made with eight imported varieties against four standards in two crops. Co 740 had sufficient consistency for it to be sent for commercial testing, all the other varieties showing some defect of adaptation, phytopathology or agronomy.

Genetic evaluation of early genotypes for quality characters in sugar cane. R. S. Sangwan, A. D. Taneja and K. L. Behl. *Indian J. Sugarcane Tech.*, 1978, **1**, 13-16. – Trials were conducted to evaluate 21 cane varieties known for early maturity, and the Brix, sucrose, purity and c.c.s. values recorded in November, December and January. Co 6803 showed the highest levels of c.c.s., reaching 10.0 in November, 11.5 in December and 12.2 in January. A number of varieties reached a peak c.c.s. value in December which fell in the next month, but most showed an increase as the season progressed. Enough variability existed which was moderately heritable, but the range of variability and genetic advance was low for all the characters under study.

Correlation and regression studies between yield and its attributes in sugar cane varieties. R. L. Yadav and R. K. Sharma. *Indian J. Sugarcane Tech.*, 1978, **1**, 17-22. Field trials were made with four varieties to determine the relationships between cane yield and contributory factors. With CoJ 64 cane there were positive and statistically significant relationships between yield and number of millable canes, weight per cane and length per cane. With CoJ 67 there was a positive significant correlation only with number of millable canes, and with Co 1158 only with girth of cane. The number of millable canes was the factor making maximum contribution to cane yield in all varieties except Co 1158, where its contribution was the same as weight per cane.

CoS 770 – an outstanding sugar cane variety for Uttar Pradesh. H. N. Singh, S. B. Singh and S. Sharma. *Indian Sugar Crops J.*, 1978, **5**, 60-65. – Cos 770 is a Co 1158 x CoS 510 cross, raised at the Sugarcane Breeding Institute, Coimbatore, and subsequently raised and selected at the Shahjahanpur Research Station. It is a thick, heavy, late-season cane giving high yield and sugar per unit area. It is moderately resistant to red rot and smut, resistant to wilt and moderately susceptible to albino disease.

Purification of water for a nutrient solution for sugar cane crosses. J. Y. J. Miocque, M. Nagumo and J. A. de Oliveira. *Brasil Açuc.*, 1978, **92**, 153-159 *(Portuguese)*. During cane seed isolation, the cut tassels are maintained in physiological activity by means of a nutrient solution, and this requires a large volume of pure water. It was found that fresh stream water, after treatment with bentonite and aluminium sulphate, was satisfactory for this purpose and so provides an easily obtainable and low-cost source.

KHS 3296 – a promising cane variety of Karnataka. B. S. Nadagaudar, C. Shankaraiah, C. Marigowda, N. Dwarkanath and G. V. Lokeshwarappa. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I), 53-60. – Evaluation of a number of varieties led to identification of KHS 3296 as a promising variety for Karnataka state, with the same yield potential as that of Co 62175. It is a thick cane with broad leaves, erect habit and shy flowering, easy to trash and a good ratooner.

The 1978 variety census of Florida sugar cane. G. Kidder and E. R. Rice. *Sugar y Azúcar*, 1978, **73**, (12), 29-30. Over 90! of all cane grown in Florida is of eleven varieties, all of them either CP (Canal Point) or CL (Clewiston) varieties. CP 63-588 represents 43.7% of plant cane and 35.9% of ratoon cane, and has been the most popular for four years.

N:Co 310 is still our main variety despite Fiji disease. Anon. *Producers' Rev.*, 1978, **68**, (11), 15. – Figures for the 1977 harvest showed that N:Co 310 remained the leading variety in Queensland with 8,451,061 tonnes or 37.8% of the crop. This represented an increase from 36.0% in 1976 and was at the expense of varieties bred by the Bureau of Sugar Experiment Stations (54.6% *vs.* 56.1%), CSR Ltd. varieties having increased slightly from 6.4 to 6.8%. Other foreign and unclassified varieties were also reduced from 1.5 to 0.7%.

SUGAR BEET AGRONOMY

Sugar beet harvesters compared. W. Gehlen. *Die Zuckerrübe*, 1979, **28**, (1), 22-25 *(German)*. – The performances of twenty-one beet harvesters, operating at 4.5 and 7 $km.hr^{-1}$, were compared, and the results are tabulated. It was found that, by comparison with the previous year, the beet losses were slightly reduced, whereas the extent of root breakage was considerably smaller. Topping quality was about the same. The higher speed had, on average, no adverse effect on the results obtained at the lower speed.

The fight against weeds in sugar beet agriculture. J. M. Belien and J. F. Salembier. *Le Betteravier*, 1979, **13**, (128), 16-17 *(French)*. – Guidance is given on selection of pre-sowing, pre- and post-emergence herbicides. Seven factors to consider when making the choice are listed.

Micro-granulators: control and new developments. A. Vigoureux. *Le Betteravier*, 1979, **13**, (128), 18 *(French)*. Advice is given on operation of micro-granulators for insecticide application and brief description is given of a new development which controls the application rate in proportion to the linear speed.

Weed beet – whose problem, the farmer's or the seed producer's? M. Arnold. *British Sugar Beet Rev.*, 1979, **47**, (1), 5-7. – The origins of various types of unwanted or weed beet are discussed. Those which arise from contamination of commercial seed are the responsibility of the breeders who are taking extensive precautions to eliminate this source. There is a natural small proportion of bolters in even the best seed, however, and seed set by these will produce beet in other crops of the rotation or in later beet crops, since they remain viable for some time. Other weed beet is derived from groundkeepers, unharvested roots, overtopped beets, etc., and these last two are a responsibility of the farmer. With the adoption of chemical control instead of hand weeding, these unwanted beet are not killed by the selective herbicides and so will persist unless destroyed in another crop. In order to improve control, more work needs to be done on causing germination of seeds, and the adoption of suitable crop rotation lengths to ensure that unwanted plants of unsuitable genetic character do not develop in the beet crop.

Weed beet in other crops of the arable rotation. J. Gunn. *British Sugar Beet Rev.*, 1979, **47**, (1), 7, 9-10. – If weed beet grow in another crop or in a fallow year of a rotation, they will provide an aggravated problem in the next. Surveys carried out in the UK since 1975 have shown that numbers are greater when beet is grown every 3rd or 4th year than in longer rotations. They occur more in beet and potato crops and can then set seed, although when they occurred in peas and lucerne the crop was usually harvested first. Fine spring seedbeds and light cultivation after cereal harvest encourages germination of the seed, and the beet plantlets can then be killed with Paraquat. Although deep ploughing reduces the number of weed beets emerging in one season, the seeds are redistributed and the problem recurs later. Weed beet surviving routine herbicide treatment need to be controlled by hand pulling, cutting or herbicide treatment with a roguing glove. Groundkeepers need to be encouraged to rot by ploughing after the sugar beet crop has been harvested, although if bolters have been present, surface cultivation is preferable so that seeds are not buried too deep and so will germinate easier and be killed by later herbicide treatment. Wild beet growing on waste ground, on verges and near clamps or loading sites should be destroyed with the cooperation of road authorities where applicable.

Partial crop failure – resow or leave. K. Jaggard and A. Dunning. *British Sugar Beet Rev.*, 1979, **47**, (1), 17-19. Resowing a partially failed crop should be done only if the second crop will intercept more sunlight (and so produce more sugar) than if the original poor stand had been left; this will only be so if resowing can be done early and a full and vigorous plant population established rapidly. It should be remembered that half the normal plant population will give about 85% of a normal yield because of reduced competition, while a one-third population can give 75% of the normal yield. In case of doubt, therefore, resowing should be avoided.

Principles of weed control in sugar beet. S. Wilcockson and K. Scott. *British Sugar Beet Rev.*, 1979, **47**, (1), 21-24. – In 1978 conditions favoured weed growth in beet fields; frequent rain encouraged weed seed germination, while cold weather retarded development of beet leaf cover. Later hot, bright weather induced delay in herbicide application to protect the beet seedlings and later rain prevented tractors getting onto the land for side-hoeing. Studies have been made of the effects on beet yield of allowing weeds to remain for variable times before removing them; loss was avoided by weeding at 4 and sometimes 6 weeks. Different weeds have different effects, fat hen reducing yield the most, followed by mayweed. Control measures are discussed, including the use of chemicals, and the adverse effect of herbicides on sugar beet is noted.

Herbicides for 1979. N. Turner. *British Sugar Beet Rev.*, 1979, **47**, (1), 31, 33. – The chemicals recommended for weed control in sugar beet in the UK are surveyed and application conditions described.

Growing sugar beet in beds. J. Topper. *British Sugar Beet Rev.*, 1979, **47**, (1), 32-33. – The system adopted at a UK farm involves growing beet in 60-in beds separated by 20-in gaps for tractor wheels. In the beds, the beet is drilled in rows 10 in apart with 7 in seed spacing within the row. Plant population is higher than with conventional drilling, but with no compaction the root shape is more uniform and the crop is less susceptible to aphids. The seeds germinate quicker, giving better weed control, and topping is better. The beet is harvested with a modified potato harvester and the system is estimated to yield an income higher by about £50 per acre.

Harvester unit plus Moreau topper equals much faster output. C. Astill and K. Graveling. *British Sugar Beet Rev.*, 1979, **47**, (1), 35. – The system used by a harvester contractor is described and illustrated. The front-mounted topper permits faster harvesting than another unit where the tops are elevated and discharged for use in silage. Other methods and equipment used by the contractor are mentioned.

BEET PESTS AND DISEASES

The distribution of *Heterodera schachtii* in California. D. A. Cooke and I. J. Thomason. *Plant Disease Reporter*, 1978, **62**, 989-993. — The sugar beet nematode *H. schachtii* occurs in 19 of the 29 beet-growing counties of California in a range of soil types. In 1976, 27,826 ha of sugar beets were reported to be infested and the loss estimated at 179,945 short tons of roots or 26,920 tons of sugar. The total area of infested land in the beet-growing areas of California is estimated as 148,347 ha.

Aldicarb post-plant control of the sugar beet cyst nematode, *Heterodera schachtii*. G. D. Griffin. *Plant Disease Reporter*, 1978, **62**, 1027-1030. — Beet yields were directly affected by the population density of *H. schachtii* in the soil and the interval between drilling and application of the nematicide Aldicarb. The differences were not significant where the soil was allowed to dry out to 20% of field capacity before irrigation. There were significant differences, however, in beet yields between Aldicarb-treated and untreated plots where irrigation was applied at 50% field capacity and, although not significantly, yields were also raised for plants grown in soil of minimum 80% field capacity in contrast to 50%.

