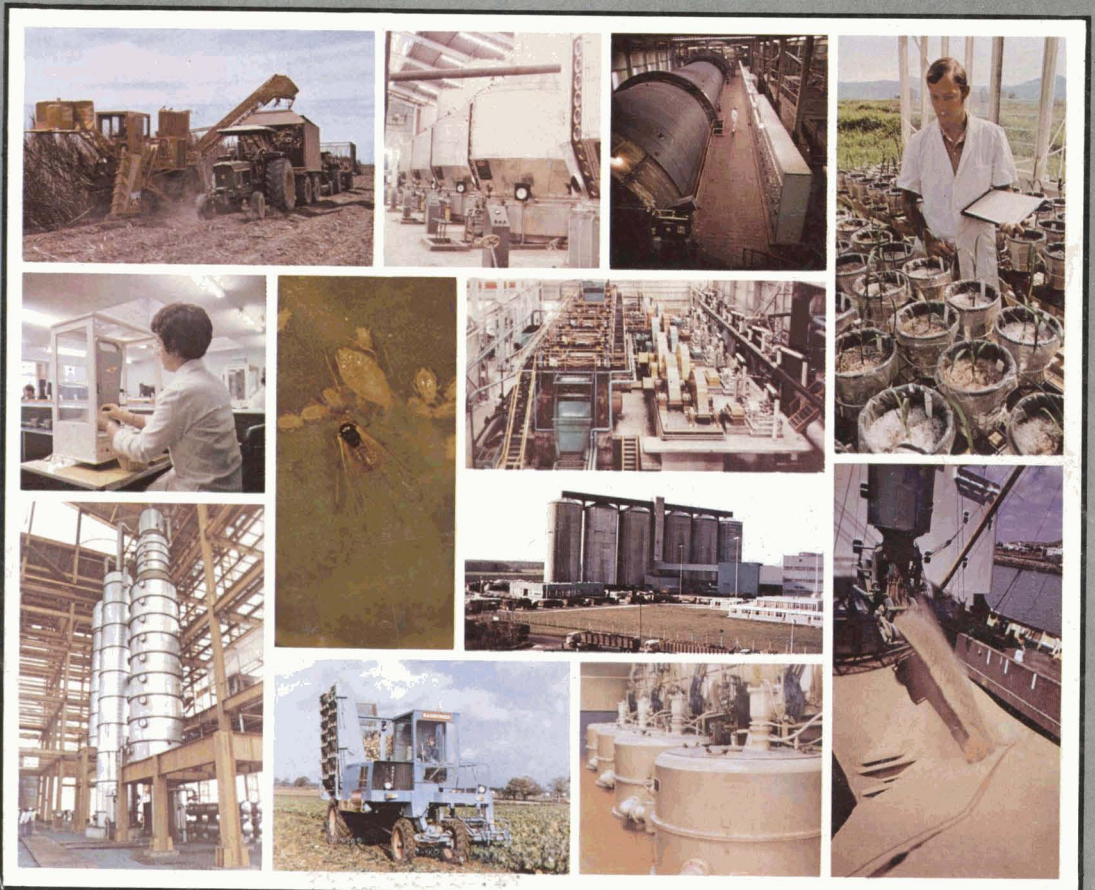
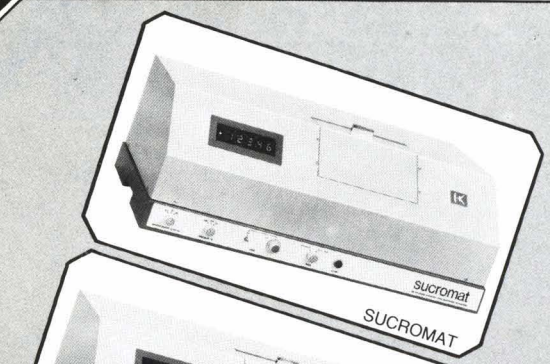
INTERNATIONAL SUGAR JOURNAL

VOLUME LXXXIV

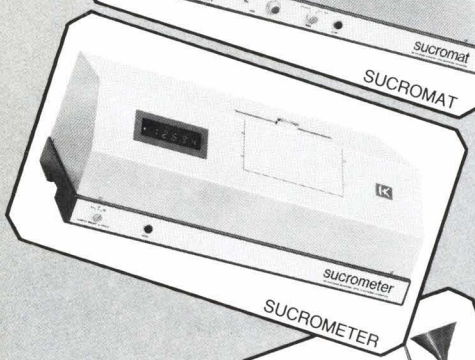
ISSUE No. 1003



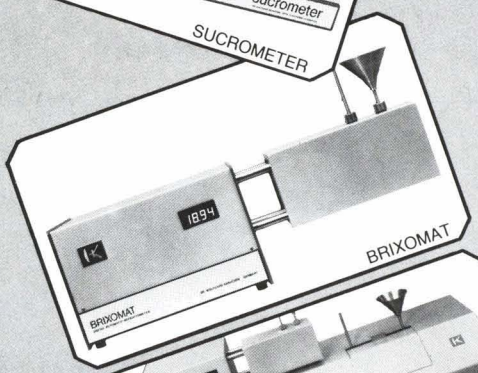
JULY 1982



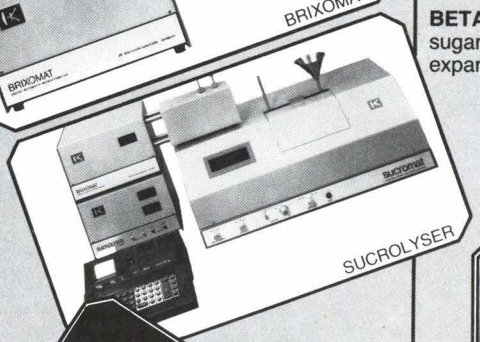
SUCROMAT



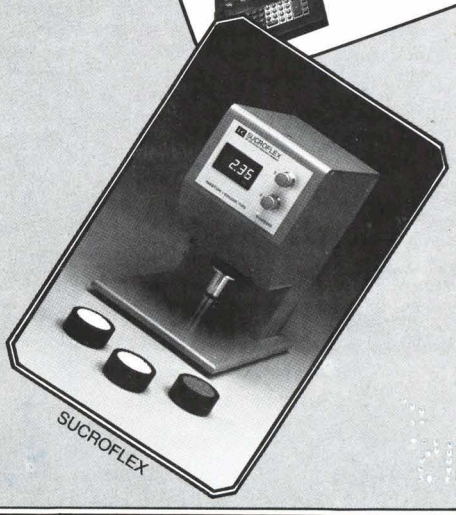
SUCROMETER



BRIXOMAT



SUCROLYSER



SUCROFLEX

Top Quality Analytical Instruments and Systems for the Sugar Industry

SUCROMAT Automatic Saccharimeter with digital display and interface capability for computers, digital printers, analog recorders and controllers.

SUCROMETER Automatic Saccharimeter with digital display.

BRIXOMAT Automatic Refractometer with digital display, temperature correction and versatile interface capability.

SUCROFLEX Digital Reflectance Colorimeter for colour measurement of crystal sugars.

SUCROLYSER Microprocessor-controlled system for quality analysis of sugarcane juice.

BETALYSER Computerized analyser for sugarbeet quality determination, expandable for soil analysis.

BETALYSER

DR. WOLFGANG KERNCHEN
OPTIK-ELEKTRONIK-AUTOMATION
P.O. Box 129 · D-3016 Seelze 2 · Germany
Phone (05 11) 40 10 61 · Telex 9 21 550

The new
Putsch
Sucroscope Model SL

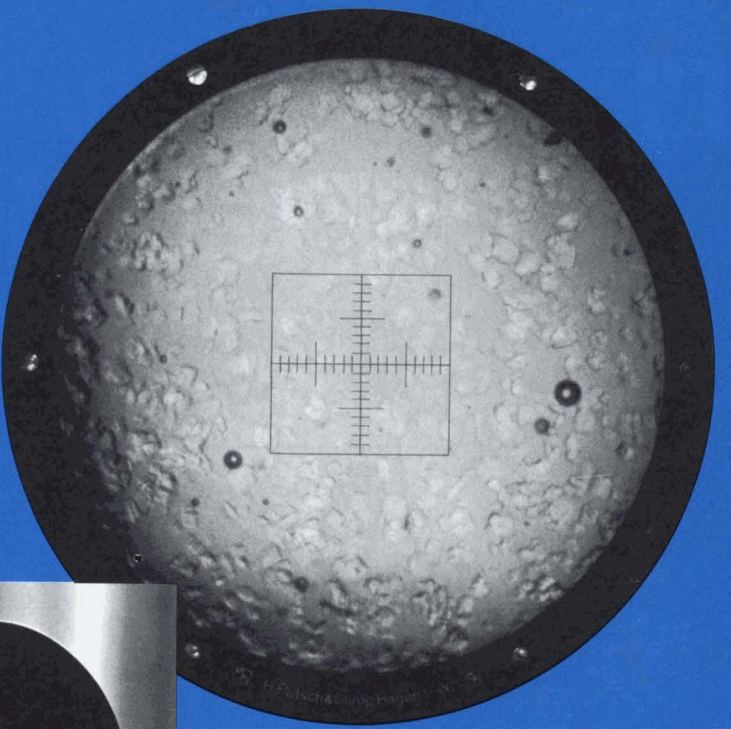


Photo shows "Low Raw"
3 hours after seeding, colour
about 10200 ICUMSA Units.

Putsch

presents the new

Sucroscope Model SL,

which is an improved version of Model K. New technical possibilities now permit observation of very dark fillmasses.

The Factory Superintendent and the Sugar Boiler will appreciate the Sucroscope as a useful and modern device for the visual observation of sugar crystals at any given moment during the boiling process.

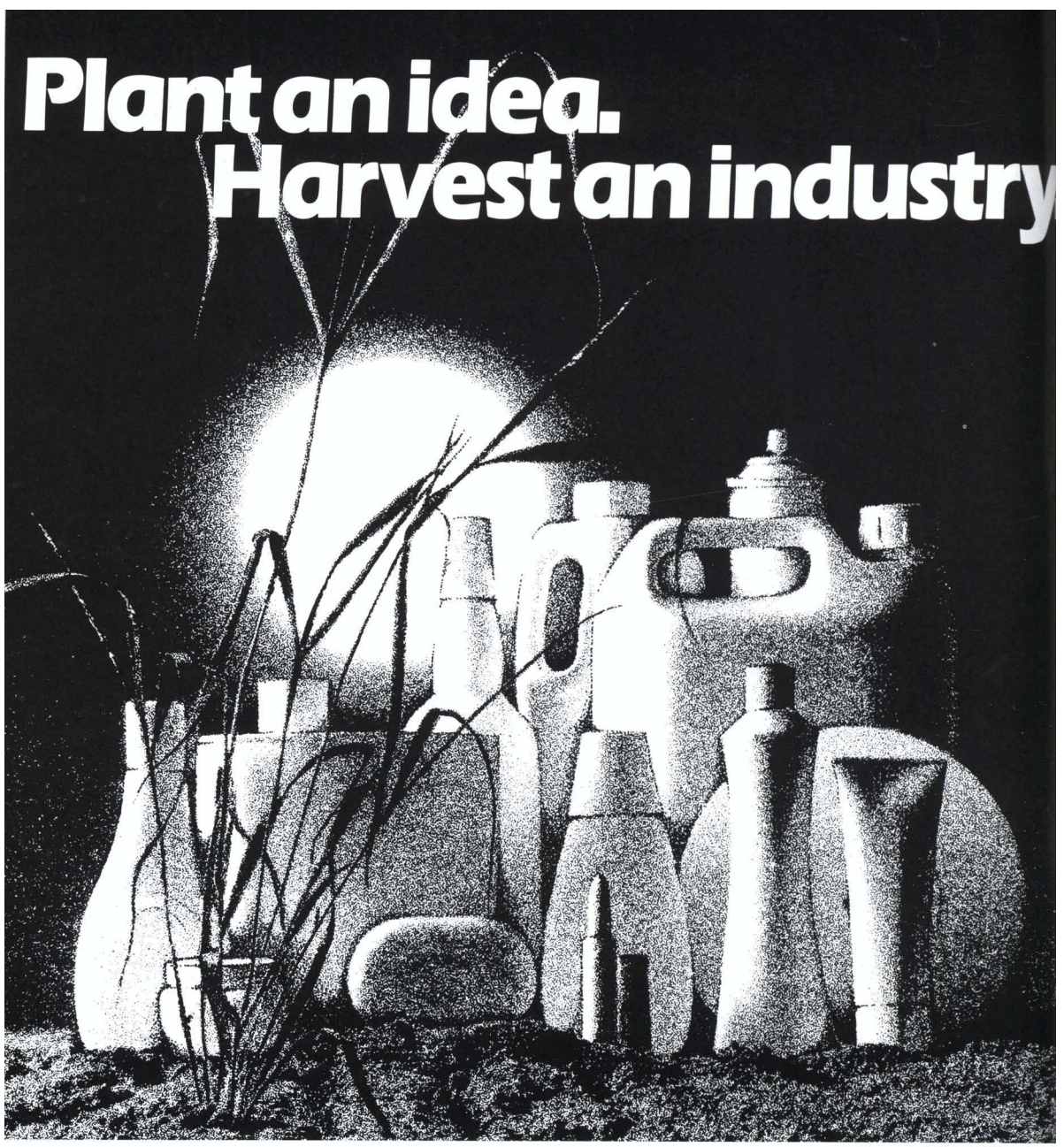
PUTSCH Sucroscope – the sleuth of your boiling station!

Please ask for details and quotation from:

Putsch

International Group

H. Putsch GmbH & Comp. · P. O. Box 4221 · 5800 Hagen 1/W.-Germany · Tel. (23 31) 3 10 31 · Telex: 8 23 795
In the USA: H. Putsch & Company, Inc. · P. O. Box 5126 · Asheville, N. C. 28803 · Tel. (704) 6 84-06 71 · Telex: 577 443



The usual effect of a crisis is to accelerate man's inventiveness. Today's major problems are high cost energy and low commodity prices. Tate and Lyle is the world's largest and most experienced independent sugar corporation and its research and development programmes are concentrated on helping to solve these problems.

Power alcohol derived from sugar is one example of maximising the conversion of the sun's energy into liquid fuel at the same time as providing an alternative use for sugar cane. New chemicals made from sugar could soon replace many more oil-based products such as detergents, plastics and cosmetics.

Tate and Lyle's scientists are working to make agricultural industry more efficient all over the world. Our aim is to add value to agricultural production and to make sure nothing is wasted – we even convert certain effluents into protein for animal foodstuffs.

But adding value can also mean better yields, and that means better agriculture. Tate and Lyle provides expertise, not only in sugar, but in all fields of agriculture and is involved in management and training schemes in many countries. If you need help with your agro-industrial development programme, come and talk to us.

Adding value to agriculture

TATE + LYLE

Tate and Lyle Agribusiness Ltd., Enterprise House, 45 Homesdale Road, Bromley, BR2 9TE, England. Tel: 01-464 6556.

INTERNATIONAL SUGAR JOURNAL

Volume 84
Issue No. 1003

CONTENTS July 1982

UK ISSN 0020-8841

Annual Subscription:
£30.00 post free

Single Copies:
£3.00 post free

Airmail charges quoted on request to

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

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.

Published by

The International Sugar Journal Ltd.

23A Easton Street, High Wycombe, Bucks., England HP11 1NX.

Telephone: 0494-29408 *Telex:* 21792 REF 869

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

France: MaG-Watt International,
6 rue des Acacias, Vert-le-Grand, 91810 Essonne.
Tel.: (6) 456-00-15.

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.

Italy: International Media Services,
C.P. 87, Via 1° Maggio 16, 20090 Segrate (Milano), Italy.
Tel.: (02) 213 9725/30.

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.

NOTES AND COMMENTS

World sugar prices

The slide in sugar prices continued in May, with the London Daily Price for raw sugar falling from £120 per tonne to £117 on May 6 as higher estimates of 1981/82 sugar production arrived from C. Czarnikow Ltd., F. O. Licht and the U.S.D.A. There was a slight recovery over the next three days but the slide resumed and the LDP reached £106 on May 14. The new stabilization scheme introduced in Japan presented an opportunity to bring into that country prompt arrival sugar at a comparatively low levy and demand increased, albeit at the probable expense of demand later in the year, whereupon the price became somewhat firmer, varying between £109 and £113 during the remander of the month which it finished at £111.

The ready availability of white sugar throughout the month, together with reluctance of buyers to cover their requirements except on a hand-to-mouth basis meant that the LDP(W) tended to follow the sugar price fairly closely with a premium rarely far from £32-£33 per tonne. Thus, from a starting figure of £151 per tonne, it dropped to £140 on May 14 but climbed again to £146 on May 26 before ending the month at £142 per tonne.

International Sugar Agreement

At its meeting in May, the International Sugar Organization agreed quota and special stock provisions for 1983 and 1984 which effectively confirm the extension of the agreement up to the end of 1984. Basic export tonnages for the two years are frozen at the same level as for 1982 which, even with the maximum possible reductions under the agreement, give a total of 16.85 million tonnes, raw value, for quotas in effect. This compares with actual requirements of only just over 12 million tonnes and so, in the absence of major crop failures during 1982/84, the ISA quota system will have no influence on sugar prices, the major function of the agreement. It will thus be kept in an ineffective, ticking-over state pending negotiation of a new agreement to take effect in 1985. The only price support mechanism to have any likely effect in the foreseeable future is the provision of special stocks, to be raised from 1 to 2.5 million tones between end-June 1982 and end-December 1983.

US sugar price protection

With the fall in world market prices, sugar import fees were increased by one cent per pound, with effect from April 21, bringing them to 4.0703 cents for raw sugar and 5.1782 cents for refined sugar. Because the extent to which the fee can be raised is limited to 50% of the f.o.b. and stowed value of the sugar, the protection afforded is limited and could even be reduced with continued falls in market price. The Commodity Credit Corporation could be faced with the need to make large support purchases of domestic sugar. As a consequence, a system of country-by-country quotas was instituted in a Presidential proclamation of May 5 which took effect on May 11 and limited imports to 220,000 short tons, raw value, for the period to June 30, as follows:

Argentina	4.3%	9,460	short tons
Australia	8.3%	18,260	„ „
Belize	1.1%	2,420	„ „
Brazil	14.5%	31,900	„ „
Canada	1.1%	2,420	„ „
Colombia	2.4%	5,280	„ „
Costa Rica	1.5%	3,300	„ „
Dominican Republic	17.6%	38,720	„ „
Ecuador	1.1%	2,420	„ „
Guatemala	4.8%	10,560	„ „
Guyana	1.2%	2,460	„ „
Honduras	1.0%	2,200	„ „
Jamaica	1.1%	2,420	„ „
Mauritius	1.1%	2,420	„ „
Mozambique	1.3%	2,860	„ „
Nicaragua	2.1%	4,620	„ „
Panama	2.9%	6,380	„ „
Peru	4.1%	9,020	„ „
Philippines	13.5%	29,700	„ „
El Salvador	2.6%	5,720	„ „
South Africa	2.3%	5,060	„ „
Swaziland	1.6%	3,520	„ „
Taiwan	1.2%	2,640	„ „
Thailand	1.4%	3,080	„ „
"Others"	5.9%	12,980	„ „

The quotas were calculated on a basis of each country's shipments during 1975/81, omitting the highest and lowest figure for each supplier during the period. The "Others" provision is for a number of smaller suppliers, to be allocated on a first-come first-served basis. Quotas for the third quarter of 1982 were to be announced on June 15, and the system will expire on October 1 unless it is decided to continue them. At the same time, the basis of calculating the import fee was changed to the domestic No. 12 spot price instead of the No. 11 world price.

The *Public Ledger's Commodity Week*[1] reported that the imposition of quotas is "causing some red faces in Washington. By adopting a protectionist strategy, the US would appear to have tarnished its reputation as the global bastion of free trade, and this is particularly embarrassing as Washington is currently accusing the EEC of unfair sugar trading practices at GATT. Furthermore, by denying Caribbean producers preferential treatment under the quota system, the Administration looks to be running contrary to the spirit of Reagan's Caribbean Basin Initiative which is supposed to give exporters in the region duty-free access to the US market".

There has been opposition to the new measures from several sources and a number of producers have expressed anxiety over possible reduction in their outlets in the US from recent levels. The US Cane Refiners' Association filed a suit in the US Court of International Trade, alleging that, under the Agricultural Adjustment Act of 1933, the Government could impose either quotas or an import fee system but not both. At a hearing on May 27, however, the judge deferred taking a decision and indicated that a case involving a specific shipment should be taken through the civil courts.

European beet area, 1982

F. O. Licht GmbH recently released their second estimate of beet areas sown in Europe for the 1982 crop[2] as well as corrected figures for 1981. The change for the whole of Europe is only 1000 ha but this is the

[1] May 8, 1982.

[2] *International Sugar Rpt.*, 1982, **114**, 213.

net result of a number of relatively small changes – reductions of 5000 ha in France, 10,000 ha in Italy, 1000 ha in Switzerland, 7000 ha in East Germany, and increases of 1000 ha in Finland, 19,000 ha in Spain and 2000 ha in Hungary, all by comparison with the first estimate[3].

The 1981 area amendment is larger – a reduction of 83,000 ha which is the net result of an increase of 5000 ha in the UK area figure and decreases of 1000 ha for Sweden and 87,000 ha for the USSR. The new totals indicate a reduction of 8.3% in the EEC beet area for 1982 relative to 1981, a reduction of 3.9% for Western Europe, an increase of 1.9% for Eastern Europe and a reduction of 0.2% for Europe as a whole.

World sugar balance, 1981/82

The third estimate of the world sugar balance for the period September 1981/August 1982 was recently published by F. O. Licht GmbH[4] but provides only confirmation of the large sugar surplus hanging over the world sugar market. Even though part of the seven million tonnes excess of production over consumption will be segregated from the market in the form of ISA special stocks and the EEC voluntary stocks, the balance is sufficient to depress sugar prices for a considerable time in the future. Licht's figures are reproduced below:

	1981/82	1980/81	1979/80
		tonnes, raw value	
Initial stocks	24,975,000	25,931,000	31,307,000
Production	97,608,000	88,183,000	84,857,000
Imports	28,791,000	28,776,000	29,551,000
	151,374,000	142,890,000	145,715,000
Exports	29,273,000	29,299,000	30,211,000
Consumption	90,743,000	88,616,000	89,573,000
Final stocks	31,358,000	24,975,000	25,931,000
" " % consumption	34.56	28.18	28.95

EEC prices for 1982/83

Farm ministers of the EEC countries had, as foreshadowed in our earlier report[5], agreed among themselves even higher farm price increases than proposed by the Commission and these included rises of 9.5% in the basic price for sugar beet and the intervention price for white sugar. The British Government had withheld its formal approval of the prices, linking them with its demand for measures to reduce what it considers to be the excessive contributions to the total budget resulting from UK food purchases at prices set under the Common Agricultural Policy. The deadlock had continued with the UK exercising its veto under the so-called Luxembourg compromise under which member countries were able to veto measures affecting their "vital interests". On May 17 the Farm Ministers of the other countries (Denmark and Greece abstaining) decided to go ahead with the new prices, ignoring the British veto. The UK protested and has stated that it would insist on maintaining the principle of unanimity which had prevailed until May 17 but retaliatory measures have not been announced; these could include temporary withdrawal from EEC affairs, or a refusal to pay any money into EEC funds.

Algerian sugar[6]

At one time Algeria produced some 66% of its total food requirements, whereas now the figure has fallen to 40%, and most of its white sugar requirements have to be met by imports, chiefly from the EEC. From 1976/77 to 1980/81 sugar production averaged 10,500 tonnes per year (raw value), although there is a theoretical beet slicing capacity of 350,000 tonnes, split between a rated 150,000 tonnes/year for the factory at Guelma and 200,000 tonnes/year for El Khemis factory. (Little is known about a third factory which is probably not producing sugar at present.) The poor results are a consequence of primitive agriculture, lack of irrigation, soil erosion, poor soil and inadequate mechanization. In addition to the white sugar imports, substantial quantities of raw sugar are also brought into the country for processing at one of three refineries, two of which are attached to the beet sugar factories while a third is situated on the coast at Mostaghanem. Each is capable of producing 60,000 tonnes of refined sugar per year plus 15,000 tonnes of tablet sugar (25,000 tonnes at Guelma). Per caput sugar consumption in Algeria is about 25 kg/year. Sugar, because of its role as a basic foodstuff, benefits from a sizeable subsidy.

Indian sugar production and problems

As mentioned earlier[7], India has requested an increased sugar export quota for 1982 under the International Sugar Agreement in the face of a sugar production level far higher than in 1981. F. O. Licht GmbH have reported[8] that the January 1982 outturn was a record at 1.42 million tonnes and production since the start of the crop in October 1981 had reached 609,000 tonnes above the corresponding figure to January 1981.

The total production figure is expected to reach 7 million tonnes, tel quel, equivalent to 7.6 million tonnes, raw value, against some 5,560,000 tonnes, raw value, in the preceding crop. Licht attributes this phenomenal rise to two main factors: a larger number of operating sugar factories (314 *vs.* 290), and a regular supply of cane, while higher recovery rates have also contributed. The steady cane supplies result from higher cane prices; despite the Union Government's decision not to raise the statutory price for cane, the various State governments have put pressure on the sugar factories to pay substantially higher prices. On the other hand, because of a declining price for their products, gur and khandsari producers have lowered the prices they pay for cane so that growers are diverting as much cane as possible to the sugar factories.

This has caused financial problems for the sugar factories which need more credit to finance the rising stocks of sugar they are producing. Companies are unsure of getting additional loans from the banks and were already facing a serious shortage of credit because of the government's tight-money policy. The industry is seeking a total credit of 6900 million rupees ($748 million) against 3900 million rupees last year ($423 million) and sources say that factories may be forced to stop making payment to cane growers unless they get more credit.

It would be interesting to know how much extra sugar is recovered by the sugar factories from the cane which is being diverted to them, by comparison with the amount which would have been recovered as gur; presumably, consumption of centrifugal sugar will rise by that amount which would otherwise have been eaten as gur, so that not all the increase in sugar production – and perhaps not even the major part – will, in fact, be added to the exportable surplus from the 1981/82 season.

[3] *I.S.J.*, 1982, **84**, 161.
[4] *International Sugar Rpt.*, 1982, **114**, 285.
[5] *I.S.J.*, 1982, **84**, 65.
[6] *Le Betteravier*, 1982, **16**, (163), 18.
[7] *I.S.J.*, 1982, **84**, 97.
[8] *International Sugar Rpt.*, 1982, **114**, 141.

Development of extraction systems for beet in the UK

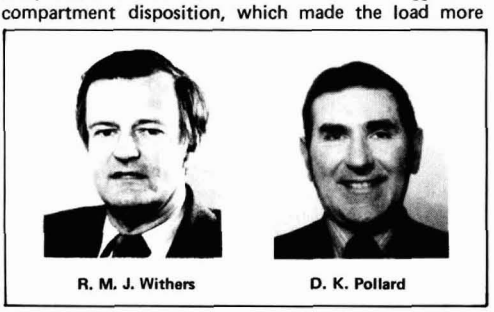
By R. M. J. WITHERS and D. K. POLLARD
(Fletcher & Stewart Ltd., Derby)

This article reviews development and trends in continuous diffusers with special reference to the rotary diffuser. To help place recent activities in perspective some introductory remarks may be made about the history of collaboration between what are now the British Sugar Corporation, Fletcher & Stewart Ltd. and the Society Sucrière d'Etudes et de Conseils, Belgium (S.S.E.C.).

The firm of Duncan Stewart & Co. Ltd., now incorporated into Fletcher & Stewart Ltd., built five of the six factories of the former Anglo-Scottish Sugar Company in the United Kingdom and supplied Raabe continuous diffusers as the standard extraction equipment. This was in many ways a novel and bold move as all the other 12 factories, which together with the Anglo-Scottish group were later to form the British Sugar Corporation, used conventional batteries. Indeed, at that time throughout Europe, continuous diffusion was in its infancy, the major rival to the Raabe being the Olier diffuser.

The technology of the Raabe diffuser had an important feature in common with the rotary diffuser which followed it, namely the lifting of the beet cossettes from one compartment to another which avoided preferential channelling of the juice flowing in counter-current. These Raabe diffusers, with an installed capacity of 500 tonnes of beet per day, were quite successful in operation, although the maintenance costs were rather heavy, and it was not until the end of World War II that they were progressively replaced with rotary diffusers which also provided an opportunity to increase the slicing capacity of the British factories.