Taking stock of nematode damage in sugar beet by aerial infra-red photography. E. Sanwald. *Zuckerind.*, 1979, **104**, 125-129 *(German)*. — Two-year investigations were conducted on the detection of beet damage by *Heterodera schachtii*, using aerial infra-red photography. Evaluation of the extent of damage (shown as bright areas against darker, healthy sections) was carried out by optical and electronic density measurement and checked against spectrophotometric studies on plant leaves, petioles and soil. This confirmed that the infra-red method is valid, and can differentiate between beet crops and other crops at a scale of 1:10,000. Comparison between soil sampling for cyst counts by the Fenwick method and the Biotest method showed sufficient differences to make both methods unreliable, so that the infra-red method is suggested as a valid means of determining where fumigation should be carried out before beet is sown, thereby preventing unnecessary expenses and environmental pollution (incurred as a result of incorrect decisions). The costs of the method are about 10% of those of conventional methods.

Ten-year field tests on fungicidal treatment of pelleted and unpelleted sugar beet seed. F. Koch. *Zuckerind.*, 1979, **104**, 131-135 *(German)*. — Reference is made to 10-year tests at various sites in a number of countries in which both pelleted and unpelleted seed was treated with various fungicides and the effects on incidence of *Phoma betae* determined. Results indicated that TMTD (Thiram), which has been used for more than twenty years, is still the most effective fungicide with both types of seed. No resistant strain of the fungus has been found.

Morphological and biochemical changes in sugar beet roots affected with heart rot. V. P. Agnihotri and K. Singh. *Indian J. Sugarcane Tech.*, 1978, **1**, 76-82. Heart rot in sugar beet, the consequence of boron deficiency, has been observed in sugar and seed beet crops, appearing in irregular patches in the fields. Symptoms usually appear in both the top and root of an affected plant; death of the growing point and tender tissues of the crown and occurrence of ladder-like thickenings on the petiole are diagnostic symptoms in a root crop, while the death of the terminal portion of an inflorescence is diagnostic in a seed crop. Mature roots affected with the disease become unfit for sugar extraction, while infection in a seed crop affects the size of the seed and its germination capacity. Heart rot reduces the length, width and crown diameter of the roots, so causing a lower yield, while sprouting of dormant axillary buds and increase in nitrogen content cause deterioration of juice quality.

Influence of benomyl on soil microbes, their related biochemical transformation and control of damping-off of sugar beet seedlings. V. P. Agnihotri, S. Pandey and K. Singh. *Indian J. Sugarcane Tech.*, 1978, **1**, 83-91. The total population of bacteria in soil was stimulated by application of 22.5 and 45 ppm of benomyl but was adversely affected by 90 ppm. *In vitro*, the fungicide completely arrested the growth of *Fusarium* sp., *Penicicillium expansum* and *Trichoderma viride* at 1.25 ppm and of *Rhizoctonia solani* and *R. bataticola* at 2.5 ppm, the last two not producing sclerotia. Benomyl impaired nitrification for 2-3 weeks, depending on the initial concentration; conversely, ammonification was enhanced, the amount of ammoniacal N accumulated depending on the concentration applied. Soil respiration was also adversely affected, initial depression of CO_2 production being directly proportional to benomyl concentration in the soil. Benomyl-treated soils showed higher levels of available P than the control. Pelleting of beet seeds with benomyl using methyl cellulose as a binder was better than conventional seed treatment for protection of seedlings against *R. solani*, while drenching of soil with benomyl t 20 $kg.ha^{-1}$ not only increased the plant stand but also increased the root:shoot ratio.

Micro-granulators: control and adjustment. T. Vreven. *Le Betteravier*, 1979, **13**, (129), 16 *(French)*. — Brief advice is given on control and adjustment of various types of micro-granulator for different pesticides and a speed of 5 $km.hr^{-1}$.

Lower leaf scorch of sugar beets resulting from potassium deficiency in the Red River Valley. J. T. Moraghan and D. F. Cole. *J. Amer. Soc. Sugar Beet Tech.*, 1978, **20**, 133-146. — A combination of greenhouse and field experiments established K deficiency as the cause of the lower leaf scorch observed, and the conclusion was supported by soil analysis but not leaf analysis; sampling of leaves some time after appearance of the symptoms might have affected their analysis as a diagnostic tool. Work is needed to establish critical levels of available soil K, the influence of soil Na and critical plant K levels.

Rhizomania — a dangerous disease for beet cultivation. P. Ioannide. *Hellenic Sugar Ind. Quarterly Bull.*, 1979, (36), 347-355 *(Greek)*. — *Rhizomania beticola* first occurred in Greece in 1972 and is now well established, posing a threat to beet fields in the Thessaly region. Details are given of the symptoms of the disease, its etiology, causative agents and hosts, and possible means of control.

CANE SUGAR MANUFACTURE

Copersucar system of milling – practical observations in season 1975-76. C. Procknor. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 309-313; through *S.I.A.*, 1978, **40**, Abs. 78-1422. – The cane preparation and milling plants at Usina Central Paulista, Jau region, are briefly described, their maintenance is discussed and performance data are evaluated. With the advent of articulated knives of hard-faced soft steel, the maintenance of preparation equipment has changed from the repair of sudden breakdowns to the preventive replacement of worn components every 10 days; the direct cost is higher, but is fully compensated by convenience and the high degree of preparation (71-83% open cells, which should reach 85% in stable operation at full capacity).

Cane diffusers – advantages and disadvantages with respect to milling. D. J. L. Hulett. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 331-338; through *S.I.A.*, 1978, **40**, Abs. 78-1426. – The BMA diffusion system at Empangeni, Zululand, is described with a diagram, problems in its initial operation are indicated and subsequent modifications are outlined. Notes are made about other diffusion systems (de Smet, Saturne, Fletcher and Stewart/Van Hengel) in South African factories, and performance data are tabulated for six factories using diffusion and six factories using milling only.

Studies on the composition of sugar factory and distillery incrustations. III. Correlation between the inorganic composition of mixed and clarified juices and the incrustations. N. A. da Glória and E. da Silva. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 293-305; through *S.I.A.*, 1978, **40**, Abs. 78-1427. – 46 samples each of mixed juice and clarified juice were obtained at seven factories by compositing sub-samples once a shift throughout several evaporator cycles between cleaning; 58 scale samples were taken in the same periods. The samples were dried, ignited at 500°C, extracted into HCl and analysed for elements; results are tabulated and discussed. During clarification, Si, P, Fe and Al were removed well, while contents of Ca^{++}, SO_4^{--} and, to a lesser extent, Na^+ increased; the high K^+ and low Mg^{++} contents were almost unaffected. Si, Fe and Al concentrations depended mainly on the amount of soil in cane delivered, and therefore varied widely; P_2O_5 in mixed juice was usually 200-250 ppm. The value of r [= P_2O_5 / (SiO_2 + Fe_2O_3 + Al_2O_3)] for mixed juice was >0.25 in 22% of cases and <0.15 in 37% of cases; according to Perk, these values should give good and difficult clarification, respectively. Occasional high Fe and Cu contents in scale indicated corrosion after clarification.

Effect of using sources of phosphate in cane juice clarification. J. F. Silva. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 339-353; through *S.I.A.*, 1978, **40**, Abs. 78-1428. – Four series of tests are reported in which mixed juice was clarified, by simple defecation or defecosulphitation, with or without dosing with 100-300 mg P_2O_5 per litre, in the form of H_3PO_4, Na_3PO_4, $(NH_4)_2HPO_4$ or Na polyphosphate. Values for % ash, hardness, P_2O_5, colour, mud volume (final, 5 minutes, 30 minutes), reducing sugars and turbidity in the clarified juices are tabulated and discussed, with indication of the statistical significance of differences.

Behaviour of polyelectrolytes as auxiliaries in cane juice clarification. J. F. Silva and E. da Silva. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 353-369; through *S.I.A.*, 1978, **40**, Abs. 78-1429. – Ten flocculants were tested at a dosage of 1–5 mg.litre^{-1} mixed juice, with and without $(NH_4)_2HPO_4$ addition to give 200 mg P_2O_5/litre. Apart from an improvement when phosphate had been added, there were no significant differences between clarified juice parameters (% ash, hardness, colour, phosphate, reducing sugars). Doses of 1.5 or 2 mg.litre^{-1} often gave faster sedimentation than 3 or 4 mg.litre^{-1}, and sedimentation with Talosep A_5 was in general at least as fast as with any of the other nine.

Planning of the boiling section. F. Zarpelon. *Anais do IV Seminario Copersucar da Agroindustria Açuc.*, 371-376; through *S.I.A.*, 1978, **40**, Abs. 78-1431. – Final massecuite should be boiled with a footing of *A* run-off syrup (purity approx.70) rather than syrup from the evaporators (purity approx.83), since the latter leads to more conglomerates and a higher total quantity of massecuite per tonne of cane; the former increases the quantity of *A*-massecuite at the expense of B-massecuite, giving higher quality and easier recovery of the majority of commercial sugar; alternatively, it allows an increase in the purity of 1st massecuite (of 2) without impairing final molasses exhaustion. When possible, small vacuum pans should be replaced by large ones. An auxiliary vessel should be provided so that massecuite can be stored as crystalline footing for future boilings; this minimizes the number of seedings and allows the boiling time of a crystal to be extended until it is a suitable size for discharge. Recommended volumetric ratios of seeded footing to eventual massecuite are: for final (*C* or 2nd) massecuite, 1:9 rather than 1:20; for *B*-massecuites, 1:9 to 1:12, depending on whether the sugar is to be bagged; for *A* or 1st massecuite, 1:9, or even 1:6 if the purity is very high.

Dilution of residual juice in intermediate bagasse and effects of chemicals through imbibition water. V. M. Murugkar, S. N. Bableswar, L. B. Adarakatti and S. J. Lagare. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Man.), 1-10. – Trials were carried out on the addition of 8-15 ppm of a surfactant, Sushira, to imbibition water. As a consequence of its use, pol % bagasse was reduced by 0.2-0.8% and moisture % bagasse by 2.0-2.6%.

Cost reduction in sugar production. A. C. Chatterjee. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Man.), 11-22. – Ways to reduce production costs are suggested, including cane harvesting on a maturity basis, coupled with cane payment on a quality basis, as well as improvements in factory operation to obtain better milling extraction and process recovery, more efficient fuel economy and higher income by utilization of by-products, elimination of the premium for bold grain sugar, improved machinery design and layout, closer control of inventory, materials, maintenance costs, and expenditure, manufacture of raw sugar for export, better instrumentation and coordinated research.

Molasses Desugarization Plant, Naantali Sugar Factory, Finland.

The experts in molasses desugarization know in sugar refining how to improve your sugar output your sugar quality

Cane and Beet Molasses

↓

Finnsugar – Pfeifer & Langen Molasses Desugarization Process

↓

Dark and light color syrups
Liquid sugar
Fructose rich syrups
Raw and white sugar

Engineering, a division of the Finnish Sugar Company, is in an excellent position to offer various services to the world's sugar industry both as consultant and plant supplier. The different activities thus extend from consultancy and preparation of feasibility studies up to the engineering and delivery of complete turn-key industrial plants with appropriate training and management. Besides sugar refining, the program includes the handling and utilization of by-products – with special emphasis on molasses desugarisation and ion exchange technology, production of isomerose, cattle feed, and various other products.