The first rotary diffuser was developed by Julian Bergé at Tirlemont in the 1930's, using the single helix method. After the Second World War, André Smet of Raffinerie Tirlemontoise S.A. converted a 3.47 m diameter Bergé diffuser (RT1), originally designed by Michel Welstein, to the double helical construction employing a new principle of diffusion in which the juice would be transported through the diffuser twice as fast as in the RT1. This was patented in 1948 as the RT2 and led to a 50% increase in capacity and a significant decrease in sugar loss. Shortly after this, one of these machines of 4.0 m diameter was built by Duncan Stewart and installed in the British Sugar factory at King's Lynn, to work alongside a diffusion battery. This machine worked reasonably well, but a further modification so as to stagger the compartment disposition, which made the load more even, was made on subsequent RT2 models. The first RT diffusers to work alone in British Sugar factories were built by Stewart in 1951 and had an installed capacity of 1200 tonnes of beet per day. Following a suggestion by Harold Silver the drainage grids in these U.K. machines were soon replaced by perforated basket screens; this modification was then incorporated in all other RT2 machines and further improved the capacity and performance. In 1956 a notable Stewart-built RT2 installation was commissioned at Wissington. This was a 5.4 m diameter machine, 34.3 m long, of 2200 tonnes beet/day capacity. It included a hydraulic coupling fitted with a scoop control for the variable speed drive (this system has since become standard for all subsequent UK diffusers), a pre-scalder so as to provide cold raw juice (Wissington had a significantly lower fuel consumption than any other B.S.C. factory), and automatically controlled acidification of the supply water so as to give good pressability of the exhausted pulp. The pre-scalder only achieved a limited cooling of the raw juice because it was not counter-current in operation and, therefore, not very efficient. Nevertheless, two further models of this type were installed at other factories of the B.S.C.



R. M. J. Withers D. K. Pollard

This 1956 installation at Wissington was, however, attracting more interest from the international sugar community on account of its advanced system of automatic control based on electronic instrumentation and the use of simple analogue computing relays. This regulated the factory automatically from the incoming beet supply right through to the thick juice tank. The successful operation of this system was in a large measure due to the predictable and flexible characteristics of the RT diffuser at work.

By this time, the RT was well established as the favoured diffuser in the factories of the British Sugar. It was also becoming widely known internationally; for example, in the years 1959/60 Stewart exported 12 diffusers to the U.S.S.R.

By comparison with the other forms of beet diffusion, the main advantages of the RT type diffuser over tower, trough, and belt types can be summarized as follows:

A. Positive displacement of the materials, juices and cossettes inside the diffuser gives a very predictable process response. Relative insensitivity to slice quality, which is important if frozen beets or deteriorated beets are to be processed.
B. Good extraction results obtained through the full range of loading up to the design capacity.
C. High purity juice produced without high consumption of anti-bacterial additives because there are no dead pockets, and liquid/solid phases are thoroughly mixed and positively separated without preferential channelling of the juice.
D. No moving parts internally and therefore moderate maintenace costs.

In 1964/5 experiments were made at the King's Lynn and Bardney factories in connexion with the development of a mathematical model for the beet sugar factory process. These experiments were designed and carried out so as to examine the accuracy of the mathematical

model of the diffusion system. The Silin diffusion equation as developed by Tom Rodgers was the basis of the diffuser section of the model.

The factorial experiments varied the level of draft, cossette thickness, and diffusion temperature. Results of the experiments showed a correlation of draft and slice thickness in line with what was expected. Thus, the further extraction for higher surface area per unit weight of cossettes was quantified (slice quality was measured in terms of the length of 100 grams of cossettes). The unknown loss was negligible in relation to the known diffuser loss, and no detectable change in the known loss due to temperature change was measured. The temperature, however, had significant effects on other aspects of the operation, particularly on the marc value and, therefore, the quantity of pressed pulp.

The successful outcome of these experiments once again confirmed the predictable and repeatable characteristics of the RT diffuser. Thus by that time there was, in the B.S.C. at least, a very favourable attitude towards RT diffusers, which were ideally suited to the varied requirements of its long campaigns. Of the 18 B.S.C. factories, one still had a battery, one still had a Raabe diffuser, one had B.M.A. towers, and another one had a D.D.S. diffuser, but all the rest were equipped with RT2 diffusers. Altogether some 250 RT2 diffusers were to be installed around the world.

Table I. Capacity:volume ratios for RT2 and RT5 diffusers

Capacity, tonnes beet/day	RT 2					RT 5				
	Dia (m)	Comp't width (mm)	Eff've length (m)	Vol (m^3)	Ratio c:v	Dia (m)	Comp't width (mm)	Eff've length (m)	Vol (m^3)	Ratio c:v
2000	4.80	890	29.37	532	3.76	4.10	880 790	29.88	395	5.07
3000	5.60	1070	35.31	870	3.45	4.70	1010 910	34.36	596	5.03
4000	6.25	1200	39.60	1215	3.29	5.15	1120 1010	38.12	794	5.04
5000	6.75	1300	42.90	1535	3.26	5.60	1190 1070	40.44	996	5.02
6000	7.25	1420	46.86	1935	3.10	6.00	1240 1120	42.24	1194	5.02
7000	7.70	1510	49.83	2320	3.02	6.15	1370 1240	46.72	1388	5.04
8000	8.00	1570	57.81	2604	3.07	6.40	1450 1310	49.40	1589	5.03
9000						6.75	1470 1320	49.92	1786	5.05
10,000						7.00	1510 1360	51.36	1977	5.06

Table II. Basket screen ratios

Capacity, tonnes beet/day	RT 2					RT 5			
	Dia (m)	Speed (rph)	Screen area (m^2)	Charge per rev (kg)	Ratio 'R'	Dia (m)	Screen area (m^2)	Charge per rev (kg)	Ratio 'R'
2000	4.80	23.3	6.8	3580	3.78	4.10	7.4	2730	5.42
3000	5.60	22.0	11.7	5680	4.12	4.70	10.8	4100	5.27
4000	6.25	19.6	15.9	8500	3.75	5.15	14.4	5460	5.28
5000	6.75	19.3	18.1	11,260	3.35	5.60	18.0	6830	5.27
6000	7.25	18.1	20.7	13,810	3.00	6.00	21.6	8200	5.27
7000	7.70	17.8	28.7	16,390	3.50	6.15	25.1	9560	5.25
8000	8.00	17.5	31.9	19,050	3.35	6.40	28.7	10,930	5.25
9000						6.75	32.3	12,300	5.25
10,000						7.00	35.9	13,660	5.26

$$\text{Ratio 'R'} = \frac{\text{Gross screen area per basket } (m^2)}{0.5 \times \text{cossette charge per rev (tonnes)}}$$

Note: The speed of the RT5 is 30.5 rph for all sizes

However, in spite of its superior operating performance there were already emerging two disadvantages in relation to competitive types of diffuser. The first was its higher capital cost, owing to the fact that the drum is never more than 34% full, whereas other diffusers may be 100% full. The second disadvantage was that the discharge of hot juice limited the use of lower temperature vapours and so reduced the opportunities for improving the heat economy of the factory.

Attempts were made at Genappe in 1958 to improve upon the RT2 involving the use of hinged screens but the RT3, as this was referred to, failed and was abandoned. A counter-current pre-scalder was also devised at about the same time, also using hinged arrangements, but the use of machinery with hinged parts in contact with the raw juice was soon abandoned and it was not until 1969 that the real breakthrough was made by Georges Duchateau who conceived the RT4. This was first installed at Coulommière as a 4.2 m machine for 2000 tonnes of beet per day. In 1976 trials at Genappe with RT4's having additional central drainage and modified juice channels to improve juice separation proved successful. In 1979 angled passages replaced the juice channels which further improved the separation of the juice from the cossettes, and the diffuser then became the RT5. In 1981 the first RT5 was commissioned at Brigg in England and is of 5.4 m diameter and designed for 3500 tonnes of beet per day initial capacity with facility for extension to 4500 tonnes of beet per day. It has already demonstrated significant improvements in its performance.

Since their inception in 1969, there have been 37 RT diffusers of the RT4, RT4 variants, and RT5 types built or on order in 12 different countries.

Design features of the RT5 diffuser

Five different aspects of the design features of the RT5 are now described in turn:

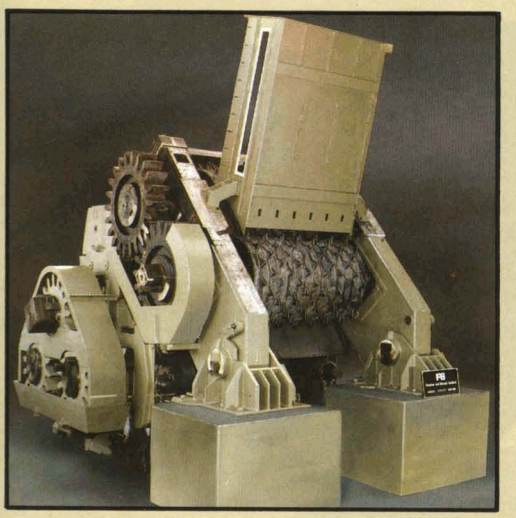
(a) Body

The RT5 diffuser, whilst employing the well-established diffusion principles of André Smet, offers a significant saving in cost effectiveness over the RT2 because of its better use of space. This factor can be quantified by comparing the relative values of the capacity/volume ratio (see Table I), and the benefit accorded to the RT5 is a direct result of an increased ratio of basket screen area to charge (see Table II) permitting higher rotational speeds to be used. Reference to Fig. 1 shows how this has been accomplished – note that the required space for the basket screen is achieved in a drum of smaller dimensions for the same capacity.

The internal construction of the RT5 differs from the RT2 in respect of the shaping and configuration of the plates forming the transport chutes and scrolls, producing a cleaner, stronger fabrication. Juice separation is accomplished during the lifting phase, first at the periphery via an angled passage, then by a central ducting (see Fig. 1), during which time it moves towards the head end, a distance equal to one compartment width, and mixes

Quality, Innovation, Value

Complete cane and beet projects designed, engineered and installed to customer's specific requirements.



FS/Polymex Pressure Fed Cane Mill for Port Vale Sugar Factory, Barbados during proof erection at FS Derby works.

Turnkey Capabilities

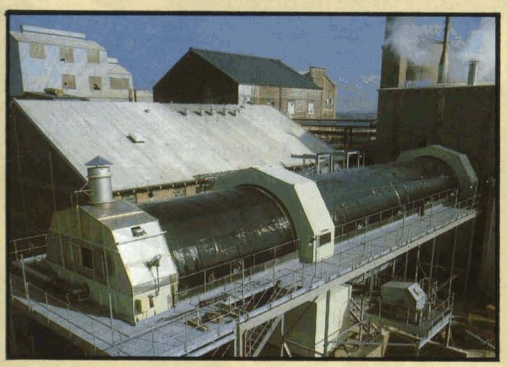
- Consultancy Services
- Preliminary Surveys and Feasability Studies
- Process and Unit Equipment Design
- Plant Manufacture and Procurement
- Construction (Including Civil Works)
- Commissioning and Training

Cane Sugar Product Range

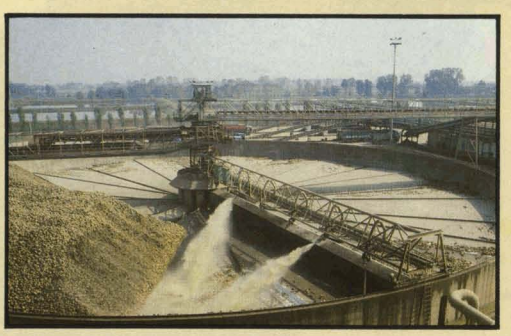
● Cane Handling Systems ● Cane Knives and Shredders ● Cane Diffusers ● 3 and 4 Roller Mills ● Pressure Fed Mills ● Rollers and Shells ● Automatic Liquid Scales — *for juice, water or molasses* ● Juice Heaters ● SRI Clarifiers ● Evaporators ● Vacuum Pans ● Crystallizers ● Centrifugals ● Rotary Vacuum Filters ● Massecuite Pumps

Beet Sugar Product Range

● Reception, Handling, Washing ● Diffusers ● Vacuum Pans, Evaporaters, Heaters ● Clarifiers ● Crystallizers and Strike Receivers ● Pumps ● Centrifugals



An RT5 Beet Diffuser capable of processing up to 4500 tonnes of beet per day recently installed and commissioned at BSC Brigg Factory England. (Photograph by permission of the British Sugar Corporation)



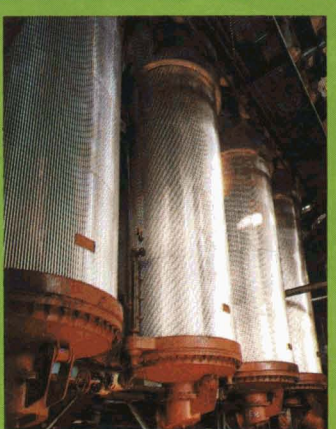
FS/Elfa Beet Silo and fluming equipment at a sugar factory in Italy.

FS

Fletcher and Stewart Limited
Derby DE2 8AB England
Telephone: Derby (0332) 40261
Telex: 37514
Cables: Amarilla Derby Telex

A World of Experience

WE RECORD OUR SUGAR ACHIEVEMENTS



Elgin Engineering Co. Ltd
3 Clydebank Road, Bayhead, Durban 4001
P.O. Box 301, Durban 4000, South Africa
Telephone:
National (031) 251461 International +27 31 251461
Telex 6-2116 SA
Telegrams & Cables 'Panelgin' 'Girders'

A Member of the Murray & Roberts Group M&R

ELGIN

with the richer slices of the next downstream compartment; since this same juice is separated again during the next lifting phase to complete one turn in the drum, the axial displacement experienced by the juice during a single revolution is equal to two compartment widths. Cossette transport meanwhile is effected in the opposite direction, a distance of half a compartment width by an inclined chute plate, and another half compartment width by the scroll, thus totalling one compartment width per revolution. In this way, the essential features of the RT diffusion principle established by André Smet is still preserved, i.e. juice of increasing sucrose richness is caused to move counter-currently twice as fast as cossettes of decreasing richness.

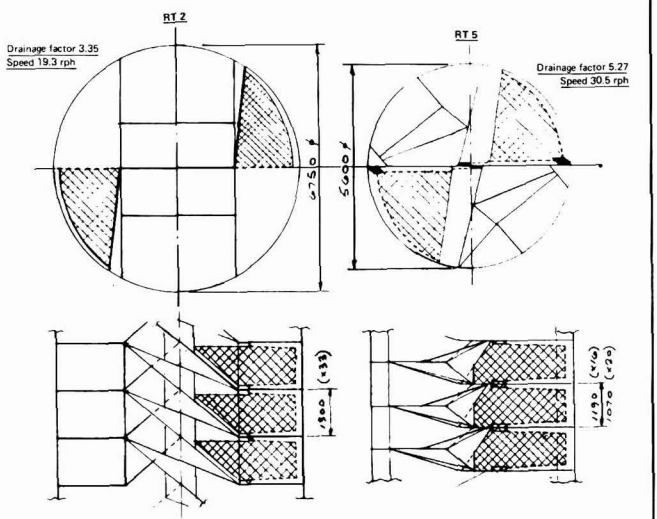


Fig. 1. Comparison for 5000 tonnes beet/day

As in all modern RT diffusers, the compartments are arranged in a helix for constant torque. However, unlike the RT2 and RT4, the internal construction of the RT5 requires this helical displacement to be opposite to the sense of rotation when viewed from the head end. A coarsely perforated baffle plate placed at the end of the juice passage prevents slices from blocking it when cossettes are discharged from the baskets across the drum. The revolving head end of the drum body, which is of the same diameter as the shell, contains feed scroll plates which, as the drum revolves, cause the freshly delivered cossettes to be transported into the first compartment.

Finely perforated screens at the periphery and face of the revolving head separate the juice from the cossettes and drains it into the fixed head. Scalding juice carried over into No. 1 compartment and diffusion juice from No. 2 compartment leave the drum via a rectangular aperture cut in the shell and also drain into the fixed head.

Revolving head screens must be kept clean if flooding problems are to be avoided, and it has been established that a cost-effective way is to employ fixed-jet sprays, although the use of compressed air is also simple and effective. With this spray system, as employed in the UK, it is usual to use 2nd carbonatation juice to avoid dilution of the raw juice leaving the fixed head. In the UK, epoxy coating techniques have become an established method of protection against corrosion and abrasive wear. In this connexion, Fletcher & Stewart recommend the use of grit-blasted pre-primed plate materials for main fabrication as an aid to achieving the necessary quality standards with regard to weld finish and surface preparation. Unlike its predecessors, the RT5 is ideally suited to this form of protection in that it does not have the erosion-prone steps of the RT2, and all surfaces are accessible.

(b) Support Gear

Path ring and trunnion problems experienced on diffusers installed in the 1950's and 60's, together with the trend towards larger and heavier drums, have led to a number of design changes, including stronger materials, double roller trunnions and hydraulically tensioned bolts.

(c) Drive systems

Mention has already been made of the scoop-controlled hydraulic coupling used to vary the shaft speed obtained from a standard squirrel-cage motor. This type of drive onto a single pinion is still favoured by the B.S.C., although other installations, notably in Italy, favour the use of twin D.C. motors driving two pinions.

The commercial availability of large shaft-mounted reduction gear units has simplified the overall installation of the conventional geared drive, which also continues to be favoured by the UK factories, despite successful alternatives of the powered-trunnion roller-friction drive used in France, and the hydraulically operated ratchet drive used in the U.S.A. For diffusers having a face width to PCD ratio of less than around 1:18, it is recommended that the pinion be carriage-mounted to ensure maximum tooth contact.

(d) Outdoor installation

The RT diffuser has been adapted for outdoor operation in a number of countries, with the object of saving factory building costs. Under these circumstances, weatherproofing may be necessary and this can involve casings for the support and drive gears, positive sealing at fixed structures and a non-permeable insulation system.

(e) Acid dosing

Since 1978 factories in Britain have adopted a combined technique of direct mid-bay acidification and sterilization which reduces pulp drying costs by improving pulp pressibility. The acid used is usually 5-10% w/w concentrated sulphuric acid fed via a special dosing gland and piping. Since epoxy coatings are not resistant to acid attack at the process temperature (70-75°C), it is usual practice to incorporate stainless

steel in certain strategic places of the dosing compartment.

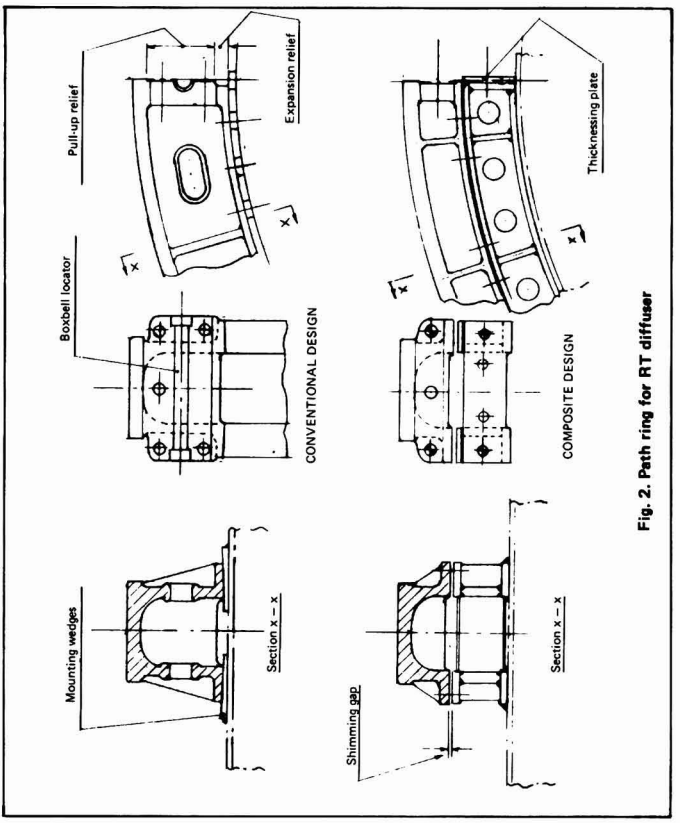


Fig. 2. Path ring for RT diffuser

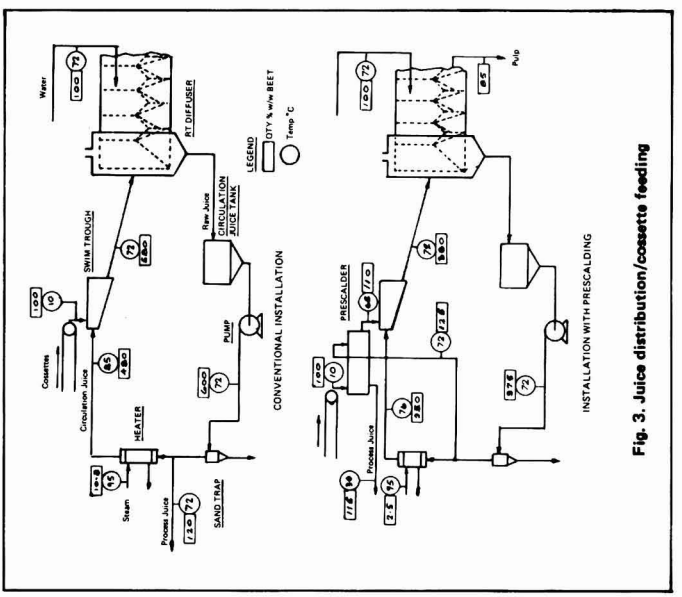


Fig. 3. Juice distribution/cossette feeding

Future trends

(a) Hydrostatic shoe support

In the early 1970's, the Swedish bearing company S.K.F. of Gothenburg developed a hydrostatic shoe bearing for supporting rotary ore grinding mills. This method of support could also be applied to the rotary beet diffuser, and in 1978-79 Fletcher & Stewart undertook a preliminary investigation into this possibility. Our conclusions were that for diffusers up to 6000 TBD capacity, 6 m diameter and weighing about 850 tonnes, conventional support rings and rollers were a proven and cost-competitive method. Above this size, the face widths required to keep surface stresses down to an acceptable level can lead to an increasing risk of excessive edge loading, and result in premature surface failure. The use of hydrostatic shoes eliminates this problem and gives better load distribution circumferentially, which should also reduce the possibility of internal weld failure so prevalent in many existing RT constructions. The hydrostatic shoe system optimizes the choice of material for path rings and gear rings; the former, requiring maximum stiffness, could be designed with generous proportions in a low-cost plain carbon steel in either cast or fabricated form, and the latter selected for the required balance of wear and strength. It has even been suggested that the path rings could, because of the absence of wear in a shoe application, be welded directly to the drum, thus eliminating any possibility of mechanical looseness developing – a problem which is often found on wedged rings.

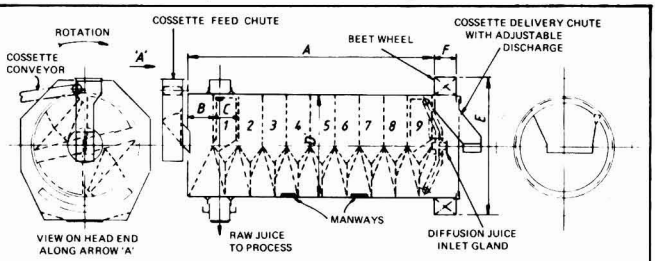
(b) Path ring design

The conventional ring is a casting in 2, 3 or 4 bolted sections and is mounted by driving wedges between its bore and the shell plate. This operation sets up very considerable tensile stresses in the ring which can cause or contribute to crack propagation. The drum expands as it is heated up to its process temperature. But the ring, being subjected to the cooling effect of the surrounding air, does not expand to the same extent and the tension forces are increased. Furthermore, the outer diameter expansion of the ring is less than the expansion at the ring bore, and the joints of the ring open up, exposing the interfaces to edge loading every time they contact the rollers. This leads to plastic deformation and crumbling damage to the path ring.

It is also a common problem, after a few years of service, to experience a loosening up of the ring on its wedged seating, and this can cause failure of the drive blocks, allowing the ring to turn relative to the drum. Fletcher & Stewart recognise these problems as weaknesses which so far have not been eliminated. We believe that there is some merit in considering the composite design shown in Fig. 2. In this design, the ring is made in two elements, an outer runner ring and an inner seating ring, the two being secured together by radial bolts. The outer ring would be made in a cast steel selected for its strength/ wear properties, whereas the inner ring would be fabricated in a weldable quality mild steel and welded to the drum body.

On erection, a gap equal to the expansion of the drum (2-3 mm approximately) is left after fitting shims between inner and outer rings. Thus when the radial securing bolts are tensioned a compressive stress in the outer ring and a tensile stress in the inner ring is set up, both of these stresses being neutralized when the drum expands to normal running temperature.

Setting up and alignment of the composite path ring is greatly facilitated by virture of the fact that the inner ring is mounted first, giving a rough location, and fine adjustment made by optimizing the positioning of the outer ring – the radial bolt-holes being generously oversized. This design not only overcomes the problems associated with the conventional ring, but is also more economical in terms of replacement since only the outer ring is a wearing part.



Capacity, tonnes/ 24 hr	Slice rate tonnes/ hr	Speed rpm	Max. cell charge, kg	Shell details					Beet wheel		Calc'd absorbed power (kW)		Installed motor size
				Inside dia 'D', mm	Length 'A' mm	Feed comp. width 'B', mm	Cell width 'C', mm	Plt thk/ shell IUTs	Inside dia 'E'	Inside width 'F'	max.	mean	
2240	93.3	55	1700	3.5	9328	1080	900	14/8	4.90	700	25	18.6	37
3310	138.0	,,	2510	4.0	10558	1230	1020	16/8	6.60	800	42	31.5	55
4740	197.5	,,	3590	4.5	11878	1380	1150	18/8	6.30	900	67	50.5	90
6510	271.3	,,	4930	5.0	13208	1540	1280	20/8	7.00	1000	103	77.0	150
8670	361.3	,,	6570	5.5	14528	1690	1410	22/8	7.70	1100	150	113.0	200
11270	469.6	,,	8540	6.0	15848	1840	1540	24/8	8.40	1200	213	160.0	280

Bulk density at No. 1 compartment = 700 kg.m^{-3}
Cossette retention time = 10 min

Fig. 4. RT5 rotary cossette heaters (prescalders)

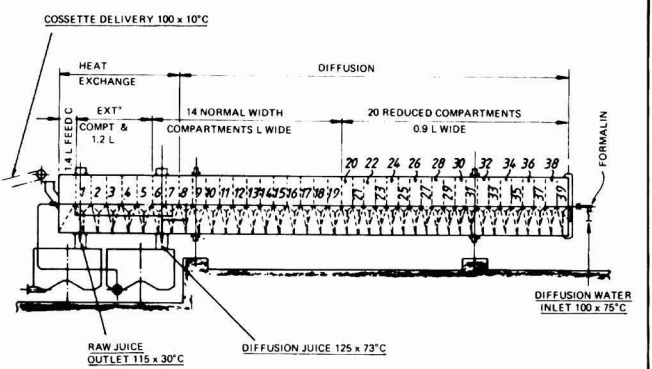


Fig. 5. Schematic arrangement of RT5 heat exchange diffuser

(c) Pre-scalder

The increasing need worldwide to economize on energy consumption has given considerable impetus to the task of developing a successful form of pre-scalder for use in conjunction with rotary drum diffusers, with the object of utilizing the hot juice from the diffuser to heat up the fresh cold cossettes from the slicers, thus producing cooled raw juice which can then utilize the low heat value of vacuum pan vapours and evaporator condensates. Fig. 3 shows diagrammatically the conventional system of juice extraction/cossette feeding, and how a pre-scalder could be used both for new installations and existing plant.

The design employed in the well-established RT diffuser for juice extraction can easily be adapted for counter-current heat exchange, and this possibility was first demonstrated in 1976 at the Bazancourt factory in France, where a 6.25 m RT4 diffuser was equippped with four compartments arranged for pre-heating of the directly-fed cold cossettes as in Fig. 4. Since then, similar installations have been made in France at Lillers and St. Germainmont, with a further one at Artenay planned for starting-up this year.

For new constructions, this incorporation of a preheating facility into the diffuser is a more economical proposition than a separate unit. In existing factories, the cossette pre-heating can be accomplished separately and S.S.E.C. have now developed an 'RT' cossette heater. Two of these machines operated for the first time during the 1981-82 campaign and the results obtained indicate that a 9 compartment heater rotating at 55 rph will produce cold raw juice at about 20°C above the cossette inlet

temperature with a prescalder draught of 120% on beet. The retention time at this speed is 10 minutes and allows generous scope for speed adjustment to cope with capacity/slice quality variations. Fletcher & Stewart proposals for this machine incorporate a generously sized feed compartment to optimize the take-up of slices having the highest volumetric density. The standard machine shown in Fig. 4 incorporates a beet wheel with adjustable delivery chute to ensure that a steady flow of heated cossettes to the diffuser is maintained.

The successful introduction of the RT rotary cossette heater into Belgian and Irish factories has led to proposals being formulated for similar constructions in the UK and France.

Fuel savings of around 10-13% (e.g. from 3.3 to 3% on beet) can be realised by the adoption of pre-scalding using the RT rotary cossette heater and, depending on fuel costs, the installation would recover its costs in 2-4 seasons.

A further advantage of particular interest to those factories which are seeking a modest (say 20-25%) increase in diffusion capacity is that some diffusion takes place within the last 3-4 compartments of the pre-scalder and, therefore, retention time in the diffuser can be lower, diffuser speed increased and increased capacity thereby realised. Apart from the thermal economies made by employing a pre-scalder, there can be a significant reduction of erosion in the diffusion system as sand removal is carried out in the pre-scalder.

There is a case for incorporating the cossette heater as an integral construction with the RT diffuser, as it would be cheaper in capital cost than providing a separate unit. However, there is some operational advantage in separating the cossette heater from the diffuser, particularly when handling beet with a wide range of temperature over a long campaign.

Literature

[1] Anon.: "A New Continuous Diffusion Process – The Julien Berge (Tirlemont) System" (I.S.J., 1934, **36**, 473).
[2] Smet: "The New Tirlemont Continuous Diffuser *(Sugar,* 1948, **43**, (6) 28).
[3] Rodgers: "Analysis of Present Day Continuous Diffusion Process" (2nd Annual Technical Conference B.S.C., 1949).
[4] Campbell-Macdonald & Withers: "Automatic Control in the B.S.C." (1st IFAC Conference, Moscow 1960).
[5] Withers, Bass & Branch: "Process Optimization"(19th Annual Technical Conference B.S.C. 1968).
[6] Duchateau: "New Developments of the RT Continuous Diffuser" (*Sucr. Belge,* 1979, **89**, 597-608).
[7] Duchateau & Hulpiau: "Recent Developments on RT4 Diffusers" (*Paper presented to 19th General Meeting of the American Society of Sugar Beet Technologists, Feb. 1976).*

Summary

The article reviews development of and trends in continuous diffusers with special reference to the rotary diffuser.

Développement de systèmes d'extraction de betteraves au Royaume Uni

Dans cet article on passe en revue le développement et les tendances de diffuseurs continus avec égard spécial au diffuseur rotatif.

Entwicklung von Rüben-Extraktionssystemen in Grossbritannien

Im Aufsatz übersichtet man über die Entwicklungen und Richtungen von kontinuierlich arbeitenden Extraktionsanlagen mit besonderem Bezug auf die rotierende Diffusion.

Desarrollo de sistemas de extracción para remolacha en el Reino Unido

En este artículo se presenta un examen del desarrollo y las tendencias en difusores contínuos con alusión especial al difusor rotario.

SPRI/SIT 1982

As was pointed out by the President, Dr. M. C. BENNETT, in his welcoming address to the 1982 Conference, Sugar Processing Research Inc. is a unique entity, combining international private and US government efforts to develop the technology of sugar processing. The financial contributions of industrial sponsors – half from the US and the remainder from seven other countries – are matched, dollar for dollar, by the US government and fund an agreed program of research by employees of SPRI, working in laboratories and having the use of facilities provided by the Agricultural Research Service of the US Department of Agriculture. With the wide applicability of new technology, for instance in the use of computers for control of sugar processing and factory data handling, SPRI is attempting to shed its former restriction to cane sugar (it is the successor to the Bone Char Research Project of 1949 and its later development, the Cane Sugar Refining Research Project) and is seeking industrial sponsorship from beet sugar companies and more non-US sugar industries.

Representatives of the present sponsors were invited to the 1982 Conference, and some 60 persons were welcomed by Dr. Bennett on April 30 at the Omni Hotel in Atlanta, Georgia. The first paper, presented by Dr. P. SMITH of CSR Ltd., described the work done in his company on the changes in the contents of flavonoid colorants in refinery liquors, measured by HPLC, during decolorization with bone char, granular carbon and resins. Dr. C. C. CHOU of Amstar Corporation then discussed two new methods – a batch test and a column evaluation – for monitoring bone char performance, correlating the results with refinery performance and applying them to development of bone char specifications.

In the past, different temperature requirements for regeneration have led to separate use as decolorizing agents of bone char and granular carbon in spite of their complementary action. Dr. F. G. CARPENTER of the USDA discussed the different characteristics and showed that, since the regeneration temperature could be amended to an intermediate value giving adequate regeneration, it is now possible to use the two agents together, and in fact several refineries are now doing this.

Mary An GODSHALL of SPRI described the work already done in the separation of phenolic and other compounds contributing to the flavour of sugars. Removal by ion exchange and recovery by chloroform extraction, followed by gas chromatography, had perm-

itted identification of 15 major components from a soft sugar.

The efforts of The Sugar Association Inc., in Washington, DC, to counter anti-sugar propaganda in the USA were described by G. N. BOLLENBACK, who referred to the mis-information prevalent in the 1970's that described sugar as a health hazard, but felt that success was attending the efforts of nutritionists to establish sugar's true role.

E. J. CULP, consultant, introduced a new means of assessing sugar solubility in low-purity solutions, involving a factor N_T, the number of water molecules per molecule of total sugars; this allows for the presence of invert sugar and is more appropriate than Ns, which concerns only sucrose and is thus applicable to high-purity materials. Maximum crystallization rate occurs at $N_T = 4.5$, and Mr. Culp associated this with a sucrose hydration model.

Minor impurities in raw sugar and their effects on filtration have been studied by SPRI, and this work was described by C. M. ELGAL. Some, such as plant particles, animal hair and foreign substances, have little effect because of their relatively large size, but dextran is able to reduce filtrability markedly and can thus lower refinery throughput by 50%. On the other hand, starch is found in granular form and does not normally reduce filtration rate, since the temperature/time requirements for transformation to a gel — which does hinder filtration — are not usually met during processing.

The last paper of the day, presented by Dr. M. A. CLARKE, Director of SPRI, described results from a continuing experiment in which raw and refined sugars have been stored for up to 36 months at 100°F and examined at intervals for changes in colour, pol, hydroxymethyl furfural and sucrose, glucose and fructose contents. Colour formation occurs in the syrup coating the crystal, but only in one case of a very highly coloured raw did it occur within the crystal. HMF did not appear to be correlated with colour formation.

In the evening, a banquet was given for technologists attending the Conference, and they were also given an interesting account of the history of the city of Atlanta from its beginning as a railroad terminus, called Terminus. On May 1 the technical meetings recommenced, and J. A. POLACK, of Audubon Sugar Institute in Louisiana State University, presented new data on the elongation of sugar crystals formed in the presence of dextran. He showed how the presence of impurities was a prerequisite and that the effect increased with lower purities.

E. J. ROBERTS of SPRI described a new method for quantitative determination of dextran in sugars based on separation of all polysaccharides, re-solution and selective precipitation of dextran as a copper complex and reaction of this with sulphuric acid to give a colour measured at 485 nm, which is used with a standard curve to establish the dextran content.

The effect of dextran and dextran hydrolysis products on the viscosity of sugar solutions has been studied at the Southern Regional Research Center of the USDA, and Dr. F. W. PARRISH showed that an oscillation viscometer could be employed for this work, that isomaltose produced by dextran hydrolysis affected viscosity only to the same extent as the same amount of sucrose, and that it did not produce crystal elongation.

Foam formation occurs as a nuisance in beet sugar manufacture but only to a limited extent with cane sugar. Dr. G. W. VANE of Tate & Lyle Ltd. described work on samples of "foaming" sugars and showed that the effect was related in part to the surface tension, so that it could be suppressed by surface-active agents. Surface viscosity appears to be an important parameter, and a protein seems to be a strong foam promoter in cane sugar, while saponin is largely responsible in the case of a raw beet sugar.

On behalf of Dr. J. C. P. CHEN, Mr. R. S. PATTERSON read a paper on the effect of a material, Biocide, on cane juice, which demonstrated the marked loss in sucrose as well as the suitability of a haze method for establishing standard curves for dextran of 40,000 and 70,000 M.W. in cane juices.

A. B. RAVNÖ then described work by the Sugar Milling Research Institute in Durban on the conditioning of refined sugar from Huletts Ltd. to see if the relatively large grain size, high C.V. and high conglomerate count would affect the process. It was found that conditioning would be achieved adequately within 72 hours except where the C.V. and grain size were markedly high. A test-tube method was developed for routine checking of the caking potential of sugars.

Cane varieties have been bred traditionally for high sucrose and not fibre, but Dr. S. J. CLARKE discussed two commercial/wild cane hybrids of high fibre and low pol content that give high cane yields per acre. He then considered the returns from separation of their pith in a Tilby separator, recovery of sugar from the latter and its use as fuel while the rind is used for e.g. board production. He concludes that the use of "unconventional" cane can give almost as much sugar as a "conventional" variety while also providing additional revenue from the fibre surplus.

The session closed with a symposium on new methods of analysis and sugar processing technology under the chairmanship of Dr Ravnö. J. F. DOWLING discussed the techniques of instrumental analysis adopted at Refined Sugars Inc. for routine process control, with especial attention to use of automatic analysers for monitoring of sugar content in condensate and waste streams, and the introduction of a digital reading automatic refractometer to complement the automatic polarimeter used in remelt recovery control.

Dr. R. A. KITCHEN described the use of a test for total polysaccharides and a quantitative method for dextran analysis as used at BC Sugars Ltd., Vancouver, while Dr. P. SMITH discussed current sophisticated techniques employed in research and considered new methods that mith be used in the future, particularly for colour studies. Dr. G. W. VANE then referred to the use of HPLC and TLC techniques for analysis of polysaccharides and their components, and discussed the use of purified enzymes to degrade such materials selectively so as to identify their chemical nature.

Dr. Bennett then summed up the meeting, thanked all participants and passed the gavel to the new President for 1982/84, Mr. S. E. GEORGE, of BC Sugars, who closed the Conference.

On the following day more sugar technologists arrived at the Omni Hotel, where a total of 200 gathered to attend the 41st Annual Meeting of Sugar Industry Technologists Inc. The first technical session began on May 3 with a short address of welcome by the President, J. A. HARRISON, of Supreme Sugar Co. The first paper was presented by W. FRIES, of Rohm & Haas Co., who described the application of sugar refining of a two-resin decolorizing system in which gross colour removal with an acrylic-based resin is followed by polish treatment with a styrene-based resin. He indicated the efficiency and economy of the system and its low energy require-

ments of regeneration, and reported that, from being an adjunct to carbon-based decolorization, the system is now used on its own in some South American refineries.

Dr. B. C. GOODACRE of Tate & Lyle Ltd. then described her work on the application of the Ecodex GL-3 powder resin to removal of colour from liquor which, in some cases, had already been clarified by the Talofloc system. She had studied the mechanism of colour removal and the practical application of the method as well as its economics.

Use of a similar system for cane sugar decolorization with Ecosorb precoats based on decolorizing resin and active carbon powders was described by Dr. R. KUNIN, Consultant to Ecodyne Corporation. The system removed colour efficiently and does not require additional plant to that existing in a sugar factory, since the precoat is merely used on a filter and discarded; no regeneration plant is employed. The question of the economics of the system appears to be unresolved, however, to judge from the discussion which followed the paper.

A second paper by Mr. Fries followed, in which he described the use of a new resin, based on the condensation of epichlorhydrin with a polyamine, for removal of colour from high fructose corn syrup. The new resin has greater capacity and chemical stability, with excellent rinse characteristics, and these advantages offset its poorer physical stability than phenolic and styrene-based weak-base resins.

Mr. B. W. DREAN and Mr. D. S. MARTIN of Tate & Lyle Ltd. presented an account of plant-scale trials of acrylic and styrene decolorizing resins at the Westburn sugar refinery in Greenock; these had demonstrated the ability of the resins to allow reduction of char burn from 11% to 4% on melt while halving the colour of fine liquor, which thus yields a higher proportion of premium-quality granulated sugar.

A survey of biotechnology in the sugar industry presented by J. A. POLACK of Louisiana State University examined two types of reactions, namely those catalysed by enzymes and those changes produced by micro-organisms, and illustrated the value of immobilization of enzymes and e.g. yeasts. He also spoke of new technology using semi-permeable membranes both as support media and for reverse osmosis, while genetic engineering may lead to development of specific enzymes having desired characteristics; a heat-resistant amylase has already been produced.

A computer-based energy scheme has been developed for use in CSR Ltd.'s six refineries; it requires input data in the form of about 180 individual items and is able to predict total energy requirements according to specific process conditions and product mixes. It does not allow for radiant heat losses, evaporation of excess water additions to process, steam leaks, condensate losses, etc., so that the calculated usage has averaged 78% of actual; however, application to individual refineries has pinpointed areas of difference, and average energy requirements have thereby been reduced by 4%. The development and application of the model were described by Mr. D. GOTTHARD of CSR Ltd.

The next paper, by J. E. SOMNER, formerly of Tate & Lyle Ltd., concerned pollution and attempts to control it by legislation dating back to 1273 A.D. He referred to the problems of developing countries and the need to balance cost and effect as well as prospects for the sugar industry and the role of SIT.

Under the chairmanship of Mr. B. A. Foster, of St. Lawrence Sugar Co., Montreal, a panel of speakers discussed ways to improve refinery yield. Mr. W. L. REED of Revere Sugars, Boston, showed how the refining process should be adjusted to the raw sugar quality; the guiding principles remain those enunciated by Oliver Lyle, amended to "optimization" rather than "maximization" of separation at each process stage and uniformity of materials, and "minimization" of solids recirculation, sucrose loss and water usage.

Mr. J. MEIKLE of C & H Sugar, Crockett, presented graphs which illustrated how the increased production of soft sugars permits higher recovery from raws, the extent of which depends on the proportion and pol of the soft sugar. Mr. S. E. GEORGE of BC Sugars, Vancouver, placed emphasis on the minimization of physical loss as well as the need for precision of weighing scales, tank volumes, etc., used in quantity control of materials in process. Dr. M. A. CLARKE of SPRI spoke on the importance of avoiding sucrose inversion; this causes a primary loss by destruction of sucrose, a secondary loss by the melassigenic nature of the invert and impurities formed, and a tertiary loss through further inversion resulting from catalysis by organic acids formed on further degradation. Precautions involve avoidance of inefficient mixing during phosphoric acid addition, hot spots in the mingler and clarification (the latter difficult to detect because of the simultaneous formation and removal of invert sugar) and localized overheating in evaporators and pans – especially those without circulators. This involves closer control of temperature and pH and cleanliness in the plant. Finally, Mr. E. D. GILLETTE of Refined Sugars Inc., New York, spoke on molasses exhaustion, pointing out that all the necessary information had been published years ago by Pieter Honig and Eugene Gillett. He suggested that their work should be studied closely if recovery was inadequate, as assessed by the Tate & Lyle Ltd. formula, and emphasized the need to avoid very small crystals in the product.

After a reception that evening, the Banquet was held, during which presentations were made of the SIT Crystal Award and Meade Award for papers selected from those presented at the 1981 Annual Meeting. This was under a Master of Ceremonies in the person of the President of Coca-Cola USA. Mr. Dyson welcomed delegates to the City of Atlanta and expressed his company's wish to ensure a successful meeting of SIT; delegates were to be welcomed at the Coca-Cola syrup plant and technical building after the meeting, as well as to a tour of Stone Mountain Park, with a visit to the Plantation Village, the Confederate memorial and a barbecue.

On the following morning, May 4, Mr. W. F. BARTON, of Atlantic Sugar Ltd., St. John, and Dr. W. J. KNEBEL, of Calgon Corporation, Pittsburgh, described the use together of bone char and Canesorb, a new type of granular carbon, on the full scale at the Canadian refinery. The history of the project, its examination on a pilot scale and subsequent successful adoption were described in detail with illustrations comparing old and new plant.

Mr. D. E. SULICK of Calgon Corporation then presented an account of the regeneration of a bone char/Canesorb granular carbon mixture in the vertical retort kilns previously used for char alone at National Sugar Refining Co., Philadelphia, and at BC Sugars Ltd., Vancouver. No mechanical changes were needed and regeneration was effective, giving good activity.

At the Baltimore refinery there are several independent sets of bone char cisterns, conveyors, piping, etc.; this allows great flexibility but involves a relatively high

proportion out of service for sweetening-off and regeneration. In order to permit an increase in melt liquor throughput, a two-stage char system has been introduced, and a description of the new system was given by Mr. D. P. DEMONE of Amstar Corporation.

Originally candy scrap was 6-8% of production at Ponce Candy Industries Corporation in Puerto Rico, and Mr. R. POU, President of the Corporation, described how it was recovered by remelting, filtering with carbon and treating with ion exchange resins to yield a liquid sugar. This process was the basis of the current operations, which involve the conversion of raw sugar to colourless liquid sugar sold to local bottlers of soft drinks, canners and other industrial users; details were given of the equipment and methods used.

Mr. F. V. RATHJE of BC Sugars Ltd. then presented an account of the packing of soft sugars which, by combination of microprocessor-controlled feeding to a polyethylene bag forming and sealing machine from a specially designed scale, has permitted a reduction from 14 to 4 in the labour requirement for packing of this rather difficult material.

A rapid modernization of control installations at Savannah sugar refinery was then described by Mr. D. M. BRYAN; over eight years, replacement of relay controls with Boolean logic cards on the affination station, use of programmable controllers on the sequencer and dilution system, central process control, press recycling, white sugar boiling and centrifugals and packing equipment have permitted an increase of 25% in average daily melt. The advantages and nature of the changes were given in detail as well as the sequence of measures to ensure acceptance and success.

Mr. E. J. ROBERTS presented further details of the application of his new method of quantitative dextran analysis in cane juice, raw and refined sugar, process liquors and molasses. Results obtained were compared with those obtained by the haze test and differences explained.

Finally, Mr. J. PAXTON of Coca-Cola gave a slide presentation to describe the syrup plant and technical building to be visited by delegates after the Meeting; Mr. J. A. Harrison resumed the chair, thanked the contributors to the Meeting and passed the gavel to Dr. M. C. Bennett, President of SIT for 1982/83, who drew the proceedings to a close.

An evaluation of DRIS based on leaf analysis for sugar cane in South Africa*

By J. H. MEYER
(South African Sugar Association Experiment Station, Mount Edgecome, Natal)

Introduction

The Experiment Station of the South African Sugar Association has successfully conducted a fertilizer advisory service, based on soil and leaf analysis, for almost 27 years. While the demand for soil tests has always exceeded that for foliar diagnosis, the records show that the gap has steadily closed during the past decade, largely owing to the wider acceptance by growers of whole cycle recommendations.

Foliar diagnosis has the important advantage over soil testing that, by determining the nutrients the plant has actually taken up, doubts about effective rooting depth of the crop and the choice of suitable chemical extractants for estimating plant-available nutrients are to a large extent eliminated. The sugar cane plant with its extensive root system will always provide a more representative sample under the highly variable soil conditions that occur in the sugar industry than will a man with an auger and somewhat arbitrary nutrient extraction procedures.

Despite the considerable merits of foliar diagnosis, it must be conceded that with its introduction a number of variables such as crop age, month and season of sampling and bioclimatic regions become important, and that these factors have little effect on soil testing. The effects of crop age and time of year on foliar N are well known and, although a standard sampling procedure and the use of a comprehensive set of threshold values may minimize these effects, it is not always possible or convenient to ensure that sugar cane is sampled at a standard physiological stage.

The major drawback to leaf analysis, however, is that the results can seldom be used to the benefit of the crop from which the sample was taken because the growing season, or most of it, has already passed. Because of these difficulties, and because current methods can be used neither to classify nutrient excesses nor to establish the order of importance of nutrient deficiencies, interest has arisen in ratios of the amounts of nutrient elements in cane leaves. The DRIS technique (Diagnosis and Recommendation Integrated System) of Beaufils[1, 2] is based on nutrient ratios and it is being evaluated for sugar cane not only in South Africa but also in Brazil[3], Florida[4] and Hawaii[5].

Interest in this approach for sugar cane arose in 1972 at the Experiment Station when it was found that the P requirement of sugar cane grown on high P-fixing soils could be assessed most reliably from the N:P and K:P ratios in the TVD (Top visible dewlap) leaf, using a DRIS chart[6]. A subsequent study of the results of twenty-four 4N x 2P x 3K regional fertilizer trials[7] indicated that the nutrient status of the crop with

* *Proc. 55th Congr. S. African Sugar Tech. Assoc.*, 1981, 169-176.

1 *J. Fert. Soc. S. Africa*, 1971, 1, 1-31.
2 *Soil Sci. Bull.* (Univ. of Natal), 1973.
3 Zambello: M.Sc. Dissertation (Univ. of São Paulo), 1979.
4 Gascho & El Wali: *Research Rpt.* (Belle Glade AREC), 1978, (EV-1978-3).
5 Jones: *Ann. Rpt. Hawaiian Sugar Planters Assoc.*, 1979, 25-26.
6 Anon: *Ann. Rpt. Expt. Sta. S. African Sugar Assoc.*, 1971/72, 20.
7 Meyer: *Proc. 49th Congr. S. African Sugar Tech. Assoc.*, 1975, 129-136.

respect to both N and P could be predicted more reliably by DRIS than by the conventional nutrient threshold approach, although it appeared unlikely that the same DRIS norms could be used in all circumstances.

The use of DRIS for sugar cane was studied subsequently in a three-year project conducted by the Soil Science Department of the University of Natal. A number of diagnostic norms were developed for establishing the order of importance of both macro and micro-nutrient deficiencies. Tentative leaf N, P, K, Ca and Mg norms were first developed from yield data obtained from South African cane growers' files in association with analytical results provided by the SASA Experiment Station's Fertilizer Advisory Service (FAS). A yield of five tonnes cane per hectare per month was used to discriminate between high-yielding and low-yielding crops. Because these data did not represent a sufficiently wide range of sampling conditions, a second set of norms was developed for diagnosing both macro and micro nutrient imbalances in leaf and soil samples. In this exercise a yield of seven tonnes cane per hectare per month was used to separate high-yielding from low-yielding cane. The results indicated that the order in which nutrients limit cane yield could be established at any stage of crop development[8]. Similar findings have been reported for crops such as maize, rubber and cotton[1,9] wheat and soya beans[10,11], potatoes[12] and tea[13].

Although these findings were promising, the testing of the newly-derived norms was unfortunately restricted to the results of a small number of trials. Crop yield data and leaf analysis from 96 fertilizer trials conducted throughout the South African sugar industry were therefore used to provide a more vigorous test of the system, and this paper concerns some of the more important conclusions that could be reached.

Procedure

The evaluation process was divided into four phases:

(i) selecting suitable DRIS norms and retrieving yield data and leaf and soil analysis in forms suitable for processing by computer into DRIS indices,

(ii) using the computed data to compare the relative effectiveness of nutrient threshold values and DRIS in predicting responses to applied nutrients at various stages of crop development and for cane grown in the coast lowlands, midlands and lowveld regions of the industry,

(iii) testing whether DRIS norms correctly predict the order of importance of nutrient deficiencies, and whether the results can be related to actual fertilizer requirements, and

(iv) establishing how DRIS could best be implemented for advisory purposes.

Although the main object of this investigation was to test the norms supplied by the University of Natal it was considered worthwhile to include the set developed previously by the SASA Experiment Station, and a further set from the Florida Sugar Experiment Station[4].

Five sets of N P K norms, designated A, B, C, D and E, were thus selected and details are given in Table I.

Table I. Details of the five sources of data, and the average third leaf norms for N, P and K

Norms	A	B	C	D	E	Overall means
Source of data bank	University Survey 1	University Survey 2	University (Growers' files)	Florida Sugar Expt Stn	SASA Expt Stn	
Yield criterion	7 tc/ha/month	8 tc/ha/month	5 tc/ha/month	125 tc/ha/crop	130 tc/ha/crop	
Total No. of samples	972	972	1 300	1 600	767	—
N/P	8.54	8.61	8.19	8.71	8.35	8.48
N/K	1.75	1.72	1.51	1.54	1.75	1.65
K/P	5.11	5.42	5.46	5.63	5.10	5.34

The general principles used in establishing a data bank and selecting parameters with significant co-variance ratios have been outlined previously by Beaufils[2].

Since the DRIS approach is intended to include as many nutrient elements as possible, a sixth set of norms, developed from the University data bank for minor elements, was also tested and the average values are shown in Table II. These are subsequently referred to as the "general" set of norms.

Table II. Third leaf norms for Ca, Mg and Zn

Norm	Ca/N	Ca/P	Ca/K	Mg/N	Mg/P	Mg/K	Ca/Mg	Zn/N	Zn/P	Zn/K	Zn/Ca	Zn/Mg
Value	0.15	1.21	0.27	0.12	0.96	0.19	1.16	13	108	22	91	94

Considering that the data to establish the various norms come from such widely divergent sources, the norms shown in Table I are surprisingly similar. The N/P and K/P norms established in Florida deviated most from the overall mean values.

These norms were used to convert approximately 1200 sets of leaf analyses, obtained from the results of 96 fertilizer trials, into N, P, K, Ca, Mg and Zn indices using the general formula developed by Beaufils[2]. The equation used for calculating the N index is given as:

$$\text{N index} = \frac{f(N/P) + f(N/K) - f(Mg/N) - f(Ca/N)}{4}$$

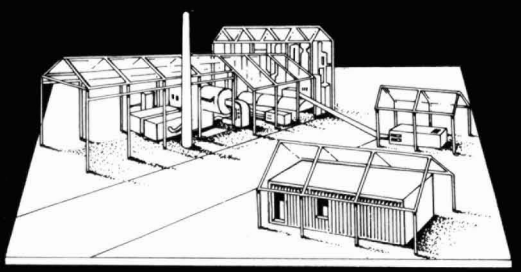
where $f(N/P) = 100\left(\frac{N/P}{n/p} - 1\right) 10/CV$ when $N/P > n/p$

or $f(N/P) = 100\left(1 - \frac{n/p}{N/P}\right) 10/CV$ when $N/P < n/p$

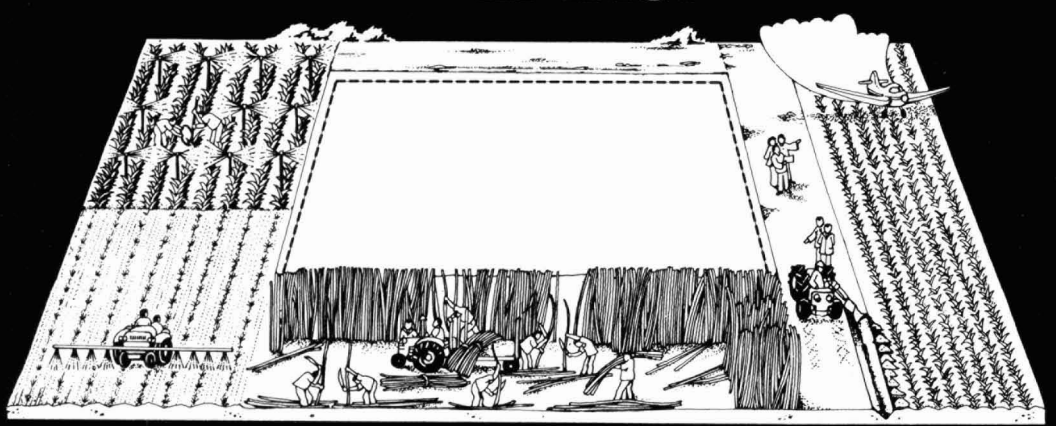
N/P is the value of the ratio (N% oven-dry third leaf

[8] Beaufils & Sumner: *Proc. 51st Congr. S. African Sugar Tech. Assoc.*, 1977, 62-67.
[9] Beaufils: *Rev. Gen. Caoutch.*, 1958, **35**, 769.
[10] Sumner: *Agron. J.*, 1977, **69**, 226-230.
[11] Idem: *Amer. Soc. Agron. J.*, 1979, **71**, 343-348.
[12] Meldal-Johnsen: M.Sc. Thesis (Univ. of Natal), 1975.
[13] Lea: *Crop Production*, 1980, **9**, 207-209.