Raw Sugar

↓

Finnsugar
Refinery Process

↓

Refined granulated sugar
Liquid sugar
Lumpsugar
Sugar loaves

The Finnish Sugar Company runs one of Europe's most modern sugar refineries and one of the world's largest molasses desugarization plants. Being independent of any machinery manufacturing group, Finnsugar

FINNSUGAR ENGINEERING

Finnish Sugar Co. Ltd.
Finnsugar Engineering
SF-02460 KANTVIK, FINLAND
Phone Helsinki 298 5131
Telex 121076

Electrical resistance heater for low-grade massecuite. V. S. Bagi. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I–Man.), 23-30. – A simple resistance heater was designed and built at Shree Datta Shetkari S. S. K. Ltd. and is used to reheat low-grade massecuite. The final molasses purity obtained is lower than that when the massecuite is heated by means of a hot-water coil unit, the difference in purity being greater when the massecuite has been cooled furthest and requires a greater temperature rise.

A simple and efficient design for a continuous cane juice clarifier. B. L. Mittal. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Man.), 33-36. – A clarifier design is described which has been applied to a 100 tcd unit installed at a khandsari sugar factory. It has a flash tank from which cloudy juice passes to a closed main tank with a single tray. Clear juice is withdrawn from the peripheral gutter at the top of the upper compartment and from a central pipe leading from the top of the bottom compartment. Residence time is just over 2 hours and this should reduce the purity drop in clarification relative to that in a conventional clarifier.

Improvements in extraction (milling and diffusion). A. C. Chatterjee. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Eng.), 1-9. – Recommendations are made in regard to milling and diffusion intended to improve extraction. These include attainment of uniform cane feeding, good cane preparation, high primary extraction, adequate and effective imbibition and efficient secondary extraction. The advantages of a higher degree of cell rupture are noted. The principles of cane diffusion are summarized and brief accounts given of a number of cane diffuser designs.

"Modern boiler" required major modifications. T. M. Karne. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Eng.), 10-24. – A popular modern boiler was installed at Shri Chatrapatti sugar factory but was subject to choked header end tubes, and burst relief tube stubs and bends. The manufacturers claimed that failures were due to improper operation and could suggest no remedies, but the factory engineers devised modifications which cured the problems. The manufacturers paid for these modifications and have adopted them for the boilers they have made subsequently.

Improvements in milling efficiency. R. K. Sirdeshmukh. *Proc. 28th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1978, (I-Eng.), 25-30. – Milling efficiency always requires a compromise between throughput and extraction but can be improved by attention to particular aspects which are discussed, namely uniform cane feeding, finer cane preparation, mill feedability, the use of Donnelly chutes and rake-type carriers, force-feeding of mills and imbibition.

Unquantified sugar losses. C. E. Monteiro. *Brasil Açuc.*, 1978, **92**, 229-231 *(Portuguese)*. – Among the losses of sugar in a factory which are not usually taken into account in chemical control are those in condensates from evaporator effects and in barometric condenser water. From measurements of sucrose content and condensate volume, the loss at a São Paulo factory are calculated as totalling 8790 g sugar per day, while that for condenser water is estimated at 229.03 $kg.day^{-1}$. The value involved indicates that it is worthwhile installing the relatively low-cost equipment needed to prevent entrainment. While few data are available on the losses of sugar occurring in cane wash water, they are thought to be large enough to warrant work on eliminating washing, such as, for example, returning in extreme cases to manual cleaning and loading of cane and also to hastening adoption of harvesters which eliminate wet cleaning. The pollution load in water streams from a sugar factory are equated to a population of 50 million, and the distribution of this load between different effluents is discussed.

Obtaining proteins from juice. J. Studnicky. *ATAC*, 1978, **37**, (2), 16-21 *(Spanish)*. – Coagulation curves for cane juice were determined over the complete range of pH on a basis of the amount of N eliminated and the quantity of mud. The optimum coagulation of the proteins occurs at pH 2.4-3.25 while adjustment of the pH with H_3PO_4 and alkaline magnesium carbonate over the range of 4.2-7.6 showed that the maximum amount of sediment was obtained at pH 4.8 when the colour of the clarified juice was also very good. A number of alternatives for the process are described and are to be tried on a micro-plant scale.

Influence of organic acids on the deterioration of final molasses in the production of sugar. J. A. Urrutia and E. L. Ramos. *ATAC*, 1978, **37**, (2), 53-65 *(Spanish)*. Experimental studies were made on the effect of organic acids and amino-acids on the deterioration of molasses at 90°C and at different initial pH values in respect of colour, pH, and sucrose measured as the difference between total sugars and reducing sugars. The results are plotted in graph form, and it is concluded that the organic acids catalyse deterioration, most markedly at low pH. Sucrose inversion plays a fundamental role in the influence of pH on molasses and sugar deterioration. The buffering power of organic acids in sugar products is largely responsible for the lower deterioration of molasses at higher pH levels, since they reduce the tendency of the pH to fall to acid levels.

Lime kiln working difficulties and remedies. K. K. Kohali. *Indian Sugar*, 1978, **28**, 315-317. – Factors affecting the operation of lime kilns are discussed. The importance of limestone and coke quality, lump size and ratio is emphasized, as is operation to maintain the desired temperature uniformly throughout the kiln and so avoid under- and over-burning, scaffolding, etc. Remedies for these conditions are listed.

Colloquium on "diffusion". *Comm. Sugar Milling Research Inst.*, 1978, (117), 50 pp. – A colloquium was organized by the SMRI in South Africa in order to present an up-to-date review of the subject, to provide the latest pertinent data and to pinpoint the outstanding problems. This was done by the presentation of a number of papers on various aspects, followed by an informal and general discussion of each (which was not recorded). The introductory papers are included, *viz.* "Cane *versus* bagasse diffusion and the optimum length of diffusers" by M. S. Greenfield, "Percolation in diffusers" by P. Rein, "Angle of percolation" by G. Matthesius, "Bagasse dewatering" by G. B. O'Reilly, "Mechanical problems – maintenance of diffusers" by B. van der Riet, "Steam consumption of a cane diffuser" by G. N. Allan, "Material balance and press water treatment" by J. Tijl, "Sanitation, pH and temperature control" by A. B. Ravnö, and "Non-sucrose formation – diffusion *vs.* milling" by A. Rouillard.

BEET SUGAR MANUFACTURE

Juice softening with cation exchanger regeneration with thick juice under factory conditions. Ya. O. Kravets, G. V. Buzovetskaya, A. A. Ivanyuk and V. A. Kolesnik-Tereshchenko. *Sakhar. Prom.*, 1979, (2), 15-18 *(Russian)*. KU-2-8 cation exchange resin was used to reduce the Ca^{++} and Mg^{++} contents in 2nd carbonatation juice; after a number of cycles, the resin was regenerated with NaCl or thick juice obtained from the resin-treated carbonatation juice. Regeneration with NaCl gave a deliming efficiency of 81%, while regeneration with thick juice gave 70% efficiency, but the advantage of the latter treatment lay in the reduced consumption of both NaCl and water and hence decreased dilution of the juice and lower waste water quantity. However, it was found necessary to use NaCl as regenerant every 1-2 cycles where the untreated juice contained more than 0.54% CaO/100°Bx or where abnormal conditions occurred; in addition, since regeneration with thick juice took double the time required for regeneration with NaCl, the amount of resin required in the unit was double the normal quantity. While deliming increased the heat transfer coefficient in the first two effects of a multiple-effect evaporator, the juice suffered a greater increase in colour content than did untreated juice; this was attributed to longer retention in process up to evaporation, and partial mixing of the juice with thick juice as a result of resin regeneration.

Juice purification by electrodialysis. N. S. Fedorova, P. P. Zagorodnii, K. P. Zakharov, Zh. I. Katrokha, V. I. Vasil'chuk and L. D. Bobrovnik. *Sakhar. Prom.*, 1979, (2), 19-22 *(Russian)*. – Tests were conducted on electrodialysis, with NaCl solution as concentrate, of 2nd carbonatation on juice pre-cooled to 50°C. At a flow rate of 0.03-0.04 $m.sec^{-1}$ and a current density of 30-40 $A.m^{-2}$, the juice purity was raised by 1.6 units and the lime salts content reduced by 26.4%; the K^+, Na^+, total N and carbonate ash contents were reduced by 31.0%, 28.8%, 8.21% and 25.8%, respectively. Colour decreased by 5.6%. The treatment increased the rate of evaporation, so that the Brix in the 3rd effect was 51.9° compared with 46.6° without electrodialysis. In addition, boiling time was reduced by 28 min, molasses yield and sugar content were 0.36% and 0.18% lower (on weight of beet) and sugar yield was increased by 0.22%.

Torsion oscillations of shafting in inclined diffusers. N. V. Zalevskaya and B. G. Khvalov. *Sakhar. Prom.*, 1979, (2), 29-34 *(Russian)*. – Investigations on Soviet-designed inclined beet diffusers showed that the main cause of torsion oscillations found in the shafting was irregularity in the running of the cogs in the transmission set resulting from faults in gear manufacture. Damping was effected by mounting two or four electric motors in parallel.

A rotary trash catcher for flumes. N. G. Lila and Yu. A. Granovskii. *Sakhar. Prom.*, 1979, (2), 35-36 *(Russian)*. Brief information is given on a 11-m diameter wheel with rake attachments around its perimeter which rotates about an axis at right angles to the flume; when stationary, the wheel has its lowest point just above the flume, the rake at this point being immersed in the water. The wheel rotates at 0.26 rpm counter to the beet flow.

Use of steam contact and sectioned heaters in raw juice heating schemes. Yu. S. Razladin, V. N. Usychenko and V. P. Shchutskii. *Sakhar. Prom.*, 1979, (2), 36-39 *(Russian)*. – Of various schemes tested for raw juice heating, the most economical was found to be that involving both steam-juice contact heaters and sectioned heaters, with heat being provided by pan vapour, condensate and 5th effect vapour.

White sugar manufacture at Schladen sugar factory. Anon. *Zuckerind.*, 1979, **104**, 117-121 *(German)*. Information is given on the equipment and processes at Schladen which was converted from a raw to a white sugar factory and started operations in its new form in the 1978/79 campaign.

Application of separators in the sugar industry. G. Pautsch. *Zuckerind.*, 1979, **104**, 138-140 *(German)*. The replacement of filters with Westfalia centrifugal separators for thick juice treatment at a number of factories in Denmark, France and Yugoslavia is mentioned and results from five Danish factories are tabulated, showing the insoluble residue (ppm) in sugar after separation. Advantages of separators are indicated, and diagrams with brief descriptions are given of two machines manufactured by Westfalia Separator AG.