NOW YOUR SUGAR COMPLEX*...



...IN LESS THAN 2 YEARS.



The AGROTECHNIP idea is based on integrated MINI-COMPLEXES adapted to their environment as well as to your needs:
Their annual production capacities range from 2000 to 12000 tons of crystalline raw or white sugar, free flowing or in cubes.

Your benefits:
- easier project financing
- shorter construction time due to the modular concept
- excellent technical performances
- sugar produced at competitive prices
- multi-regional development.

* AGROTECHNIP'S concept of a sugar complex consists not merely of a factory: it is an integrated entity which includes the plantations, the factory, and all surrounding facilities.

agrotechnip

experts who think, make, and know sugar.

Now you can protect your sugar against rats. 'Klerat' from ICI.

Rodents are among the most destructive pests of sugar cane, yet often more is spent on controlling minor pests, weeds and diseases. Rats not only eat the cane, but damaged stalks have a lower sugar content and are prone to disease infection. Rats also cause severe losses in storage yards and costly repairs in the factory. And rats in plantation accommodation cause a permanent health risk.

'Klerat' – one feed kills rats

To combat this menace ICI has developed 'Klerat', a new, more powerful, anticoagulant rodenticide.

Other anticoagulants must be eaten for several days before a lethal dose is taken. With 'Klerat' all rodent species are killed by a single feed of a small quantity of bait and there is no poison shyness. This unique property of 'Klerat' is particularly valuable in sugar, as the crop provides a highly palatable source of alternative food. Using 'Klerat', control can be obtained with as little as one quarter the amount of bait required for other anticoagulants.

'Klerat' is available in a variety of cost-effective formulations, to suit your needs.

ICI

KLERAT

'Klerat' from ICI-the best pro

'Klerat' – proven best in the field

'Klerat' has been tested worldwide by ICI and is already used to protect millions of hectares of crops. In sugar cane, the effectiveness of 'Klerat' has been proved in Latin America, as well as in Asia and Australasia.

Now, with 'Klerat' you have a realistic answer to the rats that are eating away your profits.

For further information write or send the coupon to 'Klerat' Information, ICI Plant Protection Division, Fernhurst, Haslemere, Surrey, GU27 3JE, England.

'Klerat' is also marketed as 'Talon' and 'Ratak' Super.

ICI **Plant Protection Division**
Fernhurst Haslemere Surrey England

Please send me your full range of information on 'Klerat' ☐ Please arrange for my local 'Klerat' representative to contact me ☐

Name Occupation

Company/Organisation Name

Address

ISJ1

tection for sugar against rats.

tissue ÷ P% oven-dry third leaf tissue) for a particular sample, and n/p is the value of the norm for this ratio given in Table I. CV is the coefficient of variation for the population of high yielding plants. The indices for the other nutrients are calculated similarly. The DRIS indices may be positive or negative but their sum is always zero because they measure the balance among the nutrients N, P, K, Ca and Mg. The more negative the value of an index, the greater the probability of the nutrient concerned being deficient and the crop yields being reduced. Conversely, the more positive the value of an index the smaller is the likelihood of the nutrient under consideration being deficient. An index close to zero indicates that the nutrient concerned is in adequate supply. From their indices for a given leaf sample, the nutrients can be classified in order of deficiency, adequacy and excess, the most negative index indicating the nutrient most required and the most positive index the nutrient least required.

frequency of correctly predicting responses to applied nutrients, whilst another involved using Beaufils[14] iterative procedures.

RESULTS

Probability of predicting responses to applied nutrients correctly

In this phase the probability of correctly predicting responses to applied nutrients, based on leaf samples from cane between the ages of four and nine months, was determined using threshold values alone and the DRIS procedures described above. Responses of 10% or more were deemed to have been predicted correctly when the third leaf nutrient values, expressed on a dry matter basis, were below the appropriate threshold value or, in the case of DRIS, when the value of the index was negative and the nutrient either the first or second most deficient. If the responses were associated with nutrient concentrations close to the threshold values or with DRIS indices close to zero, the predictions were considered to be doubtful. In the event of the yield responses being associated with nutrient levels above the threshold values, or with positive DRIS indices, the predictions were considered to be incorrect. In instances where there was little or no response to treatment, the data were assessed in a similar way. A comparison of the effectiveness of the two methods and the different norms, based on the proportions of correct, doubtful and incorrect predictions, is given in Table IV.

Table III. Sources of data for the assessment of DRIS discussed in this paper

Region	Nitrogen			Phosphorus			Potassium			Calcium and Magnesium			Zinc		
	No. of trials	No. of crops	No. of leaf samples	No. of trials	No. of crops	No. of leaf samples	No. of trials	No. of crops	No. of leaf samples	No. of trials	No. of crops	No. of leaf samples	No. of trials	No. of crops	No. of leaf samples
Coast Lowlands ..	26	45	79	20	36	63	32	70	91	1	1	3	14	20	42
Midlands	1	1	9	8	11	68	1	4	6	9	22	85	5	5	26
Lowveld	7	27	82	3	12	21	2	10	22	Nil	Nil	Nil	1	3	12
Overall	34	72	161	31	59	152	35	84	119	10	23	88	20	28	80
Average response to treatment, tc/ha ..	33.0			16.0			17.5			5.2			11.5		
*ters/ha	4.3			2.0			2.6			0.6			1.7		

* ters — tons estimated recoverable sugar
ers % cane = S − 0.485N − 0,057 F
Where S = sucrose % cane
N = non-sucrose % cane
F = fibre % cane.

The details concerning the sources of data used for the assessment of DRIS discussed in this paper, according to the main physiographic regions, are given in Table III. Data from only two trials in the Natal midlands were used for evaluating N and K indices for this area, but otherwise the distribution of trials represents fairly adequately the soil and climatic conditions which occur in the sugar industry.

Responses to treatment with nitrogen in the 72 crops examined varied from 12 to 62 tonnes cane per hectare, the average being 33.0 tonnes per hectare.

Table IV. A comparison of the reliability of threshold values and DRIS for predicting yield responses to treatment with nutrients

Nutrient	No. of crops	No. of leaf samples	Average response		Threshold values			Reliability of predicting a response to applied nutrients (per cent) DRIS norms																
								General			A			B			C			D			E		
			tc/ha	ters/ha	√	?	×	√	?	×	√	?	×	√	?	×	√	?	×	√	?	×	√	?	×
N	58	138	33.0	4.3	70	2	28	80	1	19	74	1	24	74	1	24	67	1	32	70	5	25	74	1	25
P	59	116	16	2.0	59	12	29	72	6	22	71	8	22	68	8	24	69	6	24	68	7	25	71	6	22
K	84	119	17.5	2.6	70	4	26	71	5	24	67	4	29	70	3	27	77	0	23	78	0	22	66	4	29
Ca	23	88	5.2	0.6	76	10	14	59	8	23															
Mg	23	88	5.2	0.6	69	6	25	76	5	19															
Zn	28	80	11.5	1.7	72	2	26	56	2	42															

√ = Correct ? = Doubtful × = Incorrect

The average responses to the other nutrients were considerably lower. In the second and third phases of the evaluation a number of tests were made concerning responses to treatment with a nutrient and the relative DRIS indices. One test was a simple assessment of the

[14] Beaufils & Summer: *Proc. 50th Congr. S. African Sugar Tech. Assoc.*, 1976, 118-124.

(To be continued)

SUGAR CANE AGRONOMY

Response of Clewiston (Cl) varieties to Polaris in small-plot and commercial-scale tests during the 1977-78 harvest. D. G. Holder, R. P. DeStefano, J. D. Stacy and J. W. Beardsley. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 56-61. —The response of several Cl varieties to Polaris ripener was determined in plantations of the United States Sugar Corporation. Tabulated results show an increase in 96° sugar yield ranging from 0.17% (absolute) to 2.12% in the commercial-scale tests, and from 0.20% to 1.02% in the small-plot tests. The amount of ripener applied was 3 lb.acre^{-1} in most cases, although 2, 2.5, 3.5 and 4 lb.acre^{-1} was also applied in individual cases.

Maturity patterns of several Louisiana sugar cane varieties. C. A. Richard. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 62-65. — Maturity data for six commercial cane varieties were collected for three years at a farm of the Louisiana Agricultural Experiment Station. Yield components were evaluated throughout the harvest season for both plant and ratoon crops. Varietal differences agreed with previously reported maturity classes. Ratoon cane was found to have a higher initial sugar content and purity than plant cane, but the rate of sugar accumulation and increase in stalk weight were greater for plant cane during the harvest season. The data support the practice of harvesting ratoon cane before plant cane.

Agronomic research and development needs in sugar crops. S. Kresovich and W. T. Lawhon. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 69-71. — When sugar crops are considered as renewable sources of energy and chemical feedstock, the agronomic goal is to maximize the production of fermentable sugars and combustible organic matter per unit land area, while keeping the unit costs to a minimum. To accomplish this, a multi-disciplinary approach is needed which includes: breeding and selection of varieties having a high fermentable sugars content and fibre content; improving cultural practices, e.g. narrowing the inter-rows spacing so as to obtain maximum yield; and designing equipment to plant the crops in narrow-spaced rows and harvest the crop while it is still green. The potential of sweet sorghum is discussed; while it has a number of advantages, it does suffer from three major disadvantages (short harvesting season, uneven maturity and too rapid degradation of juice), so that much work is needed to develop it as a large-scale commercial crop.

Row spacing effects on biomass and composition of sugar cane in Florida. G. J. Gascho and S. F. Shih. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 72-76. — Cane was planted in rows spaced 0.5 and 1.5 m apart and the effects of row spacing on cane composition and biomass (product of total cane population and average plant weight) determined monthly. Above-ground weight of young cane was much higher with the narrower spacing because of the greater number of stalks and the resultant increase in interception of sunlight and improved weed control. However, the advantage of the narrower spacing decreased with plant age. Total sugar, pol and fibre yields were greater with the narrower spacing. Application of Glyphosine 6 weeks before final harvest significantly increased total sugar and pol yields with the narrower spacing.

Sugar cane biomass production and nutrient content as related to climate in Florida. S. F. Shih and G. J. Gascho. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 77-83. — A regression model involving degree-days and solar radiation was developed to predict monthly sugar cane yield and total nutrient content. The dry weight was predicted well by either degree-days, solar radiation or a combination of the two factors. Fresh weight and N, P, K, Ca and Mg contents were predicted well only when the model combined degree-days and solar radiation. The multiple regression coefficients for biomass and nutrient content prediction ranged from 0.71 to 0.93 where the rows were 0.5 m apart, from 0.83 to 0.97 for the 1.5-m spacing, and from 0.70 to 0.92 when both row spacings were combined.

Methods of planting sugar cane in Louisiana. R. Ricaud, B. J. Cochran and G. W. Newton. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 160 *(abstract only)*. — An experiment was conducted to determine the effects of type and width of planting furrows on the growth characteristics, yield and harvestability of sugar cane. The types of furrow were single and multiple drills on standard rows 6 ft wide. The multiple drills were planted with one line of seed cane in each drill spaced 1 ft apart. The total widths of the single and multiple drills were 1, 2, 3 and 4 ft. For each width, the same amount of seed was planted in both types of furrow. A standard V-furrow with one drill was used as check. The plant population with each method of planting increased to a maximum in July and decreased thereafter until October. At harvest time the 3-ft width produced the highest stalk population, and plant height increased with increasing widths of planting. Stalk diameter was smaller with the V-furrow and 2-ft width than with the wider plantings. The method of planting did not affect % sucrose. The 3-ft width of planting produced the highest total biomass yield and sugar yield per ha. The single and multiple drills produced similar results for each width of planting.

Weed control systems in Texas sugar cane. A. W. Scott and S. A. Reeves. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 161 *(abstract only)*. — During the five years of sugar cane production in the Rio Grande Valley of Texas several weed control systems have been developed for both plant and ratoon sugar cane. Planting is accomplished, with few exceptions, from mid-August to early November, and the majority of all plant cane receives a herbicide application at planting. This application is applied broadcast or band pre-emergence or band post-emergence; plant cane is then usually treated with a lay-by herbicide in the spring. Sugar cane in the Rio Grande Valley of Texas is harvested from mid-October to mid-April. Weed control systems for ratoon cane have been developed to fit the time of harvest and weed pressure. A field harvested early during the season may require two herbicide applications, whereas a field harvested late in the season will probably require only one. Weed control systems for ratoon cane which make limited use of herbicides have also been developed.

SUGAR CANE MECHANIZATION

Dimensioning of the winged subsoiler. J. Fernandes, V. L. F. Neto and R. Stolf. *Brasil Açuc.*, 1981, **97**, 104-110 *(Portuguese).* — A comparison is made between smooth-shaft subsoilers having straight and parabolic shafts and implements in which "wings" are mounted on the shafts. The first two types do not break up the soil as well as the last, provided the distance between the wings is suitable (e.g. 50 cm for a wing spread of 30 cm and an operating depth of 45 cm). The efficiency of this subsoiler is sufficient to justify its substitution for the plough in preparation of land for cane planting.

A comparison of the Louisiana two-row and one-row harvesters and the grab and continuous loaders. W. Jackson. *Sugar J.*, 1981, **43**, (10), 14. — In tests to compare a J & L S-18 one-row harvester with a two-row harvester, a combined operation (in which the two-row machine cut the first two rows followed by the one-row harvester cutting the other four rows) proved better under wet conditions than the one-row machine operating alone in terms of cane sugar and fibre content and amount of scrap left in the field; under dry conditions, however, the differences were not significant. The aim of the combined operation was to eliminate the damage caused by the one-row harvester as it rolled over the first row while cutting the second. The grab and continuous loaders operated in both systems.

Progress report on the Louisiana two-row cane harvester — 1980 crop operation. R. Duncan. *Sugar J.*, 1981, **43**, (10), 15-16. — The two-row, whole-stalk harvester designed for the Louisiana sugar industry has been slightly modified. Details are given of major design features and components of the harvester, and some operational problems are described. Certain improvements to be made for the next crop are listed.

Two-row harvester study equipment costs. R. C. Hodson. *Sugar J.*, 1981, **43**, (10), 16-17. — The cost factors of mechanical harvesting and loading based on specific pieces of equipment, including the two-row harvester developed for the Louisiana industry, are discussed; despite its higher purchase price than for a conventional harvester, the new two-row machine is of higher capacity and is more efficient.

Locomotive gearbox design for cane railways. R. D. Peirce and C. R. Murry. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 81-87. — It has been shown that the bogie locomotive being introduced for cane train haulage can develop high tractive efforts, which in turn place severe loads on the axle-mounted gearbox. Space limitations placed on the design of these gearboxes necessitate gearing which is smaller than would otherwise be chosen. Although rating of the gearing by the methods of the British Standards Institution shows that the expected life for the assumed duty cycle will be limited, previous experience suggests that the gearing will probably be adequate. The final design of the gearing represents the optimum solution, given the problem of space constraint, and the overall design of the gearboxes is probably the most economical answer to a difficult engineering design problem.

Computer-aided design of railway track. R. D. Peirce and C. R. Murry. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 89-94. — Despite many years of operating experience, the design of railway track is a semi-empirical exercise based largely on the engineering experience of the designer, This is due mainly to a lack of understanding of the various components that constitute a railway track system. After a recent survey of the numerous methods available to the designer, these were organized into a series of computer programs for rapid and easy evaluation of a design using a number of different approaches and design criteria. The steps followed in a traditional railway track design problem are outlined and application of the methodology to the design of a section of typical cane railway track is described. The design model used acts as a guide to the effect on the total system of changes in the component sub-systems; such a design tool is of great value in view of the importance of cane railways to the sugar industry and the rising costs of its upkeep as train sizes and speeds increase.

The Clare-Dalbeg tramway project. C. Guesdon. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 95-98. — The author's firm was commissioned to provide project management services for all survey engineering and financial control associated with a 47-km section of cane railway serving two cane farms in north Queensland. Aspects of the design and construction planning are summarized and integration of these activities to ensure that the work was completed within the financial and time limits imposed is described.

Basecutter height sensing on cane harvesters. P. C. Musumeci and R. R. Bitmead. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 333-338. — Details are given of a technique for sensing the cane cutting height which is based on the variance of hydraulic pressure drop across the basecutter motor; the system incorporates a micro-processor, and the operator receives the estimated height via a light emitting diode (LED) array. Preliminary trials have, however, suggested that hydraulic pressure drop is inadequate as the sole indicator of basecutter depth, since the pressure did not change significantly with small changes in cutting depth, while large pressure fluctuations showed that the direct real-time measurement of an average pressure would be difficult. More trials are required under a variety of field conditions and under accurately controlled experimental conditions. The use of a solenoid-activated directional valve is to be considered.

Study of off-barring and the action of stubble shaving. III. On the optimization of mechanical harvesting and sugar cane yields. R. Plana and F. Alvarez. *Cienc. Técn. Agric., Caña de Azúc.*, 1980, **2**, (2), 61-69 *(Spanish).* Randomized block design of experimental plots was used to determine the effects of off-barring and stubble shaving. The effects of ridge heights 0-10 cm and 10-20 cm on a number of characteristics of the ratoon cane were determined, with and without stubble shaving. While stubble shaving had no effect, both ridge heights produced losses of cane and pol yield per ha, so that neither off-barring nor stubble shaving is recommended under the conditions studied.

CANE PESTS AND DISEASES

Studies and observations on nematode control in the Bundaberg district. R. M. Bull. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 267-274. — Nematode-susceptible soil (most of which is podzol) constitutes some 40% of the 56,500 ha of cane land in the Bundaberg district of Queensland. Nematicide trials are reported in which Temik at 2.5 or 3 $kg.ha^{-1}$ a.i. generally gave the best results in terms of increased plant cane yield; Nemacur at 4-5 $kg.ha^{-1}$ a.i. was the next most effective, followed by Mocap at 4-5 $kg.ha^{-1}$, while Dasanit failed to produce any appreciable reduction in the nematode population. Best results were obtained by applying the nematicide in the planting drill at the 3- to 5-leaf stage, immediately followed by spray irrigation with 12-35 mm water; response was greater in autumn- than in spring-planted cane because of the severity of damage occurring in the untreated areas during the 10-12 weeks of the winter dormant period.

Selection of varieties for rust resistance in the Herbert River area. W. M. Symington. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 287-291. — Rust, caused by *Puccinia melanocephala,* appeared in Queensland in 1978 and spread to the Herbert River area in 1979. Genetic and sampling variances associated with the disease and its correlation with sugar yield were studied in 44 varieties moderately infected by the disease when undergoing trials. All were rated as resistant or intermediate by comparison with the standard varieties Triton and Cassius. Genetic variation for both rust resistance and sugar yield was highly significant, but there was a small positive correlation between the two characters. Clonal repeatability for rust assessment was high and little was gained by multiple sampling from plots. Many varieties were significantly more resistant to rust than Triton or Cassius, but few were able to compete with them on the basis of sugar yield, and it was concluded that the results gave no evidence of need to alter the selection program.

Population studies on the sugar cane leafhopper *(Perkinsiella saccharicida* **Kirk.) in the Bundaberg district.** R. M. Bull. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 293-303. — A study of the title pest, a vector of Fiji disease, showed considerable fluctuation in population on a regular annual cycle. All stages of the life cycle were uncommon from May to November, after which rapid increase in numbers occurred, with nymph populations reaching a peak in January and adults in February. Adult numbers were less than half that of nymphs in the same field as a result of mortality and swarming flights from the area. The major limiting factor affecting leafhopper populations during the summer was egg predation by the Mirid bugs *Tytthus mundulus* and *T. parvulus;* other egg parasites were comparatively insignificant, and even those parasitizing adults and nymphs were not important. Variety N:Co 310, the dominant variety in the Bundaberg district, was highly favourable to the pest; it was replaced by Q 87 and CP 44-101, the latter resistant to the leafhopper while both were resistant to Fiji disease. One new variety from the current plant breeding program, 74S677, is resistant to Fiji disease and leafhoppers and has good yielding potential.

Occurrence, intensity and distribution of the sugar cane scale insect, *Melanaspis glomerata* **(Green), in western Uttar Pradesh (India).** A. D. Pawar, J. Prasad, M. P. Misra, R. Singh and K. P. Yadav. *Indian Sugar,* 1981, **30**, 681-684. — A survey is presented of the incidence of the scale insect in three factory zones of Uttar Pradesh. Ratoon crops were more severely affected than plant cane, and variety Co 1148 more than BO 70.

Red rot disease in relation to gappy stands in sugar cane ratoons. N. Singh and K. Singh. *Indian Sugar,* 1981, **30**, 737-738. — Three-year field experiments in which healthy 3-budded setts of Co 312 cane were planted in red rot-infected soil as well as uninfected soil showed that the total number of viable ratoons was lower in the diseased plots.

Assessment of losses caused by the top borer of sugar cane. A. N. Kalra and M. Prasad. *Indian Sugar Crops J.,* 1980, **7**, 79-81. — Trials are reported in which the crop weight losses in Co 1148 and Co 1158 cane (grown on 250 m^2) resulting from attack by *Tryporyza nivella* were assessed. In one experiment, the estimated loss was 8.8% for Co 1158 and 7.0% for Co 1148, and in another experiment involving only Co 1148, the loss in plant cane was estimated to be 7.5% and in ratoon cane 16.6%. In all cases, the percentage of cane attacked decreased from the 3rd to the 5th generation of borer.

Parasitization of the stalk borer *(Chilo auricilius* **Ddgn.) by** *Sturmiopsis inferens* **Towns. in Karnal.** Y. P. Madan and R. A. Singh. *Indian Sugar Crops J.,* 1980, **7**, 87. Of 1325 stalk borer larvae collected from December 1977 to March 1978 at Uchani-Karnal regional research station of Haryana Agricultural University, 14.7% were found to be parasitized by the tachinid fly, *S. inferens.*

Cane diseases. *Rpt. Centre d'Essai de Recherche et de Formation* (Réunion), 1980, 24-25 *(French).* — Mention is made of a number of varieties found to be susceptible to smut (caused by *Ustilago scitaminea),* including F 160 and Q 84. Details are given of the symptoms of gumming disease (caused by *Xanthomonas vasculorum)* as exhibited by S 17 cane. Marked incidence of the disease has been found in fields where R 397, highly susceptible to it, is still grown and provides a good source of the bacterium. Gumming disease has also been found on R 526 and H 32/8560 cane. External symptoms very similar to wilt caused by *Cephalosporium sacchari* have been found on S 17, but no cephalosporium has been isolated from the diseased stalks with any certainty. It is suggested that the symptoms could be connected with a low soil pH (3-4.5). A severe attack of red rot (caused by *Colletotrichum falcatum)* was found on R 566 which, however, is grown only on a small area because of its susceptibility to the disease. Considerable attention is being paid to rust (caused by *Puccinia melanocephala)* in view of its marked importance in recent years. Of imported varieties removed from quarantine in 1980, Q 90 and Q 100 were susceptible to the disease, while Q 84, Q 101, Q 102 and CB 45/155 were slightly susceptible. Local outbreaks of mottled stripe (caused by *Pseudomonas rubrisubalbicans)* were probably favoured by the prevailing atmospheric

conditions (rain and wind), but were not considered serious.

Cane pests. *Rpt. Centre d'Essai de Recherche et de Formation* (Réunion), 1980, 26 *(French).* — The mealybug *(Saccharicoccus sacchari)* has been known for a long time in Réunion but has not caused any noticeable damage to cane crops. However, the variety R 570 appears to be a host particularly favourable to its development by virtue of the sheaths strongly adhering to the stalk and giving ideal protection to such pests. If no control measures were adopted, the mealybug could cause considerable losses (through its adverse effect on germination and destruction of young seedlings); the only effective control is planting of pest-free setts, for which nursery blocks of heat-treated seed cane are considered necessary.

Losses caused by the sugar cane borer *Diatraea saccharalis* **in the 1976/77 and 1977/78 seasons.** M. Barba, V. Deriabín, M. Sánchez and J. Almándoz. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (2), 7-20 *(Spanish).* Total cane losses resulting from borer damage in Cuba are assessed as 22,219 tonnes in 1976/77 and 21,622 tonnes in 1977/78. A series of nine recommendations are made for reducing these losses.

Assessment of sugar cane yield losses due to diseases. H. Koike. *Sugarcane Pathologists' Newsletter,* 1981, (26), 1-2. — Yield losses can be estimated by comparing yield data before the outbreak of a given disease with data for the same fields but infected; they can also be assessed by comparing data for healthy and diseased cane in replicated trials. However, there are many factors that can affect the yield of a given variety, so that several tests must be carried out under varying conditions in order to assess the effect of disease on yield. Moreover, different strains of a given disease may have different effects on the same variety, while the same incidence of disease may have different effects on different varieties.

Biochemical studies on diseases of sugar cane. IV. Effect of sulphur application on the roots of ratoon stunting disease-affected sugar cane. Y. R. Saxena, K. Singh, U. S. Shukla, H. P. Pande and V. K. Madan. *Sugarcane Pathologists' Newsletter,* 1981, (26), 3-5. — Single-bud setts, taken from the first progeny of moist hot air-treated and untreated (RSD-affected) cane of variety BO 3, were planted in the nursery and 1-month-old plants then transplanted in earthen pots. After 20 days, S was applied as ammonium sulphate to half of the plants from treated and untreated setts, while the remainder were given urea. A second dose of S was applied 60 days after the first application. After 12 months, three plants from each treatment were weighed, and the dried roots ground to a fine powder for chemical analysis. Results showed that S had a beneficial effect on both treated and diseased cane in terms of carbohydrate utilization by the roots and protein content, gave a greater root dry weight in the case of treated cane (in the case of diseased cane, the same with as without S application) and a higher N content; the advantages of S application were greater with hot air-treated cane. The findings suggest that RSD impairs normal metabolic processes in the roots.

Cultivation of the causal agent of ratoon stunting disease of sugar cane. A. G. Gillaspie, M. J. Davis, R. W. Harris and R. H. Lawson. *Sugarcane Pathologists' Newsletter,* 1981, (26), 6-7. — Details are given of the techniques used to isolate the RSD bacterium from diseased cane, and the bacterium is briefly described. Tests for pathogenicity (established by development of juvenile and mature nodal symtoms in CP 44-101 cane and characteristic wilting of sorghum-Sudan grass hybrid uprights) showed that all isolates produced symptoms, and all attempts at re-isolation from the plants were successful.

Leaf scald disease stress mediated losses and alterations in some metabolites of sugar cane. O. Singh, K. S. Waraitch and R. S. Kanwar. *Sugarcane Pathologists' Newsletter,* 1981, (26), 7-10. — Stress induced by leaf scald increased the rate of leaf tissue dehydration, fibre, reducing sugars, polysaccharides, conductivity, titratable acidity and free proline, and reduced sucrose, protein, purity, nitrate reductase activity, leaf chlorophyll and cane and juice weight. The fall in juice quality was gradual and in line with the increase in disease instensity.

Leaf scald disease in Jamaica. M. E. A. Shaw. *Sugarcane Pathologists' Newsletter,* 1981, (26), 11. — See *I.S.J.,* 1981, **83**, 211.

Effect of mosaic disease on the growth and yield of sugar cane. M. H. Rahman, M. A. Khan and H. U. Ahmed. *Sugarcane Pathologists' Newsletter,* 1981, (26), 12-15. Tests to determine the effects of yellow and green mosaic (respectively, severe and mild forms of the disease) on cane growth and yield are reported. In all cases, the disease reduced the values of the growth parameters; cane infected with yellow mosaic suffered a greater drop in yield than green mosaic-infected cane, whereas the two forms of the disease were little different in their effects on leaf area.

On the graminaceous weeds showing mosaic symptoms in sugar cane fields in eastern Uttar Pradesh. — Sadruddin, S. N. Srivastava and J. Prakash. *Sugarcane Pathologists' Newsletter,* 1981, (26), 15-18. — Details are given of grasses showing mosaic symptoms at five locations in eastern Uttar Pradesh; they were *Echinochloa colonum, Cenchrus ciliaris* and *Dicanthium annulatum,* and all three were found in cane fields.