Separators and heat exchangers in the sugar industry. M. Wersel. *Zuckerind.*, 1979, **104**, 140-142 *(German)*. Descriptions are given of the Alfa-Laval AX 213 centrifugal separator. Trials over 4 months on molasses centrifuging at 13,000 *g* before Quentin ion exchange treatment showed that, as a result of the pre-spinning, the ion exchange resin remained in better condition, the degree of ion exchange was higher, regenerant usage and rinsing requirement lower, and the sugar purity was increased. The possibility of using the separator for treatment of thin and thick juices is suggested. The characteristics of Alfa-Laval plate and spiral heat exchangers are described and the various factory products for which they can be used are indicated.

Association between juice quality and factory performance in 1976 and 1977. J. F. T. Oldfield, M. Shore, J. V. Dutton and H. J. Teague. *Sucr. Belge*, 1979, **98**, 35-46. – See *I.S.J.*, 1979, **81**, 279.

Heat treatment of juices. Z. D. Zhuravleva, A. R. Sapronov, V. A. Lupashko, O. T. Sosorina, L. A. Lupashko and A. I. Khlebnikov. *Sakhar. Prom.*, 1979, (3), 8-10 *(Russian)*. – After earlier trials had shown that treatment of 1st carbonatation juice with live steam was successful in improving clarification and filtration, a unit was developed for juice treatment (basically a tapered horizontal mixing chamber in which the juice is mixed with steam entering from six nozzles located tangentically to the juice flow). Results of tests over three campaigns at a sugar factory showed that, even where the beets were sub-standard, treatment of the 1st carbonatation juice with live steam increased the settling rate by about 20% and purity by 0.7 unit while reducing colour by 0.8°St and lime salts content by 5%. The amount of water to be evaporated rose by only 0.5% on weight of beet.

Method for concentrating and dewatering flume-wash water mud in sugar factories. A. P. Parkhomets and Yu. V. Raskin. *Sakhar. Prom.*, 1979, (3), 11-13 *(Russian)*. — Investigations confirmed earlier findings that a considerable reduction in waste water quantity and pollution load and in fresh water consumption (as a result of treated water recycling) was possible by treating flume-wash water in a horizontal settler and transferring the mud to a vertical thickener and thence to a scroll-type continuous centrifuge to give a final average water content of 36% which was low enough to permit easy transfer of the mud to storage for final disposal as fertilizer.

Precipitation of beet pectin in an alkaline medium. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Sakhar. Prom.*, 1979, (3), 14-15 *(Russian)*. — Investigations in which increasing quantities of lime were added to raw juice at 20°C showed that the maximum amount of albumin precipitated was 78.6% of the original, at an alkalinity of 0.095% CaO (pH 11.38); with further increase in alkalinity to 0.24% CaO (pH 12), there was partial redissolution of the albumin, whereas pectin precipitation was maximum (88.9%). On the other hand, in the absence of albumin (brought about by filtration after heating of the juice in the presence of an acetate buffering solution), less pectin was precipitated than in its presence. A maximum of 66% pectin was precipitated from a model lime-sugar solution having a pectin content of 0.15% and an alkalinity of 0.095% CaO. Hence, the maximum degree of albumin precipitation should be used as criterion for colloid separation in preliming.

Syrup filtration through an element with a fixed layer of cake. A. S. Soroka and Ya. O. Kravets. *Sakhar. Prom.*, 1979, (3), 15-18 *(Russian)*. — In order to ensure adhesion of cake to the elements in a candle filter, the authors suggested use of a porous 4-layered polyethylene mesh having 6 x 6 mm perforations. Tests in which a perlite suspension in filtered 2nd carbonatation juice was applied as precoat slurry followed by syrup filtration showed that filtration efficiency was high as a result of good cake adhesion, despite marked fluctuation in initial Brix, filtration rate and pressure fall. Parallel operation of Sangerhausen centrifugal rotary disc filters supplied by VEB Chemieanlagenbau of East Germany showed that they were not as efficient as the candle filters and reduced the syrup colloid content by only 0.94% compared with 2.5% in the others.

A hydromechanized complex for unloading and feeding raw material to process at Salivonkovskii factory. A. S. Zaets, Yu. A. Zaets and N. B. Mistetskii. *Sakhar. Prom.*, 1979, (3), 33-34 *(Russian)*. — A brief description is given of the beet yard complex which is intended to handle beet reclaimed from storage piles or direct from road transport and automatically feed it by flume to process.

Optimization of low-grade massecuite ripening by temperature control. II. Method for determining the optimum crystallization temperature. J. Buriánek and R. Sobol. *Listy Cukr.*, 1979, **95**, 7-12 *(Czech)*. — The temperature at which a required supersaturation is obtained in low-grade massecuite cooling can be determined from the sugar content, pol and purity of the mother syrup, either using graphs or empirical equations. Both approaches are demonstrated by worked examples where the supersaturation is reduced (i) by raising the temperature, and (ii) by water dilution. Use of the Saturoscope to determine the optimum crystallization temperature is also briefly mentioned.

Biological treatment of waste water in the sugar industry. K. Hangyál. *Cukoripar*, 1978, **31**, 205-212; 1979, **32**, 12-19 *(Hungarian)*. — Water utilization in a sugar factory is examined, and examples of modern closed circuit schemes are described. Biological treatment of effluent is surveyed. Of those techniques requiring large surface areas, the author prefers land irrigation and advocates modernization of lagooning practices. Of methods requiring only small land areas, the use of percolating filters is considered too expensive, although more efficient than the activated sludge method, which is recommended on the basis of cost. A combination of methods is regarded as the optimum from both technical and agricultural points of view.

Investment in capacity expansion by installing a DC-10 diffuser at Ács sugar factory. I. Soós. *Cukoripar*, 1979, **32**, 26-28 *(Hungarian)*. — The installation of a DC-10 (DDS) diffuser at Ács sugar factory is described. It replaced a Robert batch diffuser, the last discontinuous type to be used in Hungary. Although in its first campaign (1977/78) the DC-10 had a throughput, at 1760 tonnes.day^{-1}, below the rated figure of 2400 tonnes.day^{-1}, juice purity and losses were satisfactory. Mention is made of teething troubles and their remedies.

Optimization of low-grade massecuite ripening. III. Results of factory-scale investigation and formulation of manufacturing instructions. J. Buriánek, R. Sobol and A. Řádková. *Listy Cukr.*, 1979, **95**, 30-37 *(Czech)*. Low-grade massecuite crystallization was carried out at two factories by cooling without dilution under batch and continuous conditions. The massecuite, when dropped from the pans, had a crystal sugar content (92-93%) such that the purity at no time exceeded 78. By optimum temperature regulation (based on the interrelationship of temperature, supersaturation and mother liquor purity for a given sugar content), a molasses purity below 58.5 was obtained in all cases. Tables are given of temperatures required to give supersaturations of 0.95-1.25 for crystal contents of 82-92% and mother liquor purities of 56-74.

Milk-of-lime dosimeter with distribution weir. J. Čepelák, A. Havlín and V. Valter. *Listy Cukr.*, 1979, **95**, 44-47 *(Czech)*. — Tests are reported on a milk-of-lime dosing device which operates on the basis of signals from a raw juice flowmeter. While the unit suffers from the disadvantage of non-linearity, which limits its field of application, if sited at a suitable position and under conditions of only slight fluctuations in flow it is sufficiently precise. Error was only ± 1-3% in the range 1.6-1.8% CaO at a flow variation of ± 15%.

Mixing in a A1-PDS-20 diffuser. S. P. Tsygankov, V. M. Lysyanskii and A. I. Fel'dman. *Izv. Vuzov, Pishch. Tekh.*, 1978, (6), 89-93 *(Russian)*. — Investigation of flow in a A1-PDS-20 inclined-trough, twin-scroll beet diffuser (similar to a DDS diffuser but having a different design of cossette transport elements) showed that the linear speed of cossette movement in the head, tail and middle sections differed, and that radial mixing of the juice-cossette mixture was inadequate, while longitudinal mixing was considerable. This resulted in irregular heating and disruption of counter-flow, causing increased losses from sucrose degradation in low-temperature zones.

LABORATORY STUDIES

Composition of vinasse. V. C. Bittencourt, L. J. B. de Castro, A. A. M. Figueiredo, A. C. S. Paixão and D. M. Polli. *Brasil Açuc.*, 1978, **92**, 217-228 *(Portuguese)*. Analyses of ash constituents in cane juices are discussed and that in clarified juice shown to depend more on the process used than on the composition of the raw juice. Ash constituents of vinasse thus also depend on the clarification process, and a series of relationships have been derived which give the expected vinasse K, P, S, Ca and Mg contents from the corresponding analyses of clarified juice. Correlation coefficients have also been calculated for the relationships between CaO and K_2O, MgO and K_2O, P_2O_5 and K_2O, and SO_3 and K_2O for mixed and clarified juice and vinasse.

New method for determination of iron in sugars with use of maltol. S. Saito and H. Ito. *Nippon Nogei Kagaku Kaishi*, 1977, **51**, (11), 639-641; through *Anal. Abs.*, 1979, **36**, (1), 71-72. — This simple and rapid method is based on the principle that Fe^{+++} in acidic solution gives a stable yellow-red complex with maltol (3-hydroxy-2-methylpyran-4-one). The absorbance is measured at 490 nm.

Operating conditions for determination of sucrose by capillary gas chromatography. D. Nurok and T. J. Reardon. *Anal. Chem.*, 1978, **50**, (7), 855-857; through *Anal. Abs.*, 1979, **36**, (1), 72. — The effects of such variables as inlet temperature, sample injection technique, carrier gas flow rate and column temperature on the determination of sucrose as its trimethylsilyl derivative on a 40 m x 0.5 mm column coated with OV-17 have been studied. Under optimum conditions the coefficient of variation (nine determinations) ranged from 0.01 to 0.1% in a random fashion.

Sorption of caramels by AV-17 x 2P anion exchanger. V. F. Selemenev, G. A. Chikin and N. V. Korchkova. *Sakhar. Prom.*, 1979, (2), 22-25 *(Russian)*. — Laboratory studies were conducted on caramel adsorption by AV-17 x 2P highly basic, macroporous anion exchange resin in Cl^- and OH^- form, respectively, as a contribution to investigation of refinery syrup decolorization. Both static and dynamic experiments were carried out. Results showed that the resin in Cl^- form was much more effective (having a maximum decolorization efficiency of 60% at a solution pH of 7-9) than in OH^- form (maximum efficiency of only 25% at pH 1, the colour increasing under alkaline conditions). From U.V. and I.R. spectra it was found that when the resin was used in OH^- form, the caramels underwent complex changes, leading to increase in the number of carboxylic groups and C=C bonds and hence colour increase. However, since treatment of the 60% sucrose solution used in the studies with resin in the Cl^- form caused the pH to fall to 5.2-5.5, it was decided to conduct further tests with the resin in mixed Cl^-/OH^- form by treating it with 6% NaCl and 0.5% NaOH to give 85-90% active groups in Cl^- form and 10-15% in OH^- form. This led to a 60% decolorization efficiency without acidification of the syrup.