Is the etiologic agent of striate mosaic of sugar cane a mycoplasma? E. Kondaiah and M. V. Nayudu. *Sugarcane Pathologists' Newsletter,* 1981, (26), 18-20. — Two staining methods were applied to diseased cane leaves, but no mycoplasma-like organisms (MLO) were observed; equally, antibiotic treatment failed to control striate mosaic, in contrast to the effects obtained with many yellow-type diseases of plants induced by MLO. It is therefore suggested that striate mosaic is not caused by MLO; electron microscopy is needed to confirm this.

Influence of striate mosaic on sugar cane varieties Co 149 and Co 6304 in Tungabhadra Project area. E. Kondaiah and M. V. Nayudu. *Sugarcane Pathologists' Newsletter,* 1981, (26), 21-25. — Striate mosaic increased cane height, weight, leaf area and juice content, but reduced juice sucrose and reducing sugars contents. Some morphological changes that may be due to the disease are mentioned.

The history and taxonomy of sugar cane rust in the western world. L. J. Liu. *Sugarcane Pathologists' Newsletter,* 1981, (26), 26-32. — A brief history of the disease is followed by a discussion of the taxonomy of

the pathogen *(Puccinia melanocephala)* and its comparison with *P. miscanthi* and *P. kuehnii.* The sizes of *P. melanocephala* uredospores and teliospores found in various countries are tabulated.

Screening of sugar cane clones for resistance to red rot. S. Natarajan and S. Muthusamy. *Sugarcane Pathologists' Newsletter,* 1981, (26), 33-34. – The results of screening trials for red rot resistance are reported. Of the 59 varieties tested, seventeen were highly resistant, five moderately resistant, two resistant, fourteen moderately susceptible, eleven susceptible and ten highly susceptible.

Etiology of wilt disease of sugar cane. M. A. Sattar and S. Ali. *Sugarcane Pathologists' Newsletter,* 1981, (26), 35-37. – Wilt attributed to *Cephalosporium sacchari* is a major cane disease in the Nizamabad district of Andhra Pradesh and has been responsible for severe yield losses and falls in sugar recovery. After various inoculation techniques had failed to induce wilt in screening tests, doubts were expressed about the actual pathogen responsible for the disorder. Six organisms were isolated from wilt-affected canes and their etiology studied. After canes had been inoculated with spore suspensions or the organisms, the average numbers of internodes affected by the organisms, individually or in combination with one of the others, were determined. Results showed that *C. sacchari + Xanthomonas* sp. gave the highest number of infected internodes, while the next highest figures were given equally by *C. sacchari, Fusarium moniliforme, F. moniliforme* var. *subglutinans* and *Acremonium kiliense* on their own. The two bacteria, *Xanthomonas* sp. and *Erwinia* sp., on their own gave low infection rates.

Relative behaviour of various sugar cane clones to *Ceratocystis paradoxa* (Dade) C. Moreau, causal organism of pineapple disease. K. S. Waraitch and B. Kumar. *Sugarcane Pathologists' Newsletter,* 1981, (26), 38-40. – Screening tests are reported in which, out of thirty clones, only two were resistant and one moderately resistant. Of the 27 found to be susceptible, two (Co 1148 and Co 1158) have earlier been reported as resistant to the Bangladesh isolate of the fungus; the differences may be due to differences in the virulence of the isolates.

Control of sugar cane smut with fungicides. S. Natarajan and S. Muthusamy. *Sugarcane Pathologists' Newsletter,* 1981, (26), 40-43. –Trials were conducted on 11 fungicides for control of *Ustilago scitaminea,* and the results expressed in terms of germination %, smut incidence % and yield (tonnes.ha^{-1}). By comparison with the untreated control, all treatments increased germination and yield and reduced smut incidence. Highest yields were given by steeping the two-budded setts for 5 minutes in Bayleton (1 g.l^{-1}), followed closely by Daconil (2.5 g.l^{-1}).

Screening of sugar cane clones against smut *(Ustilago scitaminea* Syd.) in the Punjab (India). K. S. Waraitch. *Sugarcane Pathologists' Newsletter,* 1981, (26), 44-47. The reactions of 64 clones to smut were determined. Only 3 proved resistant, 22 were moderately resistant, 14 moderately susceptible, 6 susceptible and 19 highly susceptible.

A quantitative semi-automated technique for the assessment of smut colonization of sugar cane stalk tissue prior to whip formation. H. L. Lloyd and G. Naidoo. *Sugarcane Pathologists' Newsletter,* 1981, (26), 48-51. The technique described is based on the tissue clearing and softening properties of lactic acid-phenol mixtures and the fungal staining properties of cotton-blue; although developed for the quantitative determination of the extent of colonization by the pathogen *(Ustilago scitaminea),* it is also suitable as an outline diagnostic procedure or for histopathological studies, since the characteristic haustoria are readily distinguishable in all phases of colonization after the bud stage. Full details are given of the technique and some photomicrographs are reproduced.

Sugar cane smut in Puerto Rico. L. J. Liu. *Sugarcane Pathologists' Newsletter,* 1981, (26), 52. – The disease was discovered early in 1981 in Puerto Rico but, at the time of writing of the article, was restricted to only 20 acres planted to PR 1124 in two fields. Known susceptible varieties growing in the same general area were as yet unaffected.

Survey of nematodes at eight sugar factories in Java. I. Siswojo. *Sugarcane Pathologists' Newsletter,* 1981, (26), 53-55. – Details are given of the nematode species found in eight factory regions in Java. Although *Helicotylenchus* sp. was the most dominant in soil samples, *Pratylenchus* sp. was the most abundant in cane root samples. *Meloidogyne* sp. and *Hoplolaimus* sp. were the other two species found in root samples.

Population fluctuation of *Trichogramma australicum* Girault in the cane field determined by a trapping method. W. Y. Cheng and J. K. Hung. *Rpt. Taiwan Sugar Research Inst.,* 1981, (91), 27-39 *(Chinese).* Details are given of a method used to determine the degree of parasitization of eggs of the grey stalk borer, *Argyroploce schistaceana,* by *T. australicum.* The number of eggs parasitized fluctuated in line with variations in the parasite populations, but the number of parasites trapped was reduced by animal damage to the trapping cards, while analysis failed to demonstrate the effects of artificial mass liberation of the parasite and cane growth in surrounding fields on the trapping results. Examination did reveal that 60.8% of host eggs were parasitized by a single parasite, while as many as five wasps parasitized only 0.04%.

Overwintering sugar cane borer populations in Texas, 1977-1978. T. W. Fuchs. *Proc. Amer. Soc. Sugar Cane Tech.,* 1978, 156 *(abstract only).* – Populations of the sugar cane borer *Diatraea saccharalis* were unusually high in the Rio Grande Valley of Texas during 1977. This was presumably due to the carry-over of approx. 8000 acres of unharvested sugar cane from the previous season, plus the reduced amounts of insecticide applied by producers to the low-priced sugar cane. Ten harvested sugar cane fields chosen at random were sampled to estimate the number of overwintering sugar cane borer larvae remaining in fields after the 1977-78 harvest. The data indicated an average of 356 larvae per acre. One-third of the larvae were found in stubbles and two-thirds in trash left by harvesters. Data from studies designed to determine the % mortality of borers overwintering in cane stubbles indicated that no significant mortality occurred during the winter of 1977-78.

Leaf scald disease discovered in Jamaica. M. E. A. Shaw. *Sugar y Azúcar,* 1981, **76,** (7), 21. – See *I.S.J.,* 1981, **83,** 211.

CANE BREEDING AND VARIETIES

Studies on genetic variability for stalk characters in sugar cane. R. Singh and R. S. Sangwan. *Indian Sugar,* 1980, **30**, 409-412. — The stalk characters of fifty cane varieties in the Co series, released in 1976 and 1977, were evaluated. From the results, three varieties are regarded as promising, viz. Co 7608, Co 7611 and Co 7707. Significant variability was found for all the characters studied, and heritability estimates were of a high magnitude, as was the expected genetic advance for stalk yield per row, stalk weight and number of millable stalks per row.

Characteristics and behaviour of Tuc 69-2 early variety of sugar cane. J. Scandaliaris, J. A. Mariotti, J. M. Osa and C. A. Abregú. *Rev. Ind. Agríc. Tucumán,* 1980, **57**, (1), 1-26 *(Spanish).* — An account is given of trials with the title variety which is high yielding and is classified between early and very early maturing. It is derived from a CP 52-68 x CP 53-18 cross made in 1964 and performs well in various parts of Tucumán except for the low-lying central plains. Field experiments have shown it to be resistant to smut and moderately resistant to mosaic, red stripe and leaf scald, but susceptible to attack by the borer *Diatraea saccharalis.*

Physiological changes in leaf tissues of some sugar cane varieties in relation to freeze resistance. O. Singh and R. S. Kanwar. *Indian Sugar,* 1980, **30**, 493-496. — Plants (90 days old) of ten cane varieties grown in earthenware pots were subjected to a temperature of $-2.5^{\circ}C$ for 4 hours in one spell, 2 x 2 hours, 6 hours in one spell and 2 x 3 hours, with 24-hour intervals between exposures in the second and last treatments. The leaves of susceptible varieties (Co 1158, Co 62175 and CoJ 70) dehydrated rapidly and showed a fall in chlorophyll content and increase in the free amino-acids content. Tillers were more tolerant of freeze stress than were the mother shoots. Co 1148 and CoJ 72 were frost-resistant, while CoJ 64, CoJ 67, CoJ 73, CoJ 75 and S 404/72 were moderately resistant.

Blend of varieties for extended crush and high recovery. B. S. Nadagoudar, C. Shankaraiah, N. Dwarakanath and A. B. Khot. *Indian Sugar,* 1981, **30**, 603-604. — In order to overcome the problem of low sugar recoveries at the start and finish of the crushing season, it is recommended to adopt a more rational system of cane varietal scheduling based on a number of varieties differing in their planting and maturity times. Details are given of sugar content and yield of a number of varieties at various periods after planting.

Leaf area determinations in sugar cane varietal selection programs. I. Comparative study of two conventional methods. H. S. C. Rao, A. J. Majumdar and R. Narasimhan. *Indian Sugar,* 1981, **30**, 743-744. — Two methods are used for leaf area determination: (1) a non-destructive method in which the area is calculated from the product of leaf length x maximum width multiplied by a correction factor which is the slope of the regression curve connecting actual leaf area to the assumed rectangular area; and (2) a destructive method in which the area is determined from the laminar area per g lamina dry weight. Method (1) depends on a constant leaf shape, while method (2) depends on a constant leaf thickness. The validity of the two methods are studied in eight cane varieties of contrasting leaf area. While both leaf shape and thickness appeared to be genetically controlled, leaf shape seemed to be less prone to variability, so that method (1) is preferred.

***In vitro* micro-propagation of sugar cane by cutting. The action of an auxin and a cytokinin.** D. Sauvaire and R. Galzy. *Agron. Trop.,* 1981, **36**, 63-69 *(French).* The effect of an auxin (1-naphthyl acetic acid) and of a cytokinin (benzyl adenine), added separately and then together, on cane development from cuttings was studied. While results showed that addition of 0.10 mg of the cytokinin per litre of nutrient solution (a mixture of Murashige & Skoog mineral solution, sucrose and a vitamin solution) or 0.624 mg cytokinin + 0.025 mg auxin per litre increased the number of tillers to six or seven by comparison with only three in the control, and axillary bud growth was controlled, the cytokinin had a marked inhibitory effect on the roots, even when the auxin was present. However, the possibility of separate treatments to induce tillering and then rhizogenesis is suggested.

Comparative study of 14 sugar cane varieties *(Saccharum* spp. hybrid) in two harvesting cycles on a red ferrolitic soil. R. Ortiz, C. de la Fe and C. Cairo. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (2), 21-35 *(Spanish).* Two harvesting cycles, at 14½, 12 and 12 months and 17, 12 and 11½ months, respectively, for plant cane and two ratoons were used in comparative yield trials of thirteen Cuban-bred varieties, with B 4362 as the standard. Of the varieties, C 10-66, C 166-67 and C 78-66 were the best, with yields equal to those of B 4362, and can thus be recommended for cultivation. The first crop cycle gave the highest yields of cane per ha, but the second gave highest yields of pol per ha and so is preferred.

Sugar cane selection. IV. Comparison of three selection methods in the seedling plot. R. Ortiz and C. Cairo. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (2), 37-48 *(Spanish).* — Three methods of evaluation were applied to a total of 3651 seedlings from 11 crosses. It was found that a method involving differential weighting of a number of characteristics (Brix 0-10 points, height 0-6 points, stalk number 0-4 points and flowering 0-1 point) was superior to simple evaluation by vigour or by Brix.

Components of variance in studies of pre-commercial varieties of sugar cane *(Saccharum* sp.). R. Ortiz. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (2), 49-59 *(Spanish).* — There is evidence that genotype/environment interaction is a component of phenotypic variability. Studies were made to analyse the components of variance using 16 varieties during the period 1973/77 and relationships determined for cane yield/ha, pol yield/ha, pol % cane, Brix and purity, employing a 16 x 2 x 3 factorial design. The degree of genetic determination of the different characters was calculated, using both single and replicated plot data, and found to be high. It was observed that second-order interaction genotype-cycle-year was not an essential component in the overall variation.

CANE SUGAR MANUFACTURE

Automation for cane payment systems. M. F. Nolting. *Sugar y Azúcar,* 1981, **76,** (6), 75, 78-79, 82-83. Details are given of application of the Saccharodata system of data acquisition, collection and processing, especially designed by Schmidt & Haensch for the sugar industry, to cane analysis data for automatic cane payment.

Performance equations for horizontal tubular juice heaters. P. G. Wright. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 135-143. – Mathematical expressions for heat transfer and pressure drop in tubular juice heaters are examined, and new formulae developed. That for the overall heat transfer coefficient U takes the form $\frac{1}{U} = \frac{1}{Hc} + \frac{1}{Hf} + \frac{THt}{Kt} + \frac{THsc}{Ksc}$, where Hc is the heat transfer coefficient through the condensate film, Hf is the heat transfer coefficient of the juice film, Kt is the thermal conductivity of the tube metal and Ksc is the thermal conductivity of the scale layer (all of which are expressed as $Kw.m^{-2}.°C^{-1}$), while THt is the tube wall thickness (m), and $THsc$ is the thickness of the layer of scale on the tube (m). The formula has proved to be more sensitive to juice velocity than the Australian formula, $U = 1.028\ V^{0.5}$, where velocity V is expressed in $m.sec^{-1}$; this sensitivity agrees with the finding of Crawford & Shann[1] that juice velocity is important both as regards the juice film coefficient and the rate of scaling. The predictions given by the new formula for clean tubes agree closely with values obtained by Crawford & Shann. For total juice pressure head loss, P_{tot} (m), the new expression takes the form $P_{tot} = 0.00155 \times (D \times V \times T)^{-0.2} \times V^2 \times n \times \frac{L}{D} + 0.1018 \times n \times V^2$, where D is the internal diameter of the heater tubes (m), T is temperature (°C), n is the number of passes through the heater and L is the tube length (m). Comparison of predictions given by the new formula with values obtained using the Hugot formula[2] for a typical secondary juice heater with a range of juice velocities shows that the new formula gives slightly higher results, the differences being greater for long-tube heaters (in which case the Hugot formula gives values that are too high). The new formulae are considered preferable since they take account of more of the variables associated with juice heating and follow more closely the accepted chemical engineering approach. Although more complex, they can be readily solved by modern calculators or computers.

The vertical louvre entrainment separator. C. S. Henderson, B. J. Hellmuth, E. L. Horniblow and A. F. Pape. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 145-151. – In order to reduce severe sugar losses resulting from entrainment, Cattle Creek factory installed vertical-louvre entrainment separators in the two evaporator effects that were worst affected as well as in a newly installed vacuum pan. The separators mounted in the evaporator effects removed considerable amounts of syrup and there was no visible entrainment in the vapour pipe. The vacuum pan vapour was not monitored during its four weeks of operation, but no carryover was indicated during normal operation. Costs of the vertical-louvre separator are relatively low.

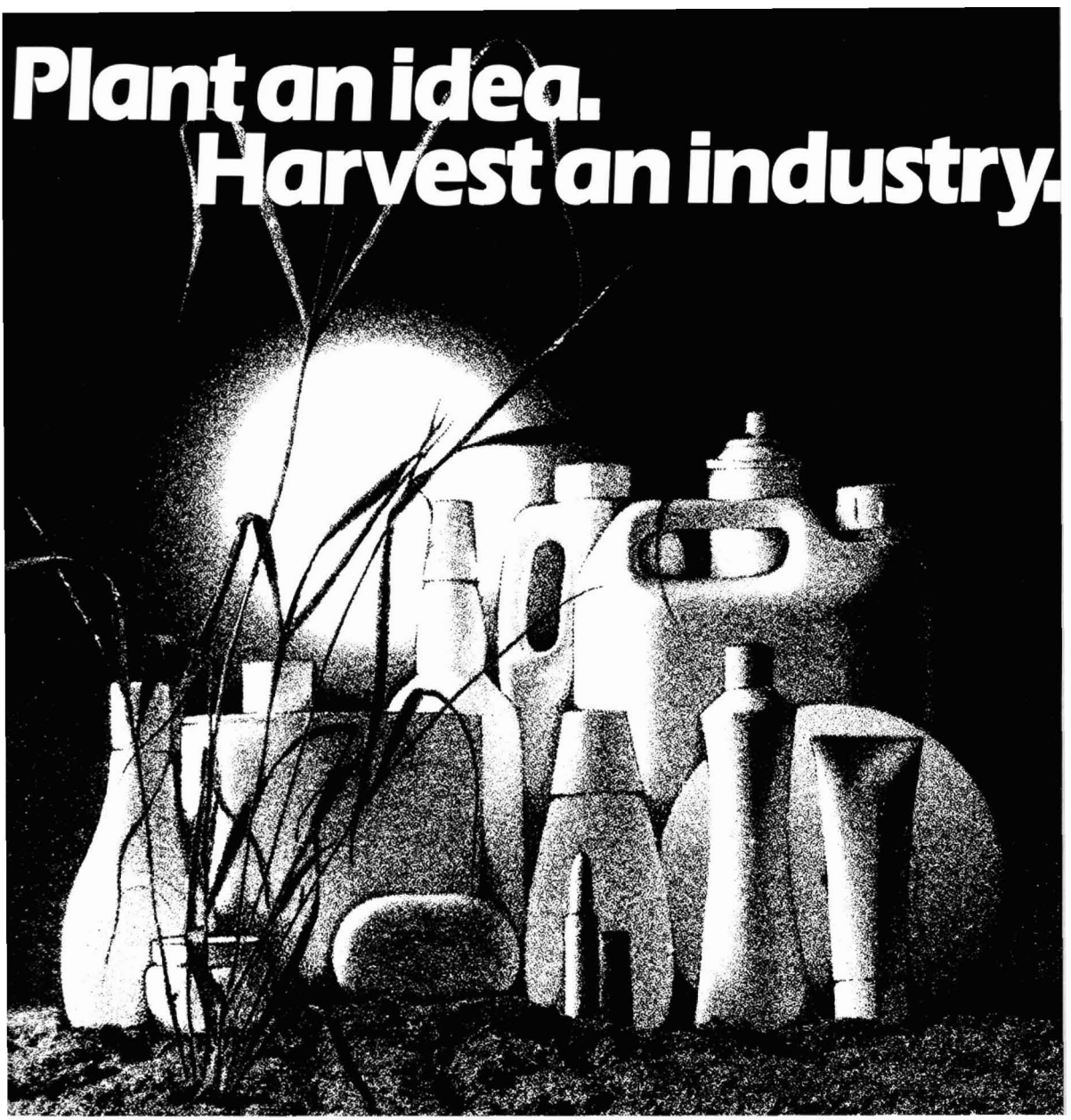
Effluent control at Cattle Creek. C. S. Henderson and K. J. Peatey. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 153-158. – Since the effluent discharged from the pond system did not meet the requirements of the Water Quality Council of Queensland, an intensive program was initiated during the 1978 crushing season to combat the problem. An activated sludge treatment plant was installed, comprising an 11,000 m^3 anaerobic pond provided with two aerators, three aerated ponds each of 455 m^3 capacity, equipment for nutrient addition, a 70 m^3 clarifier, a 23 m^3 concrete effluent storage tank and various pumps, etc. Results for 1980 indicated a final BOD_5 (determined by the Hach method) of 79 $mg.l^{-1}$, a COD of 461 $mg.l^{-1}$, a dissolved oxygen content of 6.1 $mg.l^{-1}$ and a pH of 8.0; these values conformed to the official requirements. Some difficulties have been experienced at times because of poor settling properties of the sludge, and further investigations would have to be carried out if the problem persisted. A permanent flocculant system was to be installed for 1981.

A survey of factory steam usage. D. G. Dyne and P. N. Stewart. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 159-164. – Steam consumption at South Johnstone mill was determined over a two-week period by monitoring condensate flow using orifice plates; while this system gives less information on steam balances than orifice plates installed in steam mains, it is simpler and less costly. The pressures before and after the plate were measured by a differential pressure transducer and the signals sent via a transducer termination to a data logger and thence to a tape recorder. The steam consumption by individual process stations and overall steam consumption are tabulated for 5 days, and some conclusions are drawn. The instrumentation system used has proved of value, and the overall steam usage of 59% " from and at 100°C" (the quantity of saturated steam condensing at 100°C that would yield an energy output equivalent to the measured flow) on cane compared well with previously reported data.

Steam balance by supervisory control at Racecourse mill. W. A. Black and B. McEachran. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 165-169. – Details are given of a microprocessor system installed to control steam flow and pressure in the boiler and evaporator stations. Results from the 1980 crushing season showed that the system operated continuously with very few problems. Benefits included a constant boiler load, lower incidence of severe boiler priming, reduction in boiler shutdowns and a minimum of juice-ups in the evaporator.

Improved controls for new turbo-generators. R. J. McIntyre. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 171-180. – It is stated that more than half of the sugar factories in Queensland now supply surplus energy to the public grid. During the 1979 and 1980 crushing seasons, the performances of three larger turbo-generators, rated at 9000-10,000 kW, were investigated. Details are given of the equipment and of associated controls. At South Johnstone the turbine is fitted with

[1] *I.S.J.,* 1957, 59, 49.
[2] "Handbook of cane sugar engineering", 2nd Edn. (Elsevier, Amsterdam), 1972, p. 455.



The usual effect of a crisis is to accelerate man's inventiveness. Today's major problems are high cost energy and low commodity prices. Tate and Lyle is the world's largest and most experienced independent sugar corporation and its research and development programmes are concentrated on helping to solve these problems.

Power alcohol derived from sugar is one example of maximising the conversion of the sun's energy into liquid fuel at the same time as providing an alternative use for sugar cane. New chemicals made from sugar could soon replace many more oil-based products such as detergents, plastics and cosmetics.

Tate and Lyle's scientists are working to make agricultural industry more efficient all over the world. Our aim is to add value to agricultural production and to make sure nothing is wasted – we even convert certain effluents into protein for animal foodstuffs.

But adding value can also mean better yields, and that means better agriculture. Tate and Lyle provides expertise, not only in sugar, but in all fields of agriculture and is involved in management and training schemes in many countries. If you need help with your agro-industrial development programme, come and talk to us.

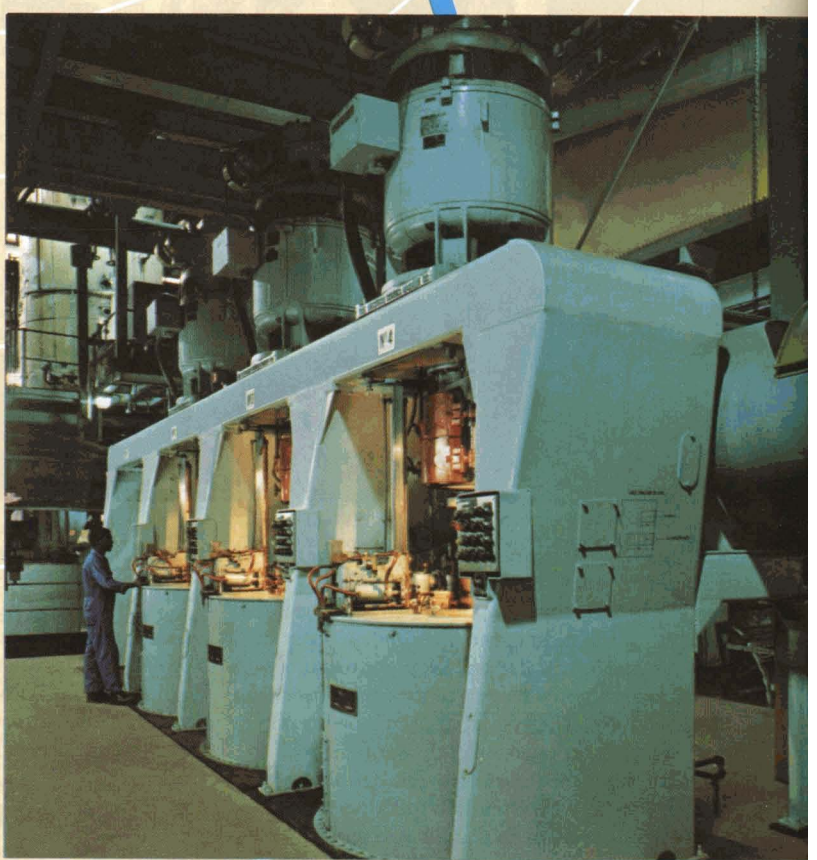
Adding value to agriculture

TATE + LYLE

Tate and Lyle Agribusiness Ltd., Cosmos House, Bromley Common, Bromley, BR2 9NA, England. Tel: 01-464 6556.

Western States

Wherever automatic centrifugal



Model G-8, "A" Centrifugals, Illovo mill

in Natal.

are used, Western States is there.

Throughout the world, no two sugar operations have exactly the same requirements, so Western States provides you with highly reliable, highly productive installations custom-designed to your particular needs, wherever in the world you're located.

These two G-8, 54″ x 40″ centrifugal installations are now producing consistently high quality sugar – and profits – for the C. G. Smith Group in the Province of Natal. Edward L. Bateman Ltd., the local Western States representative, worked closely with C. G. Smith's engineers and Western States to design and install these "A" centrifugals in the Umzimkulu and Illovo mills.

Here in Natal, as in all our installations, Western States provides the sugar producer with robust machinery incorporating high productivity, good safety factors and low maintenance design.

Western States representatives are located worldwide to help you design efficient installations, built around the most rugged centrifugals available.

For more information on custom service and our full line of centrifugals, contact your local Western States representative or The Western States Machine Company • P.O. Box 327, Hamilton, Ohio 45012 U.S.A. • Phone: 513/863-4758 Telex Numbers: 21-4577 and 21-2057.

Model G-8, "A" Centrifugals, Umzimkulu mill

THE WESTERN STATES MACHINE COMPANY

a Woodward electric proportional output actuator with an integral back-up mechanical governor linked to a Woodward 43027 electronic control unit to form a complete governing system; the performance of this system was compared with that of a traditional speed governor and shown to provide excellent control of export power which was constant over a 5-hour period in contrast to the fluctuating (sometimes widely fluctuating) pattern with a mechanical governor.

Using the bagasse utilization model to determine boiler efficiency requirements. A. J. Pinkney. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 181-185. – A description is given of a computer-based simulation program for bagasse utilization; the model can be used for calculation of bagasse storage and bagasse processing equipment capacities, of the efficiency range of a proposed boiler, of the size of a supplementary fuel container and of the benefits likely to be obtained by varying parameters such as steam consumption and lost time. A case study to determine the efficiency requirements of a proposed boiler installation illustrates use of the model and shows the oil savings which would result if the boiler efficiency were raised from 58% to 67% (a level considered more than sufficient to justify the extra capital cost involved), while less bagasse would be dumped at a lower efficiency limit not below 58%.

The air-cooled condenser system of efficiency variation for bagasse-fired boilers. P. W. Levy. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 187-194. – It is stated that several sugar factories in Australia have installed boiler plant of variable thermal efficiency so that steam requirements can be met by burning all the available bagasse. Depending on factors such as variation in cane fibre content during the crushing season, available bagasse storage capacity and steam requirement per tonne of cane, the factories have specified widely differing maximum and minimum efficiencies when purchasing new boilers. Several methods used by boiler manufacturers to achieve downward variation from the maximum design efficiency are listed; the author's company uses as standard the approach based on a conventional boiler arrangement to generate excess steam when surplus bagasse is burnt and condensation of the excess steam in an air-cooled condenser, the rejected heat being ultimately dissipated in the hot exhaust air from the condenser. Design and operation of such an arrangement are described, and advantages and disadvantages of the condenser system indicated. Important factors to be considered by the purchasing mill, in regard to pipework for the condenser and boiler, corrosion protection of the condenser and calculation of the excess steam capacity and related parameters, are discussed.

The application of polyelectrolytes to fly-ash settling. O. L. Crees, G. D. Jacklin, M. G. Topper and E. Whayman. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 195-201. Details are given of an ash removal system installed at Pleystowe, which centres on a clarifier of 4.57 m diameter; the slurry is settled with the aid of flocculant after passage through two rotary screens for removal of coarser fractions and large objects. The underflow from the clarifier is treated by a rotary filter. Results showed that the clarifier removed more than 99.5% of the solids content (initially 1.25%) at a flocculant (LT30) consumption of 30 ppm; the underflow was acceptable to the filter while still being readily pumpable.

Bagasse drying. B. P. Edwards. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 203-206. – The chief components of a basic bagasse dryer using flue gas as drying medium are listed and capital and operating costs briefly mentioned. The importance of the fan position in the dryer is indicated, and experiments are reported in which the design of the drying tube was investigated at the Sugar Research Institute. Two dryer designs were tested, but both behaved similarly, the output moisture of the bagasse depending primarily on output temparature and not on input temperature nor gas moisture content, so that output temperature rose as the output bagasse moisture fell. (The limiting drying temperature is the wet bulb temperature of the drying gas, and output temperatures do not fall below this point, which is usually about 70°C.) For a given output temperature, lower output moistures were given by a dryer fitted with swirl vanes and having a less smooth conveying path than the other dryer. Calculations are made of the surplus bagasse generated by a dryer under typical factory conditions, and the economics are examined. Comparison is made between the boiler conditions when bagasse of 50% moisture content is burnt and when relatively dry (35% moisture) bagasse is burnt. The quantities of steam are identical and temperatures in the boiler, other than in the furnace, are comparable. With the drier bagasse, the furnace feed contains less fibre, so requiring less combustion air and producing smaller quantities of flue gas, but there is the disadvantage of increase in the amount of airborne fines from conveyors and transfer points.

Mill control using pressure feeder tailbar torque. G. D. Jacklin and D. M. Jenkins. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 239-242. – As a result of reconstruction of the feed chute to No. 1 mill at Pleystowe in order to increase its volume, it was no longer possible to control mill torque and hence fibre rate. A hinged flap was therefore fitted to the chute similar to that at Victoria[1], and provision made to control the position of this flap using either the turbine chest pressure or pressure feeder tailbar torque; tests showed that the latter was more responsive than turbine chest pressure as a control parameter. Despite some problems in operation of the flap, the system of torque control was quite satisfactory.

A telemetry system for tailbar torque monitoring. S. R. Reichard and T. L. Vidler. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 243-248. – Details are given of a telemetry system developed by the Sugar Research Institute to provide continuous monitoring of mill tailbar torque and which is designed to perform three basic tasks, viz. derive a torque signal from strain gauges on the tailbar through use of suitable amplifiers, transmit (by wireless) energy to power the strain gauge amplifier and signal transmitter, and transmit the strain signal from the rotating shaft to a stationary receiver. The signal available as output from the receiver can be used for e.g. overload protection or control of mill feeding. Tests on prototypes of the system at Pleystowe showed that it is suitable for continuous operation, and that the tailbar torque signal derived by this means is preferable to mill turbine chest pressure as a control parameter (see previous abstract). The cost advantage and other benefits of building a "home-made" system are briefly discussed.

[1] Waring & McLaughlin: *I.S.J.*, 1981, **83**, 340.

BEET SUGAR MANUFACTURE

The redox potential as criterion for early detection of infections in diffusers. A. Nickisch and W. Mauch. *Zuckerind.,* 1981, **106,** 521-528 *(German).* — Investigations showed that sucrose degradation in diffusers increases with rise in the concentration of oxygen and nitrate until it is completely decomposed to CO_2 and water. However, despite a high degree of bacterial infection, hardly any lactic acid is formed and the pH does not fall, so that neither of these parameters can serve as a criterion for bacteriological control; this also applies to nitrite, since nitrate reduction is suppressed in the presence of high oxygen concentrations. Under anaerobic conditions, as normally encountered in tower diffusers, nitrite and lactic acid are only detected when the degree of infection has already reached the logarithmic growth stage, i.e. when considerable losses have already occurred. Continuous measurement of the redox potential and determination of the adenosine triphosphate (ATP) concentration permit infection to be detected some 30 minutes earlier than with the hitherto normal criteria, even under changing physico-ecological conditions. For bacteriological control, the ATP in the initial beet must be deducted from the ATP value found for the raw juice; however, it is admitted that the beet ATP undergoes marked degradation with variation in ecological conditions, so that its concentration is subject to fluctuation. The redox potential is a function of pH and oxygen partial pressure, so that correction must be made for pH; measurement of the oxygen partial pressure is only necessary when there is considerable ventilation apart from the oxygen entering the diffuser with the cossettes. Measured values of the redox potential can be used for automatic injection of disinfectant.

Utilization of computing machinery in sugar factories of Czechoslovak manufacture. E. Svoboda. *Czechoslovak Heavy Ind.,* 1981, (7), 28-33. — An algorithm developed for testing automatic boiling controls and programs devised for the calculation of massecuite curing parameters are described. Application of these permits a factory to vary boiling house operation to produce given types of sugar while maintaining optimum process conditions. A program is also available for calculation of diffusion variables. The benefits of computer programs are indicated by the results obtained in affination, where steam consumption was reduced by 0.07% on beet.

Design of a rational system of waste water recirculation. P. Voulgaris. *Hellenic Sugar Ind. Quarterly Bull.,* 1981, (45), 425-435 *(Greek).* — A scheme for a beet sugar factory is described in which the flume-wash water from a pair of Brukner clarifiers is treated successively in a quiescent tank, a second quiescent tank where activated sludge is added, three anaerobic tanks (in the third, further activated sludge is added), an aeration tank and a final quiescent tank, from which it is discharged for recirculation. The BOD_5 is reduced from 2500 to 144 $mg.litre^{-1}$. Further biological filtration and aeration is required to reduce the BOD_5 to a level (a maximum of 30 $mg.litre^{-1}$) at which the water can be discharged into a local river.

Storage tests in Hungary. K. Hangyal. *Cukoripar,* 1981, **34,** 45-48 *(Hungarian).* — The storage properties of beet as a function of irrigation and excessive N fertilization were investigated. In the trials, determinations were made of the changes in activity of invertase and pectin-degrading enzyme as well as in the contents of invert sugar, mono- and polysaccharides and lactic acid. Results indicated the adverse effect of the agronomic parameters studied on biochemical storage losses.

Factory investigation of continuous low-grade centrifugals. L. Domotor. *Cukoripar,* 1981, **34,** 59-65 *(Hungarian).* — Investigation of the performance of a Polish ACWW 1000 A continuous centrifugal at Ercsi sugar factory is reported. Results showed that under favourable conditions of load, water washing and massecuite properties, molasses losses were minimum and raw sugar quality high. Comparison is made between the technical and economic parameters of the continous and a batch machine.

Hygiene in the sugar industry. T. Csomar and I. Pocsi. *Cukoripar,* 1981, **34,** 67-70 *(Hungarian).* — A general discussion is presented on the state of hygiene in the sugar industry, covering both agronomy (including beet mechanization) and factory aspects (beet and sugar), with mention of the problem confronting the industry with regard to bacteriological control.

Comprehensive quality control in the sugar industry. F. Nemeth and I. Santa. *Cukoripar,* 1981, **34,** 70-73 *(Hungarian).* — The use of the Venema tarehouse equipment for assessment of beet quality and the general approach to quality control of sugar to meet the requirements of the customer within the Hungarian sugar industry are discussed.

Factors governing the re-utilization of flume water. L. Haraszti. *Cukoripar,* 1981, **34,** 73-78 *(Hungarian).* Flume-wash water treatment and recirculation are discussed, and the various quality parameters (BOD_5, COD, TOC) and their significance explained.

Pressure loss during forced ventilation of beet. II. Example of air distribution calculation. O. Mikus, J. Rejsek and L. Budicek. *Listy Cukr.,* 1981, **97,** 134-139 *(Czech).* — An example is presented of the calculation of air distribution and energy consumption in forced ventilation of beet piles. For a pile containing some 16,000 tonnes of beet, adequate results can be obtained by installing 20 lines of tubing 20 m long and 0.9 m in diameter; a blower fan operating at a pressure loss of 600 Pa and delivering 50 m^3 per sec is suitable. Considerable energy saving or increased air flow is obtainable by using longitudinally ribbed tubing.

Experience in the construction of a progressive preliming vessel. A. P. Ponamarenko and A. N. Nesterov. *Sakhar. Prom.,* 1981, (6), 21-23 *(Russian).* — Details are given of a prelimer designed by the authors and installed in their factory. It comprises a vertical cylinder divided into a number of sections from top to bottom, each section housing a paddle-type mixer mounted on a central rotating shaft. Means are provided for feeding 2nd carbonatation filter cake, 1st carbonatation juice or limed juice to particular groups of sections according to

the feed in question and hence on the principle of pH rise. For each set of sections there is a distributor consisting of a cylinder housing a funnel not quite reaching the top of the cylinder; between the funnel and cylinder are baffles extending slightly above the rim of the funnel so as to form an open-topped chamber with the internal cylinder wall and the outer wall of the funnel. The upper part of the funnel wall has specially profiled slots resembling inverted diaphrams of flow meters. Pipes connect the bottom of the cylinder to the appropriate prelimer section. The recycled juice or filter cake is fed into the funnel and gradually rises up the wall, to be ejected through the slots and enter the section. Raw juice, fed at the bottom of the prelimer, flows up to be mixed with the lime-carrying fluid. Recirculation takes place under the effect of the mixer paddles and the general swirling movement of fluid through the diametrically opposed slots in the conical baffles of each section.

Experience in installing and adjusting A2-PSK and A2-PSM liquid spray sulphiters. S. A. Zozulya and S. A. Chernyshev. *Sakhar. Prom.*, 1981, (6), 24-27 *(Russian)*. A critical appraisal is made of the title sulphitation vessels and recommendations are made regarding their installation and preparation for use.

Operation of an effluent biological treatment station at Glodyana sugar factory. V. M. Kruglik *et al. Sakhar. Prom.*, 1981, (6), 28-31 *(Russian)*. — Details are given of an activated sludge and aeration system for treatment of a mixture of sugar factory effluent and waste water from other neighbouring undertakings, including a state farm. The treated water is finally screened, passed through sand filters and chlorinated before discharge into the local river. The BOD_5 is reduced from 1100 mg O_2/litre to 6-8 mg.l^{-1}, the dissolved oxygen content to $\lt$ 4 mg.l^{-1} and the nitrate content to 0.5-1 mg.l^{-1}.

Tests on a sectioned counter-current carbonatation vessel. N. A. Arkhipovich, L. I. Tanashchuk and N. S. Kukhar. *Sakhar. Prom.*, 1981, (6), 31-33 *(Russian)*. — A new carbonatation vessel described comprises a vertical tank having an upper section (wider than the lower one) with feed jets for juice arranged around its perimeter. The lower section houses a series of plates, one above the other, in which inclined deflectors are located above each of a number of perforations (constituting an open area of 10%); these deflectors are, in alternate plates, at acute and obtuse angles to the perforations, so that gas flowing up through the vessel alters course at each plate. Intimate mixing of the gas and fine juice droplets takes place in the middle part of the vessel, and the juice is discharged through a bottom port. In terms of 1st carbonatation juice settling rate and filtration coefficient, and 2nd carbonatation juice lime salts, colour and purity, the new vessel is better than conventional Soviet types.

Reduction in reagent consumption for water treatment. A. B. Khanin, M. B. Konovalov, N. I. Sokolova, Yu. A. Domrachev and N. E. Parakhin. *Sakhar. Prom.*, 1981, (6), 34-35 *(Russian)*. — To reduce the salt content in sugar factory effluent and permit it to be used for agricultural purposes, tests were conducted on boiler water pre-treatment by the lime-soda process (to decrease the Ca and Mg content) followed by cation exchange resin treatment. The pre-treatment provides NaCl for resin regeneration, although use of electrodialysis as pre-treatment was sufficiently efficient as a means of reducing the water hardness that the amount of regenerant needed for the resin was considerably decreased.

Rational development of pans and condensation schemes for sugar factory process vapours. R. V. Koren'. *Sakhar. Prom.*, 1981, (6), 45-49 *(Russian)*. — Means of improving vapour condensation and design of condenser for both evaporators and vacuum pans are discussed and the need for efficient incondensables removal from pan calandrias stressed.

Some new forms of disinfectants and the possibility of using them in the sugar industry. V. Z. Nakhodkina, L. G. Belostotskii and V. V. Suprunchuk. *Sakhar. Prom.*, 1981, (6), 51-53 *(Russian)*. Tests were carried out with three disinfectants applied to washed beet and diffusion juice. Iodonal A (an iodine-based surfactant) was used as a 0.75% concentration at 3-4 kg per 100 tonnes of beet, Dikonit (sodium dichlorisocyanate) as a 0.5% concentration at 0.8-1 kg per 100 tonnes of beet, and chloride-of-lime as a 1% working solution. Best results were given by Dikonit, which reduced the numbers of mesophiles and slime-forming mesophiles in raw juice by more than 99%; chloride-of-lime and Iodonal A had only limited effect on all groups of bacteria and mould fungi.

New technological results in sugar production. E. Svoboda. *Czechoslovak Heavy Ind.*, 1981, (8), 15-21. From analysis of boiling house performances at various Czechoslovakian sugar factories, mathematical models have been derived which are applicable to optimization and automatic control of the various processes.

The potential for energy saving in the beet sugar industry. B. Karren. *Sugar J.*, 1981, **44**, (1), 8-13. — In a discussion of fuel consumption by North American sugar factories, comparison is made between various aspects of factory operation in North America and Europe. It is shown that boiler heat losses are much greater and the boiler efficiencies lower in North America, while few North American factories recover waste heat, by comparison with European factories, where recovered heat represents 10-20% of the total steam usage. The total evaporator heating surface area in European factories is generally greater, and use of 1st effect vapour very much smaller than in North America, where, on the other hand, few factories use 5th effect vapour. The significance of this for steam consumption is discussed. Generally, less massecuite is boiled in European factories (54% on beet compared with 64% in North American factories), and 3rd or 4th effect vapour is often used.

Mechanical vapour recompression — falling film evaporation. C. H. Iverson. *Sugar J.*, 1981, **44**, (1), 15-20. Mechanical vapour recompression and falling film evaporation are explained and possible application in the US beet sugar industry discussed on the basis of European practices, from which a number of conclusions are drawn. Details are given of a scheme devised for the Nampa sugar factory of Amalgamated Sugar Co. which was due to begin in August 1981. The economics are briefly discussed.

Current trends in automation within the sugar industry. M. Balaz. *Listy Cukr.*, 1981, **97**, 183-186 *(Czech)*. Automatic control in the Czechoslovakian sugar industry is briefly surveyed, and the use of digital computers in off-line and on-line open-loop systems, direct supervisory control and direct digital control explained.

LABORATORY STUDIES

Determination of the residual active chlorine in sugar factory flume-wash water. A. I. Sorokin and A. P. Parkhomets. *Sakhar. Prom.,* 1981, (4), 29-31 *(Russian).* Because of the presence of large amounts of suspension in flume-wash water, quantitative determination of active chlorine after treatment with chlorine gas, sodium hypochlorite or $CaCl_2$ by conventional iodometric or *o*-tolidine methods is difficult. An iodometric method was therefore adapted in which Ca iodide is added together with an acetate buffer solution; the 1^- ions are oxidized to liberate iodine, which is then determined by titration with sodium thiosulphate added in excess. The solution is then centrifuged and the unreacted thiosulphate in the clarified portion determined by titration with 0.01N iodine solution using 0.5% starch solution as indicator. The difference between the volume of thiosulphate added and the iodine found by titration is equivalent to the active Cl.

Study of the precipitation of the tricalcium complex of sucrose with calcium chloride. C. Francotte, J. Vandegans and D. Jacqmain. *Sucr. Belge,* 1981, **100,** 127-142 *(French).* — The initiation of precipitation from mixtures of sucrose and $CaCl_2$ of varying molar ratios was studied by adding NaOH until precipitation started and measuring the pH at this point. The solutions were maintained at a constant 12°C. Of particular interest was the pH during titration but before precipitation, the pH at the start of precipitation, the number of moles of NaOH added to initiate precipitation, and the form of the initial precipitate. The main conclusions drawn were that the Ca:sucrose molar ratio must exceed 2 in order to initiate precipitation and that the initial form of the precipitate when the ratio is between 2 and 3 is a tricalcium-sucrose complex, whereas a mixture of the complex and lime is primarily precipitated at a ratio between 3 and 4, after which only lime is primarily precipitated with further increase in the ratio. A new reaction mechanism is suggested which is based on a double ion exchange between H^+ and Na^+ and then Na^+ and Ca^{++}.

Kinetic problems in sucrose crystallization in Quentin syrups of low grade. V. Maurandi and G. Mantovani. *Sucr. Belge,* 1981, **100,** 143-152. — The crystallization rate in syrups obtained from the Quentin process was determined by a weighing method, and a probabilistic method used to establish the contribution of material transfer and surface reactions to crystallization. The method is based on the hypothesis that, for a surface reaction of the order of approx. 1, the resistance to diffusion W_d is a function of supersaturation C as defined by $W_d = \alpha e^{\beta C}$, where β can be obtained from viscosity data, and α is found by the statistical method cited. The equation was found to be valid for supersaturations in the range 1.1-1.4 by experiments in which isotherms were obtained for slight movement between the crystal and mother liquor at 50-60°C. By this means, values of the diffusion kinetic coefficient D/L (where L is the film thickness) and of W_d were obtained which agreed closely with values given by the exponential equation above. It was also confirmed that, at low syrup purities, W_d decreases less than the surface resistance W_r with temperature rise, a fact already established for higher purity syrups. Since it is practically impossible to measure the diffusion coefficient of molasses, the orders of magnitude of D and L at known values of D/L were found by establishing a relation between L, D and D/L using Sherwood, Schmidt and Reynolds dimensionless numbers and known or measurable parameters. For the Quentin syrups examined, the diffusion coefficients were one-hundredth of those of pure solutions at the same temperature and supersaturation.

Determination of the amount of raw sugar film. M. Muro M., J. Jover P., E. Curí H., I. Machado L. and M. Pérez P. *Centro Azúcar,* 1980, **7,** (3), 97-107 *(Spanish).* — From analysis of 55 samples of raw sugar ranging from low to high pol, an equation was derived, namely P = 1.58 (100 — Pol), where P is the quantity of molasses film % raw sugar, which has a correlation coefficient of 0.97. It was established that the average composition of the film was 20.8% water, 38.4% sucrose and 40.8% non-sucrose solids. Ideal affination could eliminate 72.4% of the non-sucrose solids and 59.1% of the colour from the raw sugar.

Aluminium clarification of sugar beet brei extracts. S. S. Martin, R. J. Hecker and G. A. Smith. *J. Amer. Soc. Sugar Beet Tech.,* 1980, **20,** 597-609. — Comparison was made between aluminium chloride and lead subacetate as clarifying agents for beet brei extracts. Results showed that treatment with $AlCl_3$ gave the same Na and K concentrations as with the subacetate, more amino-N (determined with ninhydrin and phthalaldehyde), slightly less total N, considerably less betaine but more nitrate. Pol measurements differed significantly only in the case of a sugar beet/fodder beet hybrid but not in the case of a commercial variety, an obsolete (high-sugar) variety and an experimental hybrid, indicating that aluminium chloride would be a satisfactory, inexpensive and non-toxic alternative to lead subacetate.

A quality inspection scheme for mill yard sugar cane arrivals based on a sequential testing method. R. Narasimhan and G. S. C. Rao. *Maharashtra Sugar,* 1981, **6,** (6), 19, 21, 23-25. — A sequential testing procedure for statistical evaluation of Brix (determined by hand refractometer) of juice samples, from the internode about mid-way between the top and bottom cut ends of cane stalks in consignments delivered to an Indian sugar factory, is described. While the method was applied to a specific situation, it is considered suitable for standing cane just before harvest.

Polarimetric estimation of dextran in sugar house products. I. Studies with technical sugar solutions. S. Bose and L. Singh. *Indian Sugar,* 1981, **30,** 585-588. Dextran solutions of known concentration in the range 250-8000 ppm were added to aliquots of technical sugar solution of 26°Bx and the pol readings compared with those of controls to which only distilled water was added. A regression equation was derived from the experimental results for calculation of dextran as a function of pol elevation; tabulated values show a mean difference between calculated and experimental results of ± 1.66%.

Cleaning semi-permeable membranes used for ultrafiltration of vegetable juices. S. Landi. *Ind. Alim. Agric.*, 1981, **98**, 283-289 *(French)*. – The problem of removing the gelatinized layer that forms at the interface between solution and membrane during ultrafiltration is discussed. While treatment with pectinolytic and proteolytic enzymes or with strong acids has proved unsuccessful, strong bases did have a positive effect which was, however, too slow for practical purposes. On the other hand, oxidizing agents are highly efficient. Sodium hypochlorite of 400 ppm concentration removed all of the gelatinous material (< 0.01 mg dry weight per cm^2 of membrane, i.e. sufficient to reduce water permeation to 30% of that through a new membrane) after the membranes had been used to treat beet diffusion juice of high dextran content (brought about by freezing the original beets, at $-15°C$ for 48 hours and then standing them for 7-8 days at $+10°C$). Cleaning involved 30 minutes' oxidation at 40°C. No membrane damage occurred after at least 650 hours' treatment, whereas a NaOCl concentration of 800 ppm caused a rise in permeability and a fall in retentivity after between 200 and 400 hours. Cleaning was preceded by cold water washing of the membrane under pressure and was followed by washing with water at the same temperature as that of the sodium hypochlorite.

Central Board's new autolab system saves time and money. Anon. *S. African Sugar J.*, 1981, **65**, 127-128. The Sugar Industry Central Board is responsible for sampling and analysing cane delivered to sugar factories, for the purpose of assessing cane payment. The relevant data referring to each cane consignment are manually transcribed onto the appropriate documents and transported to Durban where the data are logged and processed; the printout is then returned to the factories. This procedure is labour-intensive, time-consuming and liable to human error. The possibility of using a computer at the factory was investigated, and a system tested at Tongaat which has proved trouble-free and outstandingly successful during almost two complete seasons of operation. Much of the information is keyed in to a visual display terminal at the weighbridge; the gross weight of each vehicle is printed by one printer, and receipts for cane delivered are printed by another. A visual display terminal in a cabin overlooking the cane unloading site is used for the input of sample reference data. In the laboratory a visual display unit is situated next to the chemical balance and another is located in the constant-temperature room alongside the saccharimeter and refractometer. Whenever data are captured, they are edited for the correct format and checked against pre-set ranges and tolerances. Error messages are returned via the VDU's. At the end of the day, listings of all deliveries and advice notes to growers are printed out, while all data are taped on discs for further processing in Durban. Advantages of the system are indicated. The scheme is to be installed in every sugar factory.

The effect of replacement of sugar juice cations with magnesium on molasses sugar content. S. P. Vycherova, M. I. Barabanov and A. A. Ivanyuk. *Izv. Vuzov, Pisch. Tekh.*, 1981, (2), 106-108 *(Russian)*. – In tests, 2nd carbonatation juice was passed through columns of cation exchange resin in NH_4^+ form and the ammonia then driven off by treating the juice with active MgO (0.3% on juice) at 100°C. After filtration, the juice was completely transparent and had lost about 50% of its colouring matter. It was evaporated to 65-70°Bx and then boiled. After centrifuging to separate the crystals from the mother liquor, the latter was subjected to three re-crystallizations and the resultant molasses evaporated to 84°Bx before standard purity determination. The Brix, pol, viscosity, K, Na, Ca, Mg and carbonate ash were determined. The initial 2nd carbonatation juice was also analysed, and the results compared. Replacement of 97% of the cations with Mg enabled the sugar content in the molasses to be reduced by two-thirds.

Thermal degradation of sucrose in the crystalline phase and melt – a review. L. Poncini. *Sucr. Belge*, 1981, **100**, 221-229. – A review of the literature (with 109 references) is presented on the effects of heat on sucrose in both crystal and melt form (but not in the presence of acid or base), and a list is given of products isolated from sucrose in the temperature range 300-800°C.

Preservation by freezing of samples of disintegrated cane. A. C. Sturion, J. P. Stupiello and E. R. de Oliveira. *Brasil Açuc.*, 1981, **97**, 172-177 *(Portuguese)*. – Samples of prepared cane were placed in polyethylene bags and placed in a commercial freezer at −20°C. Half of the samples were treated with toluene to avoid possible microbiological deterioration of sugars. The samples had reached a temperature of −15°C only after 42 hours, however, and subsamples were analysed for Brix, pol, reducing sugars and purity at 0, 6, 18, 24 and 42 hours, using a hydraulic press to extract the juice; 3 hours were needed to thaw the prepared cane. The losses in pol ranged from 2.1% at 6 hours to 5.0% at 42 hours, and toluene was found to have no effect. The pol loss is attributed to invertase action. The method is not recommended.

Factorial design and analysis of experiments for the sugar industry. II. Complete factorial designs. J. López-Oña. *Sugar J.*, 1981, **43**, (12), 23-26. – The author explains, with the aid of examples, the use of 2^n complete factorial designs in experimentation.

Liquid sugar. A. VanHook. *Sugar J.*, 1981, **43**, (12), 31-32. – X-ray diffraction and calorimetric tests were applied to an examination of various sugar products to determine whether in fact they melted in water. From the X-ray diffractograms, heats of solution, solubilities and nucleation behaviour, it was concluded that only "cotton candy" (a centrifugally melted and quenched refined sugar), lyophilized syrup, highly milled sugar and fudge exposed to a temperature of 165° and 175°C were not crystalline, whereas Brazilian "amorphous" sugar and fudge at 130° and 150°C were at least slightly crystalline. The value of the heat of solution as an indicator of the degree of crystallinity is demonstrated.

A semi-automatic method for the potentiometric determination of reducing sugars. R. J. Noakes, A. M. Schwede and D. P. Schweinsberg. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 67-70. – Experiments were carried out on the potentiometric method of Cameron[1] for use where the end-point was diffucult to discern in the standard Lane & Eynon procedure applied to e.g. molasses or dirty first expressed juice. An automatic titrator was used, and the only major modification to the original equipment was replacement of the hot plate with a resistance coil for boiling of the sample and Fehling's solution. Typical results are given for first expressed raw juice samples before and after addition of standard invert solution, and indicated that the method is both rapid and accurate.

[1] *I.S.J.*, 1950, **52**, 343.

BY-PRODUCTS

Bagasse pellet formation by impact loading. J. G. Loughran. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 207-213. — A mathematical study of bagasse pelleting is reported. The model developed was based on an ultimate pellet density of 687 kg.m^{-3}. Results for single-stage, high-speed compaction showed that the diffusion of air trapped within the voids of a pellet is a significant problem; main parameters associated with the air diffusion characteristics are initial and final densities and, to a lesser extent, compression time. Since the performance of a pelleting machine is likely to be limited by the long residence time required for the air to diffuse, a more promising alternative would be compression in two stages, the first to raise the density to about 300 kg.m^{-3}, at which the disturbed void air would be allowed to diffuse down to equilibrium, while the second stage would be used to raise the density to the final target value. Results of tests on two-stage pelleting showed a fairly rapid reduction in pressure for increasing initial density, e.g. a gas pressure reduction by a factor of almost three after one second where the initial density is raised from 80 to 300 kg.m^{-3} and the final density is 1000 kg.m^{-3}.

Pelleting behaviour of bagasse. D. S. MacArthur. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 215-223. Results of an experimental study on the compaction behaviour of bagasse under controlled conditions of pressure (2-32 MPa), temperature (40-160°C), moisture content (9-22%) and residence time (1-64 seconds) are reported. The height of the pellet was measured 2, 8 and 32 minutes and 24 hours after pelleting and its weight determined 3 minutes and 24 hours after pelleting. Dry matter densities at 32 min and 24 hr were found to be almost identical. Final pellet density increased linearly with log pressure and log residence time, and decreased approx. linearly with increasing moisture content above 10%. Density increased with temperature in two stages, from 40° to 60°C and very rapidly at temperatures above 120°C; little change occurred between 60° and 120°C. Densities of 450-600 kg.m^{-3} were obtained at 10% moisture content, 60-100°C, 8 seconds' residence time and pressures of 8-32 MPa. Higher densities than indicated require much higher pressures and temperatures, increasing the cost of machine and energy consumption.