A chromatographic method of determining micro-quantities of formaldehyde in products of sugar manufacture. A. Z. Usmentseva and G. F. Dregval'. *Sakhar. Prom.*, 1979, (2), 44-45 *(Russian)*. — Details are given of a thin-layer chromatographic method for determining formaldehyde; accuracy is 93-95% and lowest limits are 0.02 ppm for raw juice and sugar, 0.05 ppm for beet pulp, and 0.1 ppm for molasses. To 30-50 g of sample is added 80 cm^3 distilled water and 5 cm^3 5% trichloroacetic acid, and the mixture distilled. To 80-90 cm^3 of the distillate is added 3-5 cm^3 of alcoholic dimedone (5,5-dimethyldihydroresorcinol) solution (200 $\mu g.cm^{-3}$); after heating on a boiling water bath with reflux for 15 min, the solution is cooled, transferred to a 250-cm^3 separating funnel and the formaldimedone formed is extracted three times with chloroform (15 cm^3 per extraction). The extracts are combined, passed through anhydrous sodium sulphite and evaporated to 0.1-0.2 cm^3. The residue after the solvent has been driven off is applied to a silica gel layer to give a spot no greater than 0.8-1 cm in diameter. Spotting with standard formaldimedone solution is followed, 15-20 min before analysis, by immersion in chloroform (as mobile solvent); the plate is sprayed with 0.5% iodine in chloroform, and the formaldimedone appears as greyish-violet spots on a white background. Visual comparison is made with the standard (either in terms of colour intensity or area of sample).

Chemistry of sugars. Technological aspects. V. Maurandi. *Ind. Sacc. Ital.*, 1978, **71**, 149-159 *(Italian)*. — Physico-chemical reactions of sucrose and reducing sugars of significance in relation to sugar production are discussed as a part of the course in the chemistry of sugars offered by the Serafino Cevasco sugar school in the University of Ferrara. The aspects covered include sucrose inversion and decomposition of reducing sugars, inversion catalysis by ion exchange resins, the behaviour of nitrogenous non-sugars and minerals, second carbonatation reactions, molasses formation and methods of molasses sugar recovery and loss reduction.

Determination of pol in aqueous and alcoholic medium. A. Perdomo, J. A. Cremata and R. Aranguren. *ATAC*, 1978, **37**, (2), 46-52 *(Spanish)*. — Tables are presented of pol measurements made with pure sucrose, raw and refined sugar and cane juices dissolved in or diluted with distilled water and a 1:2 alcohol:water mixture. In the case of the juices, pol measurements were made by the Schmitz-Horne method and directly, and sucrose was also determined by the Jackson & Gillis Method No. 4 and by the Walker inversion method. There is a small increase in polarization of the sugars, but with juices there is a decrease when the dilutions are of equal weights of juice and 1:2 alcohol:water; there is an increase, however, when the dilution is of equal volumes. The value of the refractometric Brix is also different when alcohol:water mixture is used for dilution, so that the purity measurement is up to 13-15 units higher than when using water. The Schmitz-Horne method is not advisable when the alcohol mixture is used. When sugar factories have problems caused by the presence of polysaccharides, it is preferable to determine Clerget sucrose.

Repetitive determinations of amylase, maltose, sucrose and lactose by sample injection in closed flow-through systems. D. P. Nikolelis and H. A. Mottola. *Anal. Chem.*, 1978, **50**, 1665-1670; through *S.I.A.*, 1979, **41**, Abs.

79-254. – A method was developed for the repetitive determination of amylase and the above disaccharides by coupling enzyme-catalysed reactions yielding glucose as a product with oxidation of glucose catalysed by glucose oxidase. Samples were injected into a continuously circulated reagent mixture, and oxygen depletion was monitored with a 3-electrode amperometric system. Maltose, sucrose and lactose in the concentration ranges 50-500 mg/100 cm^3, 10-250 mg/100 cm^3 and 25-250 mg/100 cm^3, respectively, and amylase in the concentration range 50-500 units/100 cm^3 were determined with relative errors of approx. 2%. Maximum determination for sucrose was 700 injections/hr. Application of the method to a variety of food products is reported.

The role of sucrose in coagulate peptization during raw juice treatment with lime. L. D. Bobrovnik, G. P. Voloshanenko and N. S. Fedorova. *Sakhar. Prom.*, 1979, (3), 18-21 *(Russian)*. – In studies on peptization of coagulated albumin, 2N NaOH solution was added to 50-cm^3 samples of 15% sucrose solution to give a pH of 7, 9, 11 and 13 and the electrical conductance measured at 22°C after thorough mixing; similarly, NaOH was added to $CaCl_2$ solutions (1.5 g in 250 cm^3) to give the same four pH values and the conductance measured, while a third series of samples comprised the sucrose solutions to which $CaCl_2$ and then NaOH were added before conductance measurement. The same procedure was used with samples in which sucrose was replaced with dipeptide, tripeptide and egg white. Analysis showed that where $CaCl_2$ had been added to the organic compounds, the conductance was lower than the total conductance of sucrose + $CaCl_2$, even where correction was made for viscosity. The difference was attributed to formation in the organic solutions of complexes having a Ca^{++} ion as nuclear ion and molecule of the organic compound as ligand. After additon of 14 g of cation exchange resin in Na^+ form to 100 cm^3 of 0.6% $CaCl_2$ solutions containing the individual organic compounds, constant mixing was carried out for 90 min and the resin then filtered off. Determination of the Ca salts content in the filtrate showed that in all cases, except the pectin, complexes formed at pH 11-13, but only the sucrose complex was sufficiently stable to be unaffected by the resin, the Ca^{++} concentration remaining unaltered. Hence, at high alkalinity the Ca-sucrose complex is stronger than the Ca-pectin complex and peptization occurs.

Alteration in the physico-chemical properties of ion exchange resins during prolonged use for demineralization of intermediate products in beet sugar manufacture. R. F. Kambarova, I. P. Shamritskaya, V. N. Belous and K. P. Zakharov. *Sakhar. Prom.*, 1979, (3), 21-25 *(Russian)*. – The service life of Soviet ion exchange resins after prolonged use was investigated. The fractional composition, ultimate exchange capacity and specific volume of KU-2-8 cation exchanger and AV-16GS and EDE-10PG anion exchangers were determined after 10, 40 and 60 cycles of molasses treatment (i) in a program where treatment with the cation exchanger was followed by treatment with AV-16GS anion exchanger, (ii) where EDE-10PG was used alone, and (iii) where KU-2-8 was followed by EDE-10PG. The regeneration procedures also varied. The ultimate exchange capacity of the cation exchanger fell by 15-30% after 60 cycles, compared with 30-50% for the anion exchangers (which suffered almost complete loss of exchange capacity in terms of strongly basic groups); the deterioration was mainly caused by blocking of the active centres. The change in fractional composition of the cation exchanger was less marked than for the anion exchangers. All resins underwent a fall in swelling.

The optimum wavelength of monochromatic light for determining the colour of sugar products. L. A. Korobeinikova and A. Ya. Zagorul'ko. *Sakhar. Prom.*, 1979, (3), 37-39 *(Russian)*. – The authors examine and criticize the tricoordinate system of colour measurement and the standard wavelengths recommended by ICUMSA (420 and 720 nm for light and 560 nm for dark products). Graphs of optical density *D vs.* wavelength were plotted on mm paper for final and intermediate products representing beet and cane sugar manufacture and refining. The area of paper enclosed by the axis of abscissae, axis of ordinates and the curve was cut out and weighed, the value then being reduced to mass per cm^2. The mean integral optical density $D\lambda$ was then calculated [= area/(wavelength corresponding to zero light absorption in the visible part of the spectrum – initial wavelength of visible light)] and the wavelength corresponding to $D\lambda$ found from the graphs. Results showed that the optimum wavelength for colour measurement of all sugar products is 492 nm.

Ebulliometric determination of the molecular weight of non-sugars. P. Kadlec and P. Hyndrák. *Listy Cukr.*, 1979, **95**, 13-16 *(Czech)*. – The average molecular weight of non-sugars in eight beet sugar solutions and three cane sugar solutions was found ebulliometrically. For beet sugar, the average value was 0.115 ± 0.010 $kg.mol^{-1}$, or approximately one-third of the molecular weight of sucrose; for cane sugar, it was 0.204 ± 0.10 $kg.mol^{-1}$, *i.e.* three-fifths of that for sucrose. Simplified formulae are given for calculation of the molecular weights of non-sugars on a dry solids basis.

Precision of various methods for ash determination. P. Devillers. *Sucr. Franç.*, 1979, **120**, 53-65 *(French)*. The author describes the studies on which the tables and recommendations in Subject 16 of the Proceedings of the 17th Session of ICUMSA (1978) are based, including the products analysed, participating laboratories, the determinations carried out, statistical analysis, presentation of results, and the results themselves of each determination, with notes.

Amino-acid composition of high-molecular compounds in cane sugar manufacture. M. Darias, M. Quincoses, J. Fernandez, C. Hernandez, D. Moreira and L. D. Bobrovnik. *Izv. Vuzov, Pishch. Tekh.*, 1978, (6), 147-148 *(Russian)*. – Fractions containing compounds of high M.W. were obtained by passing intermediate products through molecular sieves (Sephadex-50); they were then concentrated under vacuum and hydrolysed by heating at 100°C for 24 hours with an equal volume of 12N HCl, followed by treatment with active carbon, filtration, evaporation to dryness, addition of distilled water, evaporation to dryness, dissolution in 30% ethyl alcohol and centrifuging. Paper chromatography was carried out with 4:1:5 *n*-butanol:acetic acid:water as solvent and ninhydrin-acetone as spray reagent. Fifteen amino-acids were identified: lysine, histidine, arginine, asparagine, serine, glycine, glutamine, threonine, alanine, proline, tyrosine, methionine, valine, leucine and *iso*-leucine. Similar study on hydrolysate from cane raw sugar revealed the same amino-acids except methionine (probably present in very small quantity).

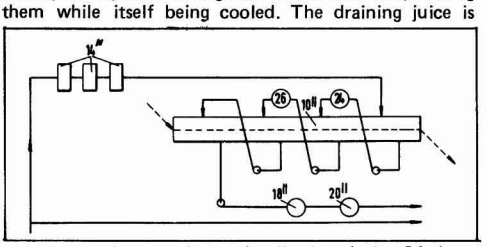
PATENTS

UNITED KINGDOM

Bagasse fibre separation for paper and board manufacture. Instituut voor Bewaring en Verwerking van Landbouwprodukten, of Wageningen, Holland. **1,474,219.** August 22, 1974; May 18, 1977. – Annual vegetable material containing cellulose fibre and lignin, *e.g.* bagasse, is extracted with 15-40/ w/w of HCl solution at a temperature $\leqslant 50^{\circ}C$ until at least 50% of the hemicellulose has been dissolved, the fibrous mass separated, washed and dried if desired. The HCl is recovered from the wash liquid and recycled for use in the initial extraction. Lignin may also be recovered from the wash water, as may xylose, furfural, and/or polyhydric alcohols.

Beet cossette reheating and scalding. Fives-Cail Babcock, and Générale Sucrière, of Paris, France. **1,475,961.** April 25, 1975; June 10, 1977.

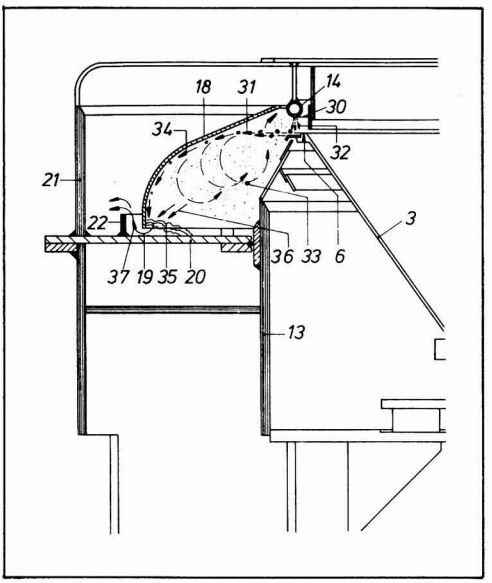
Cold beet cossettes are delivered to the endless belt conveyor 10" and pass along it as shown by the broken line and are discharged to a scalder before the diffuser. Part of the diffusion juice goes to process while another part passes through heat exchangers 14" and is delivered to the layer of cossettes at the scalder end of the conveyor. It passes through the bed of cossettes, heating them while itself being cooled. The draining juice is



collected and pumped to a distribution device 24 above the conveyer, nearer the cossette supply point. Here it drains through the bed of cossettes, raising their temperature while being cooled. The process continues a number of times, the juice temperature being progressively lowered until it reaches a point at which it is cooler than factory waste water which is then used to reheat the juice by means of heat exchangers 18", 20".

Continuous centrifugal for separation and redissolving of sugar. Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **1,476,047.** December 8, 1975; June 10, 1977.

Sugar is separated and washed on the screen 3 of the conical centrifugal and is discharged over the upper edge 6. A jet of liquid solvent is supplied through annular tube 14 and the mixture passes beneath the impact ring 18 which extends downwards to just above an intermediate plate 20, leaving a small clearance 19. Outside the impact ring but on the plate 20 and between it and the outer jacket 21 is a retaining wall 22. Very strong turbulence and eddies 33 promote dissolving of



the crystals so that most are dissolved; those remaining undissolved form an accumulation 35 in front of the clearance 19. The liquid solution passes through and over the retaining wall 22 to be drained as a completely dissolved syrup, of 60-70° Brix or more, through a discharge tube.

Method of and apparatus for sharpening beet knives. H. Putsch & Comp., of Hagen, Germany. **1,476,269.** November 26, 1975; June 10, 1977.

Immobilized dextrose isomerase and method of dextrose isomerization. CPC International Inc., of Englewood Cliffs, NJ, USA. **1,482,122.** September 13, 1974; August 3, 1977. – Dextrose isomerase is immobilized by adsorption on the surface of a particulate, porous, basic synthetic anion exchange resin. A solution containing (31-70%) dextrose at a pH of 7.0 - 8.5 (7.5 - 8.0) is brought into contact with the immobilized enzyme (at 60 - 70°C), the process being rendered continuous by passing the dextrose solution through a column of the enzyme. When the enzyme activity drops the bed is reactivated by treatment of the resin with fresh dextrose isomerase.

Bagasse hydrolysis. Anstalt Gemass, of Vaduz, Liechtenstein. **1,483,132.** January 13, 1975; August 17, 1977. Bagasse or other material containing pentosans and cellulose fibrous consituents is introduced into a hydrolysis vessel at one end and travels to the other end. A hydrolysis agent in the form of dilute sulphuric acid is also introduced into the vessel and maintained at 60-120°C (98-102°C) and a pH lower than 5. A pentose-containing hydrolysate is withdrawn from the vessel, part of this separated for further processing, and the remainder recycled to the hydrolysis vessel. Treated bagasse in the form of cellulosic fibres is withdrawn from the discharge end of the vessel, washed and the washings treated with fresh acid to raise its concentration to the treatment liquid value and this recycled to the vessel.

Cuba sugar statistics[1]

	1979	1978	1977
	tonnes, raw value		
Initial Stocks	487,089	608,768	412,655
Production	7,799,968	7,661,546	6,953,284
	8,287,057	8,270,314	7,365,939
Exports	7,269,429	7,231,219	6,238,162
Consumption	518,986	552,006	519,009
Final Stocks	498,642	487,089	608,768
Exports			
Albania	24,649	20,997	8,370
Algeria	203,088	175,633	51,145
Angola	53,886	68,059	51,063
Bulgaria	218,223	189,623	218,585
Canada	316,249	279,021	139,058
China	485,625	533,853	228,087
Colombia	–	–	41,936
Czechoslovakia	99,060	84,850	67,374
Denmark	38,622	–	–
Dutch Antilles	541	2,479	1,760
Egypt	111,320	127,054	71,893
Ethiopia	–	–	11,430
Finland	102,162	88,197	131,166
Germany, East	223,100	200,717	228,940
Hong Kong	–	–	12,035
Hungary	72,414	58,424	51,416
Indonesia	132,531	105,159	140,991
Iraq	248,484	191,421	86,591
Jamaica	–	11,102	–
Japan	297,300	530,096	183,452
Korea, North	21,621	11,838	18,542
Lebanon	–	–	5,708
Libya	42,694	27,073	–
Malaysia	25,299	64,401	–
Mongolia	4,658	4,678	2,283
Morocco	12,443	132,366	166,052
New Zealand	58,781	–	17,435
Poland	63,660	60,209	31,099
Portugal	116,613	141,771	25,582
Rumania	39,017	–	25,868
Singapore	12,611	–	–
Spain	79,807	–	158,948
Sudan	–	–	24,003
Surinam	–	2,654	3,972
Sweden	–	–	35,349
Switzerland	2,870	1,453	2,750
Syria	140,799	87,044	109,476
Tunisia	35,963	10,647	10,897
UK	12,584	–	–
USSR	3,842,211	3,936,133	3,790,424
Vietnam	111,498	82,468	67,680
West Indies	1,509	1,799	–
Yemen, South	10,839	–	–
Yugoslavia	–	–	12,573
Other countries*	6,698	–	4,229
	7,269,429	7,231,219	6,238,162

*Donations of sugar.

Tunisia sugar complex[2]. – According to reports from Tunis, a decision is expected soon on bids for construction of the Ben Bechir sugar complex near Djen Douba in the north-west of the country, estimated to cost about $100 million. The French consultants Sofreco carried out the studies for the complex which is expected to consist of a beet sugar factory, a distillery and a yeast plant. A state-controlled company, Complexe Sucrier de Tunisie, has been created to manage the complex which should be completed by June 1982. It will enable Tunisia to meet one-third of its sugar needs by 1986.

US sugar imports, 1979[3]

	1979	1978	1977
	short tons, raw value		
Argentina	234,820	271,019	266,968
Australia	107,384	165,493	494,225
Belgium	0	25,146	0
Belize	57,967	87,261	35,549
Bolivia	89,189	62,441	49,473
Brazil	1,262,358	600,684	566,862
Colombia	26,103	113,410	14,249
Costa Rica	80,405	78,317	95,365
Dominican Republic	816,967	733,530	974,788
Ecuador	82,227	37,294	55,380
Fiji	130,161	50,722	18,407
France	0	42,851	0
Germany, West	0	16,539	0
Guatemala	170,869	155,879	300,938
Haiti	11,287	5,757	0
Honduras	65,303	17,781	20,634
Madagascar	9,610	14,295	12,052
Malawi	35,727	37,028	38,358
Mauritius	115,529	112,212	57,363
Mexico	60,117	52,822	0
Mozambique	98,139	12,913	97,311
Nicaragua	122,307	108,204	119,529
Panama	157,287	123,003	131,162
Peru	188,630	225,241	314,186
Philippines	413,189	833,339	1,442,991
Rumania	0	13,209	0
El Salvador	160,957	130,365	166,028
South Africa	88,779	60,100	274,227
Swaziland	102,072	82,456	61,855
Taiwan	28,200	56,569	86,035
Thailand	9,436	64,761	0
Uruguay	0	8,220	0
West Indies	210,907	184,390	159,744
	4,935,926	4,583,251	5,866,104

Trinidad sugar production 1979[4]. – Production of sugar fell slightly from 148,137 tonnes, raw value, in 1978 to 143,521 tonnes in 1979. Exports fell also, from 103,083 tonnes to 93,877 tonnes. The two main destinations were the UK (71,394 tonnes in 1979 *vs.* 57,440 tonnes in 1978) and USA (21,451 tonnes *vs.* 44,676 tonnes).

Indonesian mini-sugar factories[5]. – On October 17, 1979, President Suharto inaugurated two new mini-sugar factories in Takengeun, Central Aceh, and in Agam regency, West Sumatra, each with an annual capacity of 2000 tonnes. The new mills are included in an ambitious Government program of building 200 so-called mini-sugar factories on islands other than Java during the third five-year plan (1979/84) in an effort to eliminate the country's dependence on sugar imports.

Czechoslovakia beet campaign. – According to official reports from Czechoslovakia, the sugar beet harvest amounted to 7,900,000 tonnes compared with 7,285,000 tonnes in 1978 and 8,229,000 tonnes in 1977[6]. It was nevertheless 9% below the 1979 plan figure of 8,700,000 tonnes. Sugar production has not been announced but if the yield was the average of the past three campaigns it would have reached 912,000 tonnes, slightly higher than the 907,000 tonnes produced in 1978.

Kenya sugar factory expansion[7]. – With financial assistance from the World Bank, the crushing capacity of the Muhuroni sugar factory of East African Sugar Industries Ltd. in Nyanza province, Kenya, is to be expanded by about 20%.

[1] C. Czarnikow Ltd., *Sugar Review*, 1980, (1484), 58.
[2] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 155.
[3] *Lamborn*, 1980, **58**, 48.
[4] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, S63.
[5] *Westway Newslettter*, 1980, (75), 10.
[6] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 128.
[7] *Standard Chartered Review*, March 1980, 16.