Explosion pulping of bagasse. H. Mamers, D. Menz and J. P. Yuritta. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 225-232. — Details are given of the Siropulper explosion pulping process developed at the CSIRO Division of Chemical Technology, South Melbourne, and results are given of trials in which the technique was compared with normal batch soda pulping. Results showed that the explosion process is rapid and requires less alkali than the soda process, but gives slightly lower yields. The pulps have a higher initial drainage rate than those from the conventional process but are slightly lower in strength than the latter, although their properties may be further improved by screening out the pith cell debris generated by the explosive discharge, which serves to fragment any pith cells associated with the pulp to an extent which is directly proportional to the applied digester pressure. The pulps can be readily bleached to a high degree of brightness, indicating their suitability for use in the manufacture of writing and printing papers. Bagasse may be satisfactorily pulped at an applied digester pressure of 3.4 MPa, corresponding to a calculated gas compression energy demand of 26 kWh per tonne of dry furnish. The steam requirements of the Siropulper process compare favourably with those of established batch processes.

Developing the potential of Australian bagasse as a paper resource. G. Gartside and N. G. Langfors. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 233-238. — Bagasse briquetting trials are reported, which showed that briquetting had little effect on yield or on pulp and paper properties. Also investigated was bagasse fractionation, whereby the best fraction for use in manufacture of paper would be separated, and the remainder used as boiler fuel. While high-quality bagasse could be obtained from the coarse fractions only, a coarse fraction suffered damage in briquetting that resulted in poorer paper properties, and studies are being carried out to establish where such deterioration can be avoided. Damage to bagasse fibres during cane milling reduced the tearing strength, particularly during cane preparation in a shredder and in the final de-watering mill, where compression is much higher than in the other mills. Most of the decrease in bonding strength (breaking length) occurs as a result of cane preparation. Hence, it is considered that the high degree of sugar extraction practised in Australia significantly limits the paper-making quality of bagasse.

Improvement of alcohol fermentation. M. C. Hsie and Y. C. Su. *Taiwan Sugar*, 1981, **28**, 46-49. — A study was made of the effect of cell recycle on alcohol manufacture from cane molasses, of the optimum amount of inoculum for batch fermentation, of the effect of fed-batch operation on fermentation efficiency and of the effect of seed culture under aeration and agitation conditions. Cell recycle increased sugar conversion to alcohol, permitting reduction in the batch fermentation time and in the quantity of molasses. The optimum inoculum quantity was in the range 5-10% v/v; more than this did reduce the fermentation time but did not obviously raise efficiency. The fed-batch process was better than a conventional batch process, particularly at a high sugar concentration (21%) using molasses from a carbonatation factory by comparison with a defecation factory.

The successful running of a second pulp machine. Anon. *Taiwan Sugar*, 1981, **28**, 51. — Details are given of an Andritz wet pulp machine installed as a complement to an existing machine at Pingtung factory. Its rated daily output is 100 tonnes of bleached bagasse pulp of 58% moisture content.

Some notes on studies of alcohol slops treatment in Taiwan. S. L. Sang *et al. Taiwan Sugar*, 1981, **28**, 52-55. Investigations have been carried out on continuous production of yeast with cell recycle and on cultivation of a fungus[1,2] on vinasse as a means of reducing the BOD. Yeast production reduced the BOD content by

[1] Chuang *et al.*: *I.S.J.*, 1980, **82**, 189.
[2] Hwang & Chuang: *ibid.*, 1982, **84**, 28.

37% (from an initial 34,200 ppm) in factory trials, while fungal growth reduced it by approx. 75% from an initial value in the range 10-20,000 ppm. A proposed scheme combining both processes studied is presented in which the fungus is grown on waste from the yeast process, and the BOD of the final waste water reduced to 400 ppm by activated sludge treatment; the scheme is based on treatment of 100 tonnes of vinasse of 30,000 ppm BOD.

Pilot scale anaerobic-aerobic biological treatment of distillery waste. B. Frostell. *Chem. and Ind.*, 1981, (14), 465-469. – Pilot plant tests on the Anamet system are reported. The plant comprised an anaerobic tank, a unit for separation of anaerobic sludge, an aerobic tank and a clarifier for separation of the aerobic sludge, which was recycled to the aerobic and anaerobic tanks. The waste water was a 49:1 v/v mixture of rum distillery slop and fermenter bottoms having an expected initial COD of 100 g/litre. Treatment reduced the COD by more than 80% and the BOD by 99% without the need for additional nutrients or chemicals for pH adjustment. The sludge contained 0.05 kg total suspended solids per kg COD added, while 0.35 m^3 of gas (containing 50% methane by volume) was obtained. After 20 days' start-up, a steady daily load of 2.5-3.0 kg COD per m^3 was maintained. After stops of less than two weeks, the plant could be restarted immediately at the previous load, while full gas production was reached within one week after a 10-week stop. Investment and operating costs are discussed.

Microbial method for evaluation of antiseptics employed in alcohol industries. M. P. Cereda, G. E. Serra, A. M. Cagliari and M. A. Meneguim. *Brasil Açuc.*, 1981, **97**, 184-191 *(Portuguese)*. – A method is described in which disinfectants are tested by addition to standardized cultures of a *Leuconostoc* mico-organism isolated from a sugar factory cane juice. After incubation at 32°C for 24 hr, counts are made on the samples and the effectiveness of the disinfectant assessed from the numbers obtained.

Microbial protein produced from bagasse pith. IV. Production of fungal protein in a laboratory-scale fermenter. C. Y. Chang, Y. C. Kuo and L. H. Wang. *Rpt. Taiwan Sugar Research Inst.*, 1981, (91), 59-66 *(Chinese)*. Investigations of fungal protein production from bagasse pith by *Trichoderma reesei* showed that 5.6 g could be manufactured from 30 g of pith by cultivation at 30°C, pH 5-6, an aeration rate of 1 vvm, an agitation speed of 300 rpm and a volumetric coefficient of oxygen transfer (K_La) of 4 min^{-1}. *Aspergillus oryzae* could enhance production of mycelial protein when used in a mixed culture with *T. reesei*, while 10% more protein was obtainable when *A. oryzae* was inoculated 48 hours after *T. reesei*. The final product could be recovered simply by filtering the fermentation broth instead of using centrifugation. The protein yield was comparable to those given in the literature for various micro-organisms and various sources of cellulolytic substances.

Development of technology for producing ethanol for fuel directly from sugar cane. III. Attempts at selecting yeasts suitable for the EX-FERM process. C. Rolz and S. de Cabrera. *Informe Tecnico ICAITI*, 1979, (79-121), 93 pp; through *S.I.A.*, 1981, **43**, Abs. 81-1153. – Tests with 117 strains of *Saccharomyces* were performed involving sucrose, cane juice, syrup, molasses and cane chips, under various conditions. Results are tabulated in detail and the most efficient strains are identified with regard to sugars utilization and ethanol yield. The most suitable strain for two-stage fermentation of cane chips appears to be *S. cerevisiae* CBS 1242.

Transformation of Quentin molasses in the alcohol industry. B. Kovacs and A. Wieland. *Szeszipar*, 1979, **27**, (2), 45-53; through *S.I.A.*, 1981, **43**, Abs. 81-1163. Recent declines in the quality of molasses produced in Hungary are stated to be due partly to decreases in the sugar content of the beet, and partly to introduction of the Quentin ion exchange system for juice treatment. This molasses gives poor results in the fermentation and baker's yeast industries, because of insufficient concentration of yeast growth factors. Various quality characteristics of beet molasses are tabulated.

Utilization of raffinose (melitriose) in molasses. I. Szep and L. V. Vigyazo. *Szeszipar*, 1980, **28**, (1), 19-22; through *S.I.A.*, 1981, **43**, Abs. 81-1164. – Molasses produced in Central Europe contains about 0.5-2.0% raffinose. In Hungary, the alcohol industry uses, on average, 200,000 tonnes of molasses/year. Assuming a raffinose content of 1%, this corresponds to 2000 tonnes of raffinose/year, which at present is wasted, because *Saccharomyces cerevisiae* commonly used for industrial fermentation does not contain an enzyme able to utilize the melibiose which constitutes two-thirds of the raffinose. To avoid this waste, it is proposed to split the melibiose by means of alpha-galactosidase, which can be obtained from broad beans or sweet almonds.

Production of citric acid from molasses in the presence of potassium ferrocyanide (FC) by *Aspergillus aculeatus* and *A. carbonarius*. M. S. Nour el Dein Selim and M. G. Ibrahim Emaish. *Indian J. Exp. Biology*, 1979, **17**, (1), 105-106; through *S.I.A.*, 1981, **43**, Abs. 81-1175. – These two species of mould were cultured in cane molasses media containing 17.6% w/v sugars, with addition of FC to give 0, 20, 40, 60, 70 or 100 mg/100 ml. Citric acid yield increased with FC concentration up to 60 mg/100 ml, then decreased.

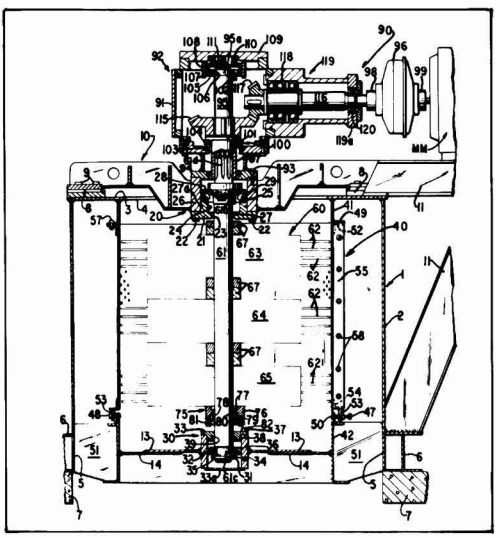
Digestion by cellulolytic enzymes of alkali pretreated bagasse. P. P. Gray, N. A. Hendy and N. W. Dunn. *J. Aust. Inst. Agr. Sci.*, 1978, **44**, (3-4), 210-212; through *S.I.A.*, 1981, **43**, Abs. 81-1180. – Alkali-treated bagasse was incubated for 14 days with a cellulase preparation from *Trichoderma reesei*. Digestion was better when the bagasse was fractionated into different particle sizes and pretreated wet with 0.1 g NaOH/g dry solids than it was for whole bagasse or for dry samples treated with NaOH. Under the best conditions, 137 mg glucose/g bagasse was released. The feasibility of converting the resulting glucose to ethanol was demonstrated with a strain of *Saccharomyces uvarum*.

Silage made from sugar cane bagasse treated with sodium hydroxide. H. J. Andreis and R. P. De Stefano. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 12-15. – In a feed trial to assess animal performance and silage acceptance, steers consumed up to 45 lb of the silage per day. Treatment of the bagasse silage with NaOH improved palatability, gave better weight gains, lowered the feed conversion factor and reduced the consumption of molasses and mineral in the rations by comparison with silage made from untreated bagasse.

PATENTS

UNITED STATES

(Bagasse) Depither. F. J. Malinak, of Hamilton, Ohio, USA, *assr.* The Western States Machine Co. **4,202,078.** September 19, 1977; May 13, 1980.



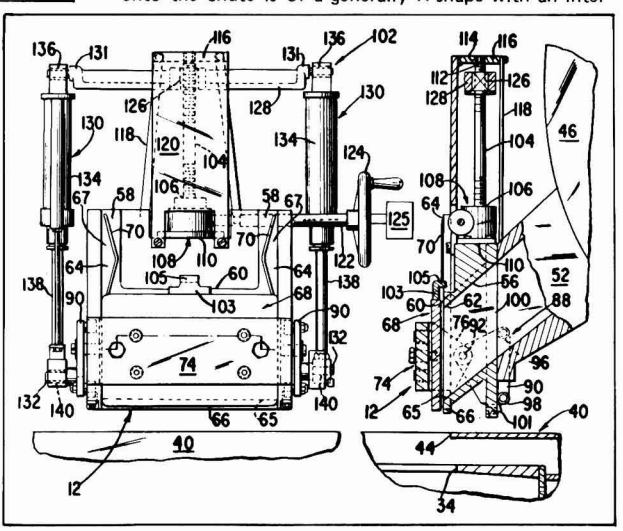
The depither comprises an upright casing 1 having a vertical side wall 2 extending between the base 5 and a top plate 3 with a central aperture 4. Secured to base 5 is a framework 6 strong enough to support the depither in operation and fitted to a floor or platform 7. Secured to top plate 3 by way of mounting pads 8 and bolts 9 is a rigid frame 10 which supports the transmission unit 92 of the drive assembly 90 and the rotary hammer assembly 60. Brackets 11 secured to framework 6 carry the driving motor MM coupled to the transmission unit 92 through clutch 96.

Within casing 1 is a screen wall 40 comprised of four sections bolted together and surrounding the hammer assembly 60. The hammers 62 are swingable relative to their holders and are arranged in three groups, 63, 64 and 65 separated by spacers 67 and mounted on shaft 61. The hammers are held by pins in eccentric bushes which may be turned by an indexing disc to adjust the clearance between the hammers and the screen wall 40. Bagasse fed into the machine through opening 4 is separated into fibre and pith components and the pith driven through the perforations in screen wall 40, while the fibre continues down within the screen wall, separate bottom discharge apertures being provided for each.

The hammer assembly is supported in suspension and in the plumb position by the mounting of its shaft 61 in the upper bearing support 20 on frame 10. This support comprises an annular housing 26 welded to the frame and has a bearing retainer 21 fixed to it by capscrews 22 and separated from shaft 61 by oil seal 27. Annular portion 24 of the bearing retainer, sealed to housing wall 26 by O-ring 27a, extends inside the housing to an upwardly and inwardly facing spherically curved annular bearing seat 25 which supports a series of spherical roller bearings 29. These are held between it and an upper annular bearing ring that fits on an enlargement 61a of the upper portion of shaft 61 beneath a thrust 61b fixed to the shaft. This bearing assembly permits shaft 61a to attain a plumb position by gravity during assembly. The lower end of shaft 61 is secured in a radial ball bearing 32 comprising a race located around a part 61c of shaft 61 of narrower diameter, held by a lockwasher 31 and housed in a casing having a top cover 33 and bottom plate 33a, the top cover being sealed to the shaft by O-ring 39. The whole construction allows easy dismantling for repair and replacement of parts worn or damaged by e.g. stones entering with the bagasse.

Power-operated loading gate for centrifugal machines incorporating an auxiliary drive device. D. L. Hurley, F. H. Wessel and J. B. Bange, *assrs.* The Western States Machine Co., of Hamilton, Ohio, USA. **4,203,570.** August 23, 1978; May 20, 1980.

The loading gate assembly 12 of a batch centrifugal comprises a chute 52 which extends down from mixer tank 46 to a position above the curb 40 of the basket. The forward end wall 58 of the gate body 56 bolted onto the chute is of a generally H-shape with an inter-



Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

Make a safe investment in alcohol. Rely on the greatest Brazilian experience.

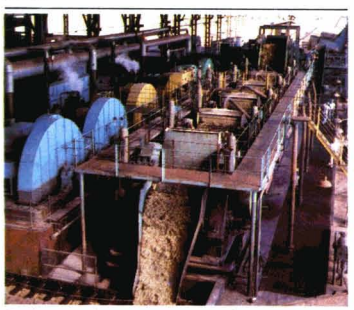
Every six days, Dedini produces a complete alcohol distillery. More than 400 units installed in Brazil, and the company is already exporting turn-key distilleries. Of the 4.5 billion liters alcohol expected for the 82/83 harvest, at least 3.1 billion will be produced by equipments with the Dedini trade mark.

More than 60 years of solid experience in processes and equipments for the sugar industry have made it possible for Dedini to develop the most up-to-date technology for the manufacture of the equipments used by the alcohol industry.

Dedini is a market leader and the most experienced Brazilian firm in this field of activities. They supply crushing mills, steam turbines, speed reducers, boilers, syrup heaters, as well as fully assembled systems for distillation.

Dedini equipments: efficiency and profits

By supplying highly enduring and efficient equipments - which are also of easy maintenance and have a low energy consumption - Dedini assures real profits in alcohol production.



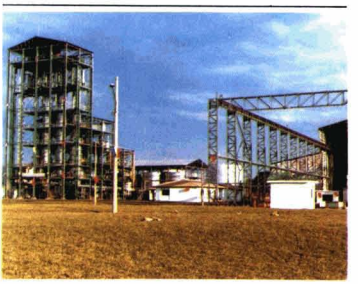
Dedini produces 5 distilleries/month, with a 120 thousand liters/day production capacity.

This is possible owing to the fact that every product is planned in accordance with specific needs and - through manufacture - submitted to the most advanced tests, which comply with Brazilian and international technical standards, such as ABNT, ASTM, SAE, DIN, AFNOR, NEMA, etc.

Mechanical, metallographic, macrographic, chemical exams and dimensional controls are carried out to guarantee an absolutely perfect performance of the equipments.

Exports: a growing capacity

Dedini's services start even before a product is bought, when the company gives advice on the best way to invest the available capital, thus simplifying the arrangements for financing.



Turn-key alcohol distillery delivered to Paraguay in September 1980.

Then, from project to final installation, Dedini supplies equipments or complete distilleries for any and every company or country that might be interested in replacing oil by alcohol-chemistry.

Dedini's capacity also makes it possible to supply turn-key distilleries. Indeed, Paraguay has already imported a unit through this system, pioneer in the history of alcohol industry.

Technical assistance: quickness and safety

Dedini's services do not finish here. They are still present during the project implantation, when specialized technicians supervise assembly. And they go on, with permanent technical assistance, providing spare parts in every country, quickly and efficiently.

Projected, manufactured, installed and assisted by Dedini, the distillery starts producing alcohol and profits.

From the project, through final installation, the client may count on a specialized staff's advice.

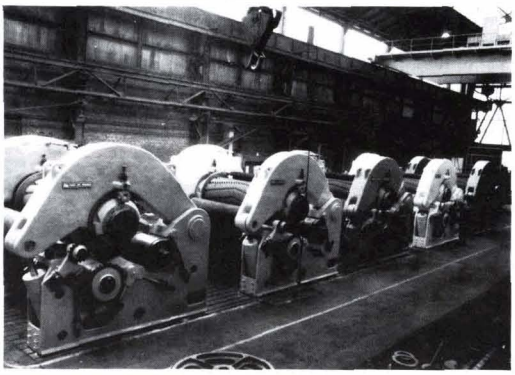
Trust the capacity of the experts in alcohol. Ask for Dedini's advice.

DEDINI

M. DEDINI S.A. METALURGICA

Av. Limeira, 222 - Jardim Universitário - Phone: PABX (0194) 34-5455 - CEP 13400 - Piracicaba - SP - Brazil

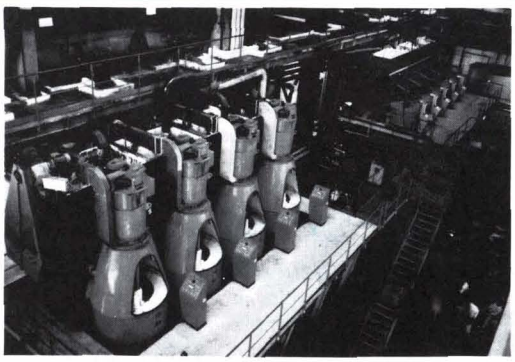
The main feature of the FCB self-setting mill is that the top roller is solidary with top housing members acting as lever arms and having the top roller describe an arc of a circle when setting the feed opening. This particular design incorporates the following advantages among others: easy setting of mill ratio; constant mill ratio; increased capacity; higher extraction; reduced power peak; higher permissible roller wear; etc.
For the drive of their mills, FCB offer an elaborate range of steam turbines, reducers and transmission gears. FCB are also specialized in the drive of mills by electric motors. (Brochure N° 21091 upon request).



Assembly, in our works, of a tandem of five 1050 x 2100 mm (42" x 83") self-setting mills.

- "COMPACT" automatic batch centrifugals are mainly used for processing high-purity products. They are constantly updated through the incorporation of state-of-the-art features (e.g., microprocessors allowing complete automation of crystallisation shops). They are produced in 3 versions with basket sizes 48" x 30", 48" x 42" and 54" x 42" and respective load capacities of 700, 1000 and 1300 kg. (Brochure N° 21100 upon request).
- "FC" continuous centrifugals are suitable for almost all massecuite curing operations:

– The FC 1000 series (basket dia. 1000 mm) is fitted either with 34° basket for low-grade massecuites, or with 30° basket for affination and B massecuites, or with 25° basket (runoffs separation) for beet 2nd strike massecuites, cane B strike affination and A strike.
To avoid crystal breakage, the FC 1000 can be equipped with 3 m, 4 m or 5 m dia casings. It is also possible to adapt, on centrifugals with 30° and 25° baskets, a device allowing almost instantaneous sugar melting.
– The FC 1250 series is equipped with a 1250 mm dia., 34° basket. Centrifugals of this series are high-capacity units used for beet 3rd strike and affination and cane C strike and affination. (Brochure N° 21108 upon request).

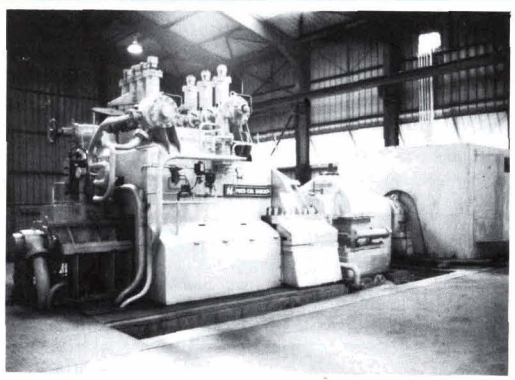


Centrifugal station of the N'Koteng, Cameroons, cane sugar factory. In the foreground, four "COMPACT 411" centrifugals. In the background, five continuous "FC 1000" centrifugals.

About one thousand FCB turbo-generator sets are in operation in sugar factories in the whole world. They offer to the users the following main advantages:
– High efficiency
– Low installation and operating costs
– High reliability.

The FCB turbo-generator sets are suitable for any type of operation:
- Single back-pressure with controlled or non-controlled distribution pressure
- Condensation with controlled or non-controlled extraction
- Possibility of connection with the mains
- Possibility of operation in parallel with other turbo-generators.

FCB manufactures turbo-generators up to 25 MW per unit. (Brochure n° 27008 upon request).



7000 kW turbo-alternator, of the condensation with regulated extraction type, at the Borotou-Koro cane sugar factory, Ivory Coast.

SAGAL Publicité - Paris - N° 1663 A

FIVES-CAIL BABCOCK

7, rue Montalivet, 75383 PARIS CEDEX 08 - FRANCE - ☎ (1) 266.35.25 - Telex : FIVCAIL 650 328 - Cables : FIVCAIL - PARIS

Retention time. How short should it be?

The Dorr-Oliver RapiDorr® 444 is six ways better than so-called "Short Retention Time" clarifiers.

There is no question that the shortest practical retention time is desirable in cane juice clarification. But when the disadvantages of extremely short retention time clarifiers outweigh the advantages, then it is vital to reconsider how short short should be. The Dorr-Oliver RapiDorr 444 clarifier is designed for shorter retention time than other conventional units. And it offers six distinct advantages over what have become known as "Short Retention Time" (SRT) clarifiers.

1 "SRT" clarifiers depend on polyelectrolytes for best results. The RapiDorr 444 does not. Polyelectrolyte additives are very costly for one thing. Not to mention such complications as lack of uniformity of raw material, or the unavailability of polyelectrolytes in some areas and even, in some cases, government restrictions against their use. (Incidentally, if your clarification would be improved by adding polyelectrolytes, you can with the RapiDorr 444 — that's up to you. But remember, this is not necessary to make the machine function efficiently.)

2 "SRT" clarifiers tend to be "nervous" in operation, or extremely delicate. The RapiDorr 444 is far more stable, has more surge or holding capacity and is easier to operate, resulting in better overall performance.

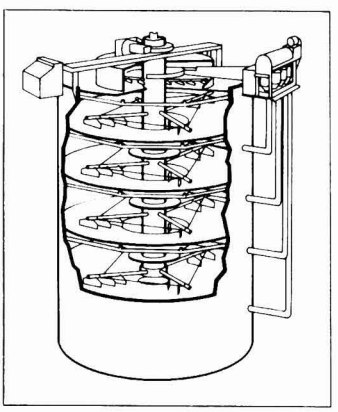
3 The true test of a cane juice clarifier is how well it operates when conditions are tough. When weather is bad, or stale cane produces refractory or hard-to-settle juices, then you need the extra retention time and larger settling areas the RapiDorr 444 provides. And "SRT" clarifiers just don't.

4 "SRT" clarifiers normally require complicated continuous pH, temperature and flow control as well as an extra large flash tank. With the RapiDorr 444 clarifier, you avoid these extra expenses.

5 Mud thickening, mud holding and mud withdrawal capacity are built into the RapiDorr 444. Most "SRT" clarifiers do not have this ability.

6 "SRT" clarifiers can be a mechanical nightmare of pipes, launders, controls, cones, and the like, and difficult to maintain. The simplicity of RapiDorr 444 construction precludes continuous expensive maintenance.

Avoid the risk of getting short changed with short retention clarifiers. Send for complete information on the RapiDorr 444. Write Larry Engel, Dorr-Oliver International Headquarters, Stamford, CT 06904 U.S.A.



DORR-OLIVER

A step ahead in process equipment.

mediate cross member 60 overlying the upper margin of chute outlet 62 and joined at its ends to two vertical legs 64, the lower portions 65 of which are connected by a lower cross-member 66. The upper portions 67 of legs 64 project above cross-member 60 and provide a slide way for gate 68 moving from a closed position covering outlet 62 to an open position above. Narrow bearing strips 70 on the forward surface of end wall 58 ensure tight fitting of the gate and wipe off accumulated deposits of massecuite as the gate passes over them.

A cross-head 74 extends across the outer front face of the gate 68 and has rearwardly directed ends 76 which fit loosely round the outer sides of gate body 56. Bolts through the cross-head engage with recesses in gate 68, allowing limited relative vertical movement of the two, while adjustable compression springs between them hold the gate against the bearing strips 70. The cross-head is held in operative position against the front face of the gate by pull plate assemblies 88. These comprise plates 90 linked by pins 92 to the ends 76 of cross head 74 and carrying rollers 96, 98 which travel vertically along a rail 100; at the bottom of each rail is a wedge 101 so that the plate 90 and thus the crosshead and gate 68 are forced rearwardly to close tightly against the chute outlet 62. The wedges also serve as limits for downward movement of the gate in its closed position, as does the inverted J portion 105 of the arm 103 secured to the top of gate 68 which abuts the top surface of cross member 60.

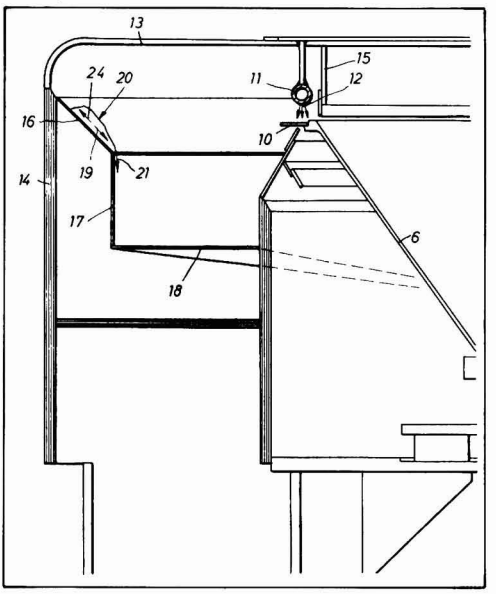
Manual operation of the gate is possible by means of a hand wheel 124 which operates a shaft geared to a vertically mounted shaft 104 the rotation of which causes movement of a travelling nut 126 and so the tie bar 131. This is connected to the plates 90 by shafts 132 and bearings 140. Double-acting hydraulic pistons 138 are also provided, however, for powered actuation of the gate through the same linkage to plates 90 and so to gate 68.

Immobilization of enzymes. J. E. Bailey and Y. K. Cho, *assrs.* Illinois Water Treatment Co., of Rockford, IL, USA. **4,204,041.** October 3, 1977; May 20, 1980. – A method of immobilizing enzymes comprises (first oxidizing and then) treating an activated carbon with a solution of a water-soluble carbodiimide [1-cyclohexyl-3-(2-aminoethyl) carbodiimide quaternary ammonium salt; 1-cyclohexyl-3-(2-morpholinoethyl) carbodiimide metho-*p*-toluene sulphonate] which forms a complex with reactive groups on the surface of the carbon; the activated carbon complex is then treated with a solution of the enzyme whereupon the latter displaces the carbodiimide and forms a carbon-enzyme complex which is then separated from the reaction medium.

Cane planter. D. J. Quick, of Bundaberg, Queensland, Australia, *assr.* Massey-Ferguson Services N.V. **4,204,491.** March 29, 1978; May 27, 1980.

Process for renewal of an insolubilized glucose isomerase. Y. Fujita, A. Matsumoto, I. Miyachi, N. Imai, I. Kawakami, T. Hishida and A. Kamata, *assrs.* Mitsubishi Chemical Industries Ltd. and Seikagaku Kogyo Co. Ltd., of Tokyo, Japan. **4,205,127.** June 20, 1978; May 27, 1980. A (50-85%) deactivated glucose isomerase enzyme, immobilized by adsorption onto an anion exchange resin, which has been used for the isomerization of glucose to fructose, is treated successively with an aqueous mineral acid (0.2-2.0N) (hydrochloric or sulphuric acid) in combination with an aqueous (0.2-2.0N) solution of alkali (NaOH, KOH) (in a molecular ratio of 20:1-1:2) or electrolytic salt (0.2-5M) (NaCl, Na_2SO_4, KCl, K_2SO_4) or a mineral acid or mixture of acids (0.2-2.0N) (HCl and/or H_2SO_4), in order to release adsorbed material from the resin, which is converted into a salt type. Fresh glucose isomerase is then adsorbed onto the resin to immobilize it for further use.

Continuous centrifugal. E. Zeichner, H. Kurland and H. Luehrs, *assrs.* Braunschweigische Maschinenbauanstalt, of Brunswick, Germany. **4,205,999.** January 16, 1979; June 3, 1980.



The centrifugal is designed for continuously separating crystals from a massecuite and for re-mingling the separated sugar. The latter passes over the upper edge of conical basket 6 and onto annular plate 10. Mingling syrup is delivered as jets 12 through perforations in annular pipe 11, the effect of air currents on the direction of the jets being avoided by provision of a baffle 15. The sugar and mingling syrup are flung outwardly to strike the baffle 16; initially, their kinetic energy takes them upwards in the direction of arrow 24 but gravity then brings them in the direction of arrow 19 so that they fall off the lower edge of baffle 16 in the direction of arrow 21. This causes formation of a "pad" of crystals and mingling syrup 20 which serves to receive fresh crystals and avoids their breakage. The mixture falls into a compartment 17 having a helical, downwardly sloping bottom 18 and is sufficiently well mixed that it can be directed without further treatment to a second centrifugal.

Method of reducing storage losses in harvested sugar beets. A. H. Freytag and W. R. Akeson, of Longmont, CO, USA, *assrs.* The Great Western Sugar Co. **4,206,242.** October 5, 1978; June 3, 1980. – Losses in storage are reduced by treating harvested beets with [<750 ppm (10-500 ppm) of] propylene [as a gas, or by dipping in or spraying with an aqueous solution (having a pH of 7-9)].

TRADE NOTICES

PUBLICATIONS RECEIVED

Bulk storage. Nils Weibull AB, P.O. Box 194, S-218 01 Hässleholm, Sweden.

Literature available from Nils Weibull AB describes the various types of bulk storage silos they supply for a variety of materials, including raw and white sugar. Apart from pamphlets describing particular types of silo, a reference list is also available which gives details of silos supplied by the company to many countries since 1933, most being for sugar storage.

Centrifugals. ASEA AB, Process Industries Division, S-721 83 Västeras, Sweden.

Pamphlets available from ASEA give details of ASEA-Weibull centrifugals, including their batch machines and the 3630 continuous centrifugal. In addition to technical information on the centrifugals, lists are available showing the many sugar manufacturing companies that have bought ASEA-Weibull equipment.

Waste water purification. AB Sorigona, P.O. Box 134, S-245 00 Staffanstorp, Sweden.

The Anamet process is the result of research work begun by the Swedish Sugar Co. in 1970 and is now available from AB Sorigona, a sister company. Based on the use of anaerobic micro-organisms to convert waste water pollutants into gases, mostly methane and carbon dioxide, which are then separated from the water, the Anamet system has been supplied to many beet sugar factories in various countries, and plants are under construction at a number of locations for treatment of e.g. vinasse and beet sugar factory waste water. Literature describing the process is available from AB Sorigona.

Autocane. Edwards Engineering Corporation, 7400 Townsend Place, New Orleans, LA 70126, USA.

A new leaflet from Edwards Engineering describes the Mark V Autocane system for automatic operation of cane carriers and tables, which has override facility to prevent knife chokes, incorporates reliable pneumatic controls, and is provided with high-torque, low-speed or low torque, high-speed drive assemblies.

Fermentation alcohol. Tate & Lyle Process Technology, 55 Liddon Rd., Bromley BR1 2SR, England.

A new brochure has been produced which illustrates the latest developments by Tate & Lyle Process Technology in the fermentation alcohol industry. A full-colour flow chart identifies where T & L Talo technology can be applied to processes using a number of alternative feedstocks, as well as highlighting applications to effluent treatment and by-product recovery. Apart from dramatic reductions in clarification costs, Talo technology has made possible a higher yeast yield with a more efficient yeast recycle, a reduction in still column scaling and a decrease in effluent treatment costs.

"Black makes white". Norit NV, 3800 AC Amersfoort, Postbus 105, Holland.

A 16-page brochure available from Norit describes how activated carbon works, how it is made and the many applications where it is used; the activities of Norit NV in the manufacture of activated carbon and in associated developments, such as that of a fluidized-bed reactivation furnace that can be installed on the client's site, are also outlined.

"Maguin Info". Soc. Nouvelle des Ets. A. Maguin, B.P.1, Charmes, 02800 La Fère, France.

Issue No. 5 of "Maguin Info" describes three new Maguin innovations for the beet sugar factory: a modification to the conventional juice spraying system in a De Smet diffuser, a prescalder system in which juice is sprayed onto the cossettes as they travel along a conveyor made up of stainless steel plates (the juice flowing twice through the cossette bed), and a pre-washer intended to raise the efficiency of conventional beet washers.

Green cane harvester. Claas OHG, Postfach 1140, D-4834 Harsewinkel 1, Germany.

Pamphlets available from Claas OHG describe their CC 1400 cane harvester developed specifically to handle green cane (in 1981 it harvested over 5 million tonnes of such cane) and its application, in association with Tullner Zuckerfabrik AG, in Austria, in sweet sorghum harvesting trials, for which the harvester was modified.

Gears. David Brown Gear Industries Ltd., Park Gear Works, Huddersfield HD4 5DD, England.

"Precision gearing for industry" is the title of a new brochure published by David Brown giving details of nine types of medium- and high-quality loose gears, including spur gears, clutch gears, single and double helical gears, epicyclic gears, worm gears, straight and spiral bevel and hypoid gears, and sprockets.

Sweetener technology. Finnsugar Engineering, Finnish Sugar Co. Ltd., SF-02460 Kantvik, Finland.

Three new brochures available from Finnsugar Engineering are entitled "Sugar from starch", "Sweetener technology" and "Sugar refining process". They describe the many aspects in which the company contributes to improvement in technology such as in the manufacture of maltose syrups, high conversion syrups, dextrose syrups, 42% high fructose syrup and 55% enriched fructose syrup, liquid and crystal sugar manufacture from beet or cane molasses using the well-known molasses desugaring process, and in refining of cane and beet raw sugar, for which Finnsugar Engineering offers syrup purification and decolorization systems, microprocessor-based control systems and individual items of refinery equipment.

Chemap equipment. Chemap AG, Alte Landstrasse 415, P.O. Box, CH-8708, Switzerland.

A brochure produced in connexion with the ACHEMA-82 exhibition gives descriptions and photographs of the various pieces of filtration equipment produced by Chemap AG, including the new Fundabac vertical pressure filter for use in refining and filtration of 1st and 2nd carbonatation juices, the Funda filter (also a vertical pressure type), Chemap cell culture equipment and fermenters, and Fundafoam foam separator for fermentation and other applications.

Ivory Coast sugar factory. – SODESUCRE have signed the final acceptance document for the Zuenoula sugar factory set up by Abay S.A. in association with the Dutch consultants, HVA International BV. Abay was responsible for all the studies and the factory design, supply of the equipment, supervision of the construction work and start-up of the factory, which has a crushing capacity of 4000 tcd.

New activated carbon plant in UK. – On May 25 a new activated carbon plant was officially opened on behalf of Norit NV. The factory, built on the site of the former Clyde Iron Works in Glasgow, Scotland, will produce grades of carbon that are particularly suitable for use in the food industry, including sugar and glucose manufacture. One of the world's leading authorities on carbon chemistry, Professor P. L. Walker, Jr., of Pennsylvania State University, attended the opening and gave a talk on new developments in activated carbon.

Indonesian contracts for Tate & Lyle. – The Indonesian Government has awarded three contracts to Tate & Lyle Agribusiness for the supply of agricultural equipment to three new sugar cane plantations in Sumatra. TLA are coordinating supplies, training services and finance for a group of leading manufacturers, including Ford Motor Co. Ltd., County Commercial Cars Ltd. and Ransomes, Sims & Jefferies Ltd. of the UK, Claas OHG of West Germany, and Bonel Brothers Pty. Ltd. of Australia. The three projects are part of Indonesia's crash program to become self-sufficient in sugar; the new estates will be developed in areas not previously used for cane cultivation, so that coordinated supply of equipment and training is of prime importance. County Commercial Cars Ltd. have announced receipt of orders valued at about £1 million for the supply of four-wheel-drive tractors to Indonesia for use on sugar cane plantations; the tractors will range in power from 80 to 150 hp.

Filter order from Ireland. – M & M-Schenk Filters Ltd. have recently received a contract for the supply of four horizontal plate filters, having centrifugal means of cake discharge, to the Irish Sugar Co. Ltd. The order is worth £152,000.

ISSCT 18th Congress

The program for the 18th Congress of the International Society of Sugar Cane Technologists, to be held in Havana in February 1983, has been announced, as follows:

February 18	Registration and evening cocktail party.
February 19	Agriculture group visit to Mechanization and Field Day of the Cuban Sugar Research Institute; Factory group visit to Central 30 de Noviembre and the Soroa Tourist Centre; opening of the Congress Exhibition in the evening.
February 20	Agriculture group visit either to the Jovellanos Sugar Cane Experiment Station or to plants at Holguín for the manufacture of cane harvesters and agricultural implements, with afternoon free; Factory group visit either to Central Camilo Cienfuegos, its refinery and particle board plant and to Santa Cruz distillery, or to the Cuban Sugar Research Institute, the Cuba-9 pulp and paper research centre and the Cuba-10 development centre for fermentation and nutrition. Registration for members undertaking the partial program.
February 21	Congress official opening and plenary session in the morning, followed by technical sessions in the afternoon. Official dinner with Cuban artistic floor show.
February 22-25	Technical sessions, held in the Palace of Conventions.
February 26	Closing plenary session in the morning with afternoon free and farewell banquet in the evening with floor show in the Tropicana night club.

All persons wishing to attend must be members of the Society who shall have been admitted no later than 30 days before the official opening of the Congress. Membership costs US $15 for individuals, while a further $85 is required if the member wishes to receive a copy of the Proceedings. The member wishing to attend must complete a registration form, obtainable from the Secretary-Treasurer (or perhaps through his local Society of Cane Sugar Technologists) and send it to Havana together with the cost of the package deal chosen. The package deal cost for the complete program is $1100 (single room occupancy) or $950 (double room occupancy); $850 or $740 for the partial program, single or double room occupancy, respectively; and $750 for the ladies program provided for wives of members accompanying their husbands. The payments may be made in sterling or in Canadian, Swiss, French, Spanish, Mexican, West German, Belgian, Dutch, Swedish, Danish, Norwegian, Finnish, Austrian, Portuguese, Venezuelan, Panamanian, Italian or Japanese currency, and should be addressed to:

The General Secretary-Treasurer, ISSCT,
c/o ATAC, P.O. Box 4063,
Havana, Cuba.

Nicaragua sugar factory. – It is reported[1] that a sugar factory is under construction near the Nicaraguan capital, Managua. The factory, built with Cuban aid, is planned for completion by the end of 1984 and will produce 125,000 tonnes of sugar annually as well as 54,000 tonnes of molasses.

US sugar exports, 1981[2]

	1981	1980	1979
	tonnes, raw value		
Algeria	0	23,631	0
Bahamas	3,958	4,480	1,520
Barbados	1,926	2	6
Belize	357	0	5
Bermuda	459	118	48
Canada	10,121	13,121	3,767
Chile	19,081	69,149	0
Costa Rica	4,389	1	1
Dutch West Indies & Surinam	5,689	5,191	3,906
Egypt	23,043	23,687	3
Haiti	7,256	34	2
India	69,100	1	0
Indonesia	25,689	3	18
Iran	15,516	0	0
Iraq	14,309	12,359	0
Israel	4,566	19	0
Jamaica	12,884	3,264	1,366
Japan	8,051	5	5
Jordan	26,025	14,011	0
Mexico	289,206	209,268	211
Peru	123,732	48,695	0
Portugal	13,650	13,083	34
Syria	12,305	14,826	0
Trinidad	17,648	20,852	1
Turkey	80,128	11,800	0
USSR	38,560	8,180	0
Venezuela	111,503	85,056	4
Other countries	9,356	6,213	3,413
	948,507	587,049	14,310

Ivory Coast export quota. – The International Sugar Organization is stated[3] to have agreed on an extra 15,000 tonnes export quota for the Ivory Coast this year to reflect its increased production capacity. The quota now starts at 85,000 tonnes.

Cane fires in Dominican Republic. – Fires, started deliberately, are reported[4] to have caused the loss of some 67,000 tonnes of sugar in the south-east of the Dominican Republic. The plantations involved supply cane to Boca Chica, Quisqueya, Consuelo, Ozama and Porvenir mills in San Pedro de Macoris.

EEC sugar import quotas[5]. – The Ivory Coast has asked the EEC to grant it a sugar export quota under the Lomé Convention Sugar Protocol; this follows expansion of its sugar production capacity to an estimated annual exportable surplus of 100,000 tonnes. Although the Ivory Coast has not yet asked for a specific quota, its request was seen by EEC Commission officials as likely to pose serious problems, since its sugar production costs were much higher than EEC guaranteed prices. The Congo and Kenya have also asked to rejoin the Protocol following cancellation of their quotas when they failed to deliver the permitted exports. Zimbabwe has been given special status under the terms of the Lomé Convention[6], whereby it will be entitled to ship 6000 tonnes of sugar to the EEC during the balance of the 1981/82 sugar year (April-June), with a 25,000 tonnes quota set for 1982/83.

GEPLACEA meeting in Nicaragua[7]. – A 4-day meeting of GEPLACEA (the Group of Latin American and Caribbean Sugar Exporting Countries) began in Nicaragua on April 26. Its marketing head, José Lago, had earlier said that the depressed state of the world market, the possible EEC membership of the International Sugar Organization, President Reagan's Caribbean Basin aid plan (which could allow duty-free imports of sugar from the Dominican Republic, Panama and Guatemala) and an extension of the International Sugar Agreement would be discussed.

Afghanistan sugar production decline[8]. – According to reports from Moscow, sugar production has declined from 11,200 tonnes, white value, in 1977/78 to 8700 tonnes in 1979/80 and 5000 tonnes in 1981/82.

1 *Die Lebensmittelind.*, 1982, **28**, 50.
2 *I.S.O. Stat. Bull.*, 1982, **41**, (3), 43-44.
3 *Public Ledger*, 1982, May 1.
4 *Reuter Sugar Newsletter*, 1982, March 29.
5 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 222-223.
6 *Public Ledger's Commodity Week*, 1982, May 1.
7 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 226.
8 *Zuckerind.*, 1982, **107**, 464.

Canada sugar imports, 1981[1]

	1981	1980
	tonnes, tel quel	
Raw sugar		
Australia	281,778	355,936
Commonwealth Africa	27,906	0
Cuba	303,928	276,299
Fiji	0	20,004
Guyana	10,119	41,548
South Africa	225,800	164,786
Other countries	21	13
	849,552	858,586
Refined sugar		
USA	6,616	13,910
Other countries	165	1,114
	6,781	15,024

Cuban sugar industry investment[2]. – More than 25 million pesos has been earmarked for investment in the sugar industry of Cienfuegos province; of this sum, some 15 million pesos is to be used to complete and start-up the twelfth sugar factory to be built in the province. Almost 7 million pesos is being invested in the 13 sugar factories of Camagüey province, the bulk of the money being spent on equipment replacement in seven factories (particularly Ignacio Agramonte mill). A fourteenth mill, the Jesús Suárez Gayol factory, is being built in Camagüey.

Czechoslovakia sugar yield improvement program. – In recent years sugar production in Czechoslovakia has been stagnating; in 1981 farmers produced only 6,825,000 tonnes of beet, 88% of the planned quantity, and the sugar content was low, largely owing to unfavourable weather, so that sugar production was 24% below the target. Greater attention is needed to the nutrition of the plants and a survey is therefore to start in 1982 of all fields on which beet is grown. Soil analyses are to be made to determine proper fertilizer recommendations, as well as trials to select the varieties best suited to the soils and climatic conditions. The work will be carried out over five years and it is hoped to achieve an average of 5 tonnes of sugar, white value, per hectare against 3.6 tonnes in the period 1976/80. It is thought that 6-7 tonnes per hectare may be obtained in 1990.

New borer-resistant cane variety[3]. – A new variety, Co 7314, has been released by plant breeders from Haryana Agricultural University and approved by the State Variety Release Committee. It has shown a yield of about 80 tonnes per hectare and is resistant to sugar cane borer attack. It ripens in the middle of November and possesses a fairly high sugar content.

Molasses de-ashing process[4]. – A new separation process for ash removal from molasses has been announced by the Desaltec Division of Ravel Investments Pty. Ltd., of Sydney, Australia. It involves passage of molasses through a nest of hollow fibres through the walls of which metallic ions such as those of K, Ca and Mg pass into a countercurrent of water, removing most of the ash content of the molasses in exchange for an approximately 10% dilution. Semi-commercial trials with a 60-tube module for desalting molasses at a distillery permitted a 10% increase in utilization of sugars, a 12% increase in alcohol concentration, a 50% reduction in batch fermentation time and a reduction in the quantity of vinasse. The module was able to treat 1.8 tonnes of molasses per hour.

New Pakistan sugar factory[5]. – An agreement for the supply of a complete sugar factory of 2000 tonnes daily cane crushing capacity, extendable to 3000 tonnes, was signed in Karachi on March 31 between Faran Sugar Mills and the Karachi Shipyard and Engineering Works in collaboration with Fives-Cail Babcock of France. The factory will be similar to that supplied by Fives-Cail Babcock for Thatta Sugar Mills and will be set up at Dhaikh Bhrikio in Hyderabad district.

Kenya sugar production decline[6]. – The US Agricultural Attaché in Kenya has said that the Kenya Sugar Authority is concerned that the decline in cane production may accelerate with farmers switching to more profitable crops. Total cane sugar production for calendar year 1982 is estimated at 360,000 tonnes, compared with 368,970 tonnes in 1981 and 401,291 tonnes in 1980. Substantial increases in production costs have eroded new producer price increases and this, combined with dry spells and frequent fires in the past two seasons, inadequate crushing capacity and land utilization policy, continue to affect growers' planting decisions, according to the Sugar Authority.

Fiji sugar exports, 1981[7]

	1981	1980	1979
	tonnes, raw value		
Canada	0	20,717	0
China	0	32,630	0
EEC	189,686	149,102	196,482
Japan	41,177	43,507	10,872
Malaysia	62,282	63,720	24,850
New Zealand	54,027	80,775	63,209
Singapore	26,470	16,574	16,567
USA	40,520	42,399	123,048
	141,162	449,424	435,028

Czechoslovakia cane mill exports. – Czechoslovakia will shortly be delivering a new mill to Burma which will be able to crush 1500 tonnes of cane per day, while a contract has recently been signed for the delivery of two mills to Peru. The ZVU Engineering Works in Hradec Kralove, Eastern Bohemia, and the Skoda Plzen Works produce sugar factories capable of processing from 50 up to 7000 tonnes of cane per day. Since World War II the country's biggest customer has been the Soviet Union where almost thirty sugar factories with a daily beet slicing capacity of 1200-1400 tonnes have been supplied with equipment from Hradec Kralove.

Environmental pollution symposium. – An international symposium on the "Food Industry and the Environment" is being organized in Budapest during September 9-11 under the auspices of the International Commission for Agricultural and Food Industries (CIIA), the International Union of Food Science and Technology and the Working Group – Food of the European Chemical Engineering Federation. The sugar industry is not specified as part of the program but would be covered in the section "Other industrial branches"; other industries treated individually are the canning, dairy and meat industries. Information is available from the CIIA at 35 rue du Général Foy, 75008 Paris, France.

Texas sugar crop, 1981/82. – The ninth Texas cane harvest began on October 15, 1981 and ended on April 17, 1982. During the 185-day period, 18.4 days were lost owing to wet weather. The Rio Grande Valley Sugar Growers Inc. factory had its second best production season, crushing 1,135,402 gross tonnes (1,049,906 net tonnes) of cane from 14,801 hectares (76.69 and 70.96 tonnes.ha^{-1}, respectively). The equivalent of 98,044 tonnes of 96° sugar were produced, i.e. 6.35 tonnes.ha^{-1}. The trash content averaged 7.53%, a record low level which is attributed to a concerted effort on the part of the personnel who maintained and operated the combine harvesters. All the crop was mechanically harvested, using 22 Claas machines, one Toft 6000 and two Toft 364 harvesters, handling on average 32.57 tonnes of gross cane and and 0.42 hectares per harvester hour. The rice borer, *Eoreuma loftini,* which menaced the crop in 1980/81, was controlled by proper timing and judicious application of Azinphos-methyl and Monocrotophos insecticides. The warm, wet autumn of 1981 delayed maturing of the crop and, before cold weather could build pol content, a frost on January 10 destroyed tops and growing points, although internal stalk damage was minimal. A unique system was installed at the factory in which all the mill juice was used to wash soil from the incoming billet cane before it was shredded, in order to reduce the damaging effects of sand on the mill rollers and in the boilers. A cyclone filter was then used to separate the particulate matter.

Fructose syrup plant in Germany[8]. – Starcosa GmbH, a member of the BMA Group, has delivered to Norddeutsche Zucker GmbH & Co. KG of Uelzen a plant for production of a syrup containing at least 95% fructose. The plant has been put into operation successfully at the Lehrte factory and employs an American process under licence for concentration of the fructose.

PERSONAL NOTES

Professor A. J. Vlitos is to make a comprehensive investigation of sweetener and carbohydrate research in North America, with effect from July 1. He will be based in Florida and will continue to serve as the Tate & Lyle Group's worldwide spokesman at Research Conferences and Seminars.

1 C. Czarnikow Ltd., *Sugar Review,* 1982, (1590), 54.
2 *Cuba Economic News,* 1981, (123), 12-13.
3 *Indian Sugar,* 1982, **31**, 657.
4 *Sugar J.,* 1982, **44**, (11), 20.
5 *Dawn* (Karachi), April 7, 1982.
6 F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 229.
7 *I.S.O. Stat. Bull.,* 1982, **41**, (2), 16.
8 *Starch/Stärke,* 1982, **34**, 180.

Index to Advertisers

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.

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 £0.20 per page includes air mail postage and payment should be sent with the order.

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 £30.00 for supply by surface mail. The additional cost for air mail will be quoted on application.

FIRST FOLD

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 .....

SECOND FOLD

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

FIRST FOLD

THIRD FOLD AND TUCK IN

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 .....

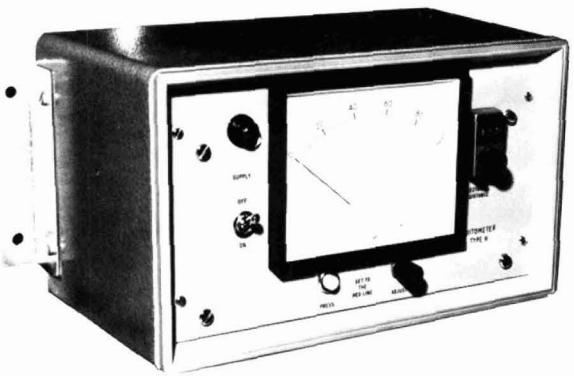
Date .....

I enclose cheque/draft/M.O./P.O. for £30.00.

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

Suma Products

VACUUM PAN CONTROL



The redesigned **CUITOMETER** type H incorporates solid state electronics. Three d.c. outputs are now provided so that the unit can be used either for manual or semi-automatic control. Provision for testing the instrument during operation is provided so that a greater degree of control is now available. A special sensitivity control device is incorporated so that the high purity syrups can also be controlled as well as low product boilings, thus increasing the scope of the instrument. A further modification lies in the fact that the instrument will now operate either from a 50 or 60 Hz supply single phase A.C. 110/125 or 220/240 V.

The **CRYSTALOSCOPE** crystal projection instrument enables the pan operator to view the crystal growth throughout the boiling cycle. The $8\frac{1}{2}$" diameter observation screen is fitted with a squared graticule each side of which represents 0.5mm. on the crystal surface. The instrument will fit into an aperture of $6\frac{1}{2}$" diam. in the pan wall and is held in position bv 8 equally spaced $\frac{5}{8}$" diam. bolts on $8\frac{3}{4}$" P.C.D. The magnification is ×30. Provision is made for the alteration in gap between the two observation ports and for focussing the crystals on the screen to give a sharp image over the entire screen area which is evenly illuminated. Operation is from a single phase A.C. 110/125 or 220/240V supply.

Write now for details of our complete range of factory and laboratory equipment.

The Sugar Manufacturers' Supply Co. Ltd.

18 CITY ROAD, LONDON, ENGLAND EC1Y 2AP

Telephone: 01-638 9331. *Cables: Vairon, London, Telex* *Telex: 886945*

AROUND THE WORLD, FABCON'S JSP TEAM INCREASES SUGAR RECOVERY AND QUALITY.

Sharp improvement in the clarity and purity of cane juice and syrup is helping sugar factories recover more sugar per ton cane, and with better quality results than before. The reason: Fabcon's JSP (Juice and Syrup Purification) team.

The JSP system combines two specially designed pieces of equipment—a Prefloc Tower and a Syrup Clarifier—working in tandem. With controlled use of chemical polymer and micronized air, this team is producing consistently higher-purity and lower-viscosity syrup. In addition, pol loss to molasses and mud is reduced, while boiling house capacity is increased in clarifiers, filters, pans and centrifugals.

South America Two years of commercial operation in three factories show an improvement in juice and syrup clarity as well as color, plus a 30% reduction in overall clarifier retention. In one factory alone, icumsa color of sugar has been reduced from 150+ to an average of 60 for the entire last crop.

Asia The first JSP system was commissioned November 1980, and achieved a sharp improvement in clarified juice purity, and quality. Clarified syrup purity is now averaging 2½% above mixed juice purity. Washed sugar quality is also outstanding.

Hawaii Our licensor, Davies Hamakua Sugar Company, commissioned their commercial syrup clarifier in November 1980 with excellent results, confirming the results of a four-year pilot plant study.

By returning dirty scum from the syrup clarifier to mixed juice, the Prefloc Tower works to homogenize, flocculate and compact all insoluble solids in scum, filtrate and mixed juice. An increase of 1%-2% in clarified juice purity, plus a reduction in ph drop of 50% or more is typical, with reduced costs for both lime and polymer. And the Prefloc Tower/Syrup Clarifier combination assures improved juice and syrup quality—all day and all night—without need of skilled operators.

Fabcon's technical staff has over six years experience installing, commissioning and operating JSP Systems internationally. Its expertise, plus guaranteed JSP performance is available to you today. Contact our San Francisco office for more information.

FABCON. THE NAME FOR INTEGRATED TECHNOLOGY.

Fabcon, Inc., 965 Mission St.,
San Francisco, Calif. 94103, U.S.A. Telex 34 0884