USSR sugar imports and exports[1]

	1979	1978	1977
	tonnes, raw value		
Imports			
Argentina	–	12,199	–
Belgium/Luxembourg	31,389	–	60,467
Brazil	68,969	83,270	24,188
Cuba	3,706,767	3,797,337	3,652,000
Czechoslovakia	38,973	–	–
Denmark	38,432	–	–
Dominican Republic	–	45,923	–
France	134,392	25,879	151,540
Germany, West	25,224	13,753	–
Guatemala	–	12,003	–
Holland	–	–	36,765
Hungary	10,837	1,714	–
Irish Republic	5,787	–	–
Philippines	–	–	634,998
Poland	1,516	1,385	–
Rumania	6,843	–	164,475
Thailand	11,176	–	–
Other countries	–	–	51,338
	4,080,305	3,993,463	4,775,771
Exports			
Afghanistan	97,138	58,236	23,119
Algeria	6,068	3,170	–
Belgium/Luxembourg	–	7,525	–
Benin	1,399	–	–
Bulgaria	4,285	4,309	2,389
Congo	568	4,268	–
Gambia	434	430	–
Guinea Bissau	2,365	1,344	2,688
Ivory Coast	–	5,310	–
Laos	–	1,076	–
Lebanon	3,945	–	–
Libya	6,779	–	–
Mali	9,152	1,075	–
Mauritania	2,923	–	–
Mongolia	33,629	33,741	32,077
Niger	–	12,954	–
Nigeria	5,413	–	–
Portugal	2,273	–	–
Syria	12,504	–	–
Vietnam	10,826	10,750	10,750
Yemen, North	16,543	–	–
Yemen, South	27,917	30,100	16,072
	244,161	174,288	87,095

Poland sugar production[2]. – According to official Polish figures, the beet harvest in 1979 amounted to 14.2 million tonnes, 9.9% less than the 15,707,000 tonnes of 1978. The beet yield was better at 31.1 tonnes.ha^{-1} against 30.0 in 1978. Sugar production in the 1979/80 campaign is set at 1,581,000 tonnes, against 1,763,000 tonnes in the previous campaign.

Texas 1979/80 sugar crop. – In its seventh crop, which ended on March 15, Rio Grande Valley Sugar Growers Inc. crushed a total of 876,700 tonnes gross cane (773,688 tonnes net cane) to produce 83,562 tonnes 96° raw sugar and 30,229 tonnes of molasses. The 12,494 hectares harvested for sugar yielded 61.93 tonnes of cane per ha and 6.69 tonnes of sugar per ha. The yield of sugar % net cane was a record at 10.80 and compares with the previous record of 9.79 % achieved in 1975/76. The prime factors influencing the high sugar content were a dry October which inhibited N uptake late in the growing period, reduced N fertilization applied to the crop, heavy floral initiation but delayed tassel emergence owing to dry conditions, and the absence of frost damage. Cane yield per ha was low because 42% of the harvest area was of 5th or later ratoon cane. For 1980/81 over 2765 ha have been newly planted and 1100 ha of poorer cane discarded. Prospects are for a crop of 1,140,000 tonnes.

Philippines sugar exports[3]

	1979	1978	1977
	tonnes, raw value		
Algeria	0	0	33,696
China	119,251	204,923	277,418
Indonesia	0	10,869	13,125
Iraq	85,109	107,684	0
Japan	350,482	52,617	250,352
Korea, South	159,906	85,984	5,886
Malaysia	11,265	44,811	37,064
Singapore	8,132	8,173	0
USA	403,828	626,865	1,301,570
USSR	19,484	0	655,714
	1,157,457	1,141,926	2,574,825

Ethiopia sugar industry plans[4]. – The combined annual capacity of the three former HVA sugar factories in Ethiopia amounts to 150,000 tonnes of raw sugar per year. They are now operated by the Ethiopian Sugar Corporation which plans to add refining capacity to all three, as well as to build a new factory and refinery at Fincha, in Welega province.

Guyana sugar production 1979[5]. – Guyana's sugar production for the 1979 season fell to 298,268 tonnes, from 324,000 tonnes the previous year. The 1979 figure is 6.8% below the revised industry target and 17.2% below the original 1979 estimate. Bad weather severely hampered the first of the season's two crops, which produced only 110,299 tonnes.

Brazil sugar technologists meetings, 1980. – The Sociedade dos Técnicos Açucareiros do Brasil (STAB) organized a training course for analysts on the quantitative and qualitative determination of alcohol during April 22-25 at the University of São Paulo, Piracicaba, under the leadership of J. P. Stupiello. On June 12/13 STAB are holding a technical seminar at Ribeirão Preto, SP, covering agricultural aspects of sugar cane, coordinated by F. O. Brieger and H. C. de Arrudo. In August the Society is to organize an agro-industrial technical seminar specifically for the state of Minas Gerais, coordinated by C. V. de Brito and J. P. Stupiello, while in September another seminar is to be held at Piracicaba on the industrial processing of sugar and alcohol, and vinasse and environment protection. Coordinators will be J. G. S. Ometto and J. P. Stupiello. Com. H. Morganti and J. P. Stupiello are heading a group of technologists of the southern section of STAB who are producing a manual of standard methods for use in laboratories of factories processing cane to sugar and alcohol. This manual should be available in April 1981 during the 2nd National Congress of STAB to be held in Rio de Janeiro.

US sugar cane quarantine proposals. – An up-dating of Federal regulations is proposed which would quarantine Hawaii and parts of Florida because of cane smut disease, Hawaii and Puerto Rico because of leaf scald, and would continue quarantining Puerto Rico because of gummosis. It is also proposed to restrict interstate movement of plants and plant materials from parts of Florida, Puerto Rico and the US Virgin Islands as a measure against spread of the West Indian cane root borer.

New Cuban sugar factory[6]. – The new sugar factory, Central 30 de Noviembre, which was scheduled to begin operations in mid-March, includes about 60% of Cuban-made equipment, and provides for a high degree of automation. It is the first new factory to be built in Cuba since the revolution and is located at San Cristobal, Pinar del Río.

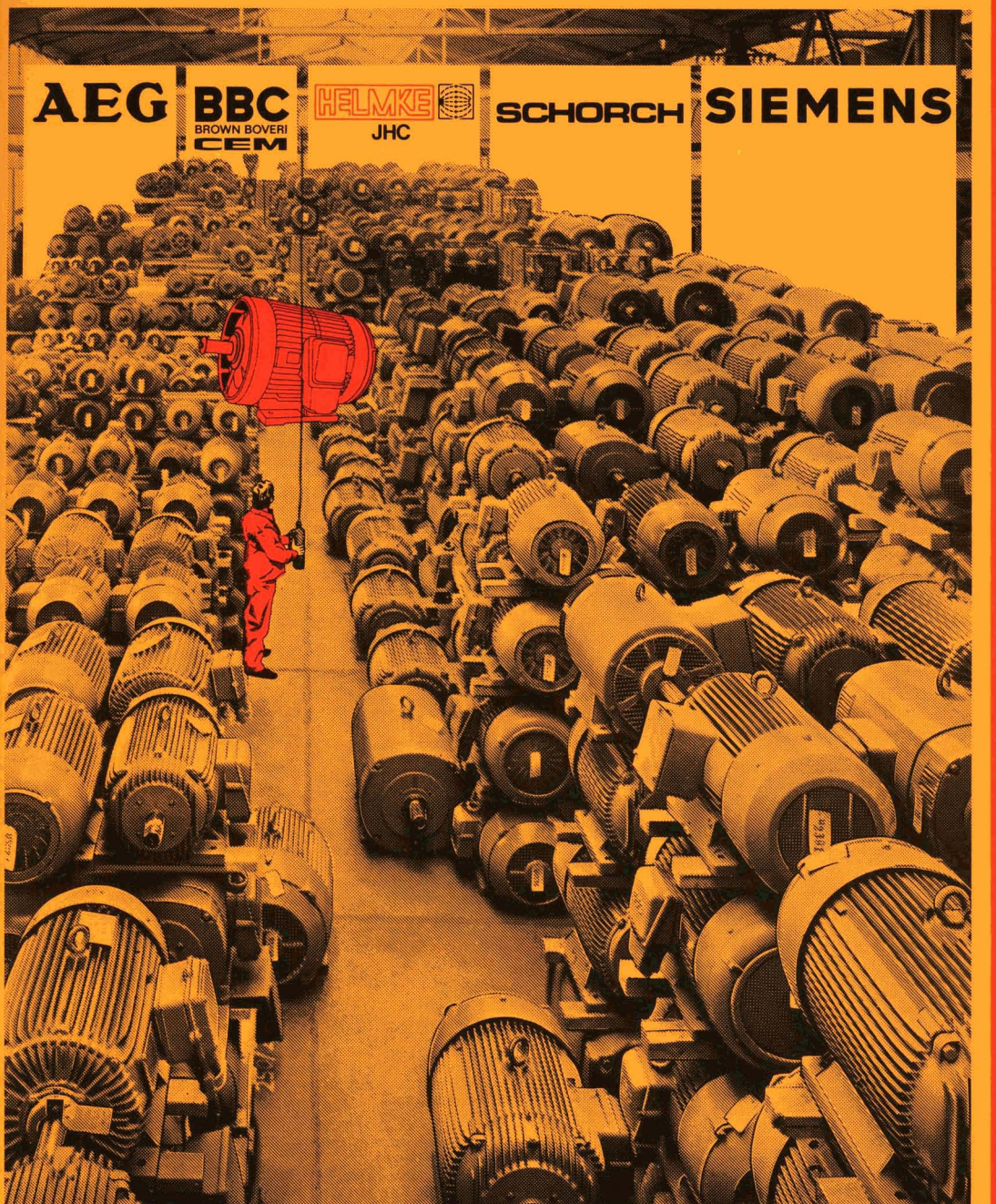
PERSONAL NOTES

Following the retirement of **Mr. Robert Antoine** on June 30, 1980, **Mr. J.D. de R. de St. Antoine** will succeed him as Director of the Mauritius Sugar Industry Research Institute. The Executive Board of MSIRI have also approved the appointment of **Dr. J. R. Williams** and **Dr. C. Ricaud** as Assistant Directors of the Institute.

[1] C. Czarnikow Ltd., *Sugar Review*, 1980, (1486), 70.
[2] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 128.
[3] C. Czarnikow Ltd., *Sugar Review*, 1980, (1479), 32.
[4] *Middle East Economic Digest*, January 28, 1980.
[5] *Reuters Sugar Rpt.*, January 14, 1980.
[6] F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 154.

Index to Advertisers

Portrait '80 HELMKE



HELMKE

HANNOVER
Garvensstraße 5
D-3000 Hannover 89
Tel.: 05 11-86 40 21
Telex: 9 21 521
Telefax: 05 11/86 39 30

MULHOUSE
15, rue d'Ensisheim
F-68110 Illzach-Mulhouse
Tel.: (89) 52 02 03
Telex: 8 81 701
Télécopieur: 89/52 03 13

E.L.E.C. (Exposition Internationale de l'Equipement Electrique), Paris
Hannover-Messe Halle 11, Stand 140

I. PRODUCTEN EN LEVERINGEN

Andere fabrikanten verkopen alleen hun eigen producten. HELMKE biedt alternatieven en optimale oplossingen in techniek, prijs en levertijd.
Want HELMKE heeft **„onder één dak"** de nieuwste **ELECTROMOTOREN:**
IEC-standaardmotoren van de vooraanstaandste fabrikaten **en** de prijsaantrekkelijke HELMKE serie, speciaal met grotere vermogens en in speciale uitvoeringen .– Hijskraanmotoren – Vertragingsmotoren.
Fabrieksnieuw tegen fabriekspijzen, condities en natuurlijk met fabrieksgarantie. Onmiddelijke levering uit de HELMKE-voorraden, de belangrijkste in Europa, en doorlopende fabrikatie van alle modellen.
Fabrieksnieuwe Hoogspanningsmotoren in isolatieklasse „F" tot 10.000 kW en grote laagspanningsmotoren in optimale sortering.
HELMKE hoogspanningsmotoren uit moderne gangbare series. Alle IEC koelsystemen.
Nieuwe gelijkstroommachines – ook HELMKE series in genormaliseerde afmetingen.
Engineering van complete aandrijvingen met thyristor of frequentie geregelde toerentallen.
Roterende omvormers in alle soorten.
Zelfregelende generatoren van de HELMKE-Normserie „RL" met bijzonder korte uitregeltijden.
Nieuwe aggregaten tot 10 MVA in alle uitvoeringen.
Nieuwe vermogens- en verdeeltransformatoren tot 500 MVA en 750 kV. Prijsaantrekkelijke normseries.
Geheel gerevideerde machines, op elk gebied, met 12 maanden fabrieksgarantie.
Motoren voor bijzondere doeleinden bijvoorbeeld voor aandrijving van walserijen, cementmachines enz.
HELMKE heeft de gehele serie.
HELMKE is onafhankelijk, flexibel en betrouwbaar.

II. FABRIEKSMOGELIJKHEDEN

Reparaties en speciaal uitvoeringen, zowel electrisch als mechanisch, van grote machines.
Speciale wikkelingen tot 10 kV in de isolatieklasse „F" en „H", waaronder ook „Roebel" wikkelingen.

III. SPECIALE SERVICE

Stand-by voorraden van machines die continue door u gebruikt worden.
Verhuur, terugneming, ruiling en financieringen.
Engineering-service gegarandeerd – over de hele wereld – de gunstigste en snelste oplossing van uw aandrijfproblemen.
HELMKE – betekent niet aan leveringstermijnen gebonden zijn. Spoed- en luchtvrachtleveringen dag en nacht.

IV. HELMKE-ORBIS

De devisie „HELMKE-ORBIS" Projekten en machines wijdt zich aan deelname en samenwerking bij internationale projecten, zoals engineering en leveringen van komplete machines en installaties, in het bijzonder in de exportsfeer. „Package offers".

V. HELMKE-HANDEL

Houdt zich speciaal bezig met het snel en goedkoop leveren van alle soorten technische artikelen aan haar buitenlandse relaties. „Engineering supplies".

VI. Vertegenwoordigingen en kantoren in 39 landen.

I. PRODUCTIONS ET LIVRAISONS

Chaque constructeur ne vend que ses propres produits. HELMKE VOUS PROPOSE le choix et des solutions optimales en technique, prix et délai de livraison.
Car HELMKE dispose sous un même toit des **moteurs électriques** les plus récents: **moteurs normalisés CEI** des marques les plus réputées et les séries HELMKE, avantageuses, surtout en grandes puissances et en exécutions spéciales – moteurs de levage – motoréducteurs.
Moteurs neufs, à des prix et conditions constructeurs et bénéficiant de la garantie d'usine. Livraison immédiate à partir des stocks HELMKE parmi les plus importants d'EUROPE;
Production courante de tous modèles.
De plus: «D'UN SEUL PARTENAIRE»
Moteurs moyenne tension neufs en classe d'isolation "F", jusqu'à 10.000 kW et gros moteurs basse tension possédant des caractéristiques optimales.
Moteurs moyenne tension de séries HELMKE. Production moderne en tous types d'exécution comportant tous modes de refroidissement CEI.
Moteurs courant continu neufs également des séries HELMKE normalisées.
Ingéniérie de système d'entraînement complet avec asservissement de vitesse par variateur à thyristors ou onduleur pour asservissement de moteurs asynchrones.
Groupes convertisseurs tournants de tous types.
Alternateurs auto-régulés de série HELMKE "RL" avec facteur de régulation minimal.
Groupes électrogènes neufs en toutes exécutions jusqu'à 10 MVA.
Transformateurs neufs de puissance et de distribution jusqu'à 500 MVA et 750 kV – séries normalisées – à des conditions avantageuses.
Transformateurs de distribution coulés dans la résine
Machines d'occasion de tous types et bénéficiant d'une garantie d'usine de 12 mois.
Moteurs spéciaux en particulier pour laminoirs, broyeurs, etc. . . .
HELMKE couvre toute la gamme. HELMKE est indépendant, souple et fiable.

II. PRESTATIONS D'USINE

Réparations et exécutions particulières dans les ateliers HELMKE spécialisés pour grosses puissances.
Ateliers de réparation agréés par les fabricants les plus réputés.
Bobinage spécial jusqu'à 10 kV en classe "F" et "H". Ateliers agréés pour le bobinage de moteurs à sécurité augmentée et anti-déflagrants.
Barres Roebel pour turbo-alternateurs.

III. PRESTATIONS SPÉCIALES

Stocks permanents adaptés aux besoins des clients pour les modèles dont ils ont couramment besoin.
Location, reprises, échanges et financements.
Equipe d'ingénieurs qualifiés assurant dans le monde entier la solution idéale et la plus rapide à vos problèmes d'entraînements.
HELMKE, pour ne plus dépendre de vos délais de livraison. Expédition jour et nuit par express et par avion.

IV. HELMKE-ORBIS

Le groupe de sociétés HELMKE-ORBIS Projekte und Ausrüstungen et HELMKE-ORBIS Études et Équipements a pour objet la participation également en tant que partenaire, aux projets et soumissions internationaux, ainsi qu'aux livraisons d'installations et d'équipements industriels complets, surtout à l'exportation. "Package offers".

V. DIVISION HELMKE COMMERCIAL

récemment créée dans le cadre du groupe HELMKE-ORBIS et en particulier pour les clients à l'étranger, se consacre essentiellement à la livraison et l'approvisionnement de matériel les plus divers destinés aux domaines technique et général. "Engineering supplies".

VI. REPRÉSENTATIONS et bureaux dans 39 pays.

reader inquiry service

If you wish to receive further information on the products and services mentioned in the advertisements please fill in the inquiry section of this card and post it to us.

reader inquiry service

Please arrange for me to receive without obligation further details of the products referred to below which are advertised in your .....19.....issue.

Advertiser	Product	Page

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

photocopy service

We are able to supply one photocopy, for research or private study purposes, of most of the original papers abstracted in this journal. It should be noted that these are *not* translations but are in the original language of publication which, if not English, is indicated in italics in each abstract. The charge of 40 cents per page includes air mail postage and payment should be sent with the order.

photocopy service

Please supply one photocopy of each of the following original papers, abstracts of which appeared in your .....19.....issue.

Page	Author(s)	Title

Signature . . . . . .

Block Letters

NAME . . . . . Date . . . . . .

Position . . . . . .

Firm . . . . . .

Address . . . . . .

Payment of $ is enclosed

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of U.S. $50.00 for supply by surface mail. The additional cost for air mail will be quoted on application.

additional subscription order

Please send a further copy of your journal each month to the address below starting with the issue of

. . . . . .19 . . . . . .

Block Letters

. . . . . .

. . . . . .

. . . . . .

. . . . . .

. . . . . .

Signature . . . . . .

Date . . . . . .

I enclose cheque/draft/M.O./P.O. for $50.00.

Reader Inquiry Service,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.
England.

Photocopies Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks,
England.

Subscriptions Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.,
England.

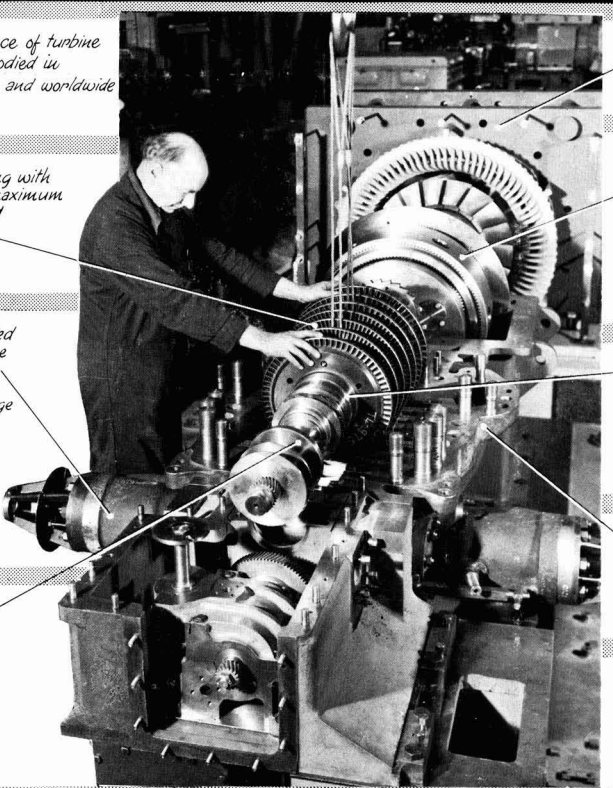
STEAM TURBINES FOR THE SUGAR INDUSTRY

Sixty years' experience of turbine manufacture is embodied in design, manufacture and worldwide service facilities.

Impulse type blading with integral root giving maximum strength to withstand arduous operating conditions.

Hydraulically-operated control valves. A range of mechanical and hydraulic governing systems using package type governors is available to ensure optimum response and control.

Substantial thrust collar locates the rotor in white metal tilting-pad bearings and capable of withstanding significant over loadings.



Standard arrangements include both alternators and mechanical drives.

High efficiency epicyclic gear of APE-Allen manufacture. A wide range of both epicyclic and parallel-shaft standard gears ensures that the turbine runs at optimum efficiency.

Rotor of stiff shaft design with first critical speed at least 30% above normal operating speed. Risk of maloperation is minimised.

Cast steel casing of rugged and robust construction for long life.

Total turbo-set engineered throughout to achieve maximum reliability and proved in cane and beet sugar industries worldwide.

1880 CENTENARY 1980

APE-Allen Limited

APE

Queens Engineering Works Bedford England.

TELEPHONE: BEDFORD (0234) 67400. TELEGRAMS: APENG Bedford. TELEX: 82486.

AN AMALGAMATED POWER ENGINEERING COMPANY

A110A

Printed by the Wrightsons Group of Companies, London; and published by the Proprietors, The International Sugar Journal Ltd., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.
PRINTED IN GREAT BRITAIN.