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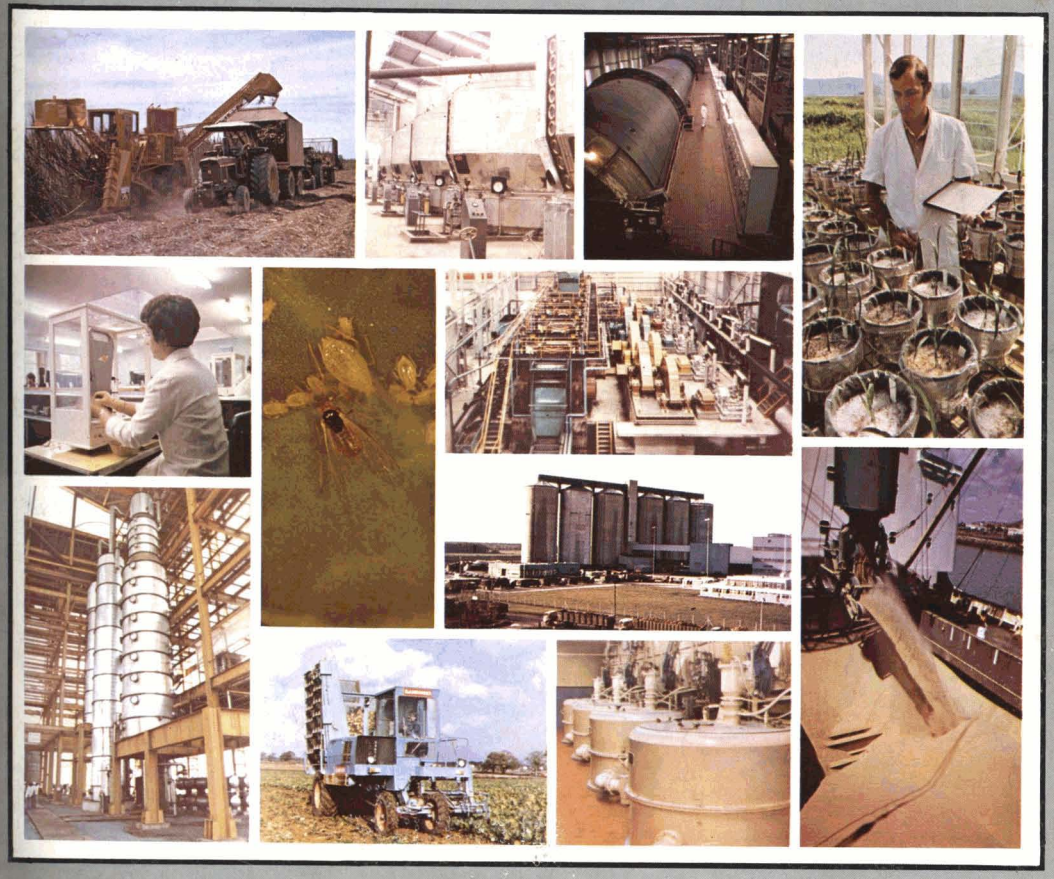

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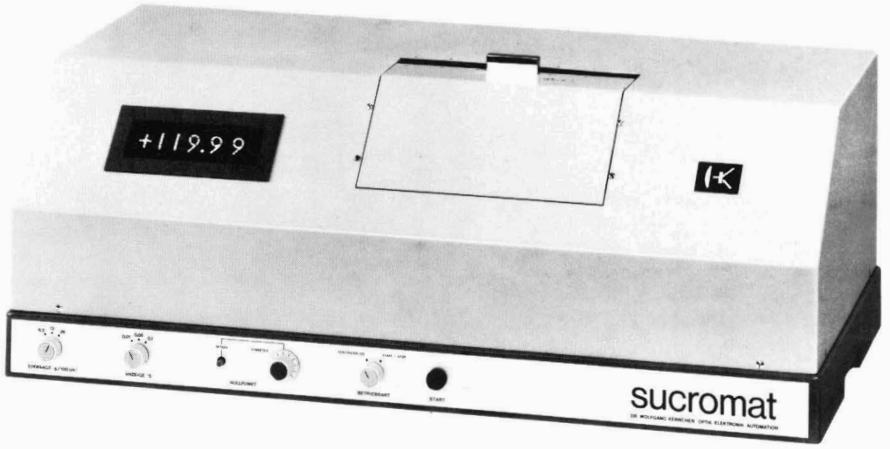

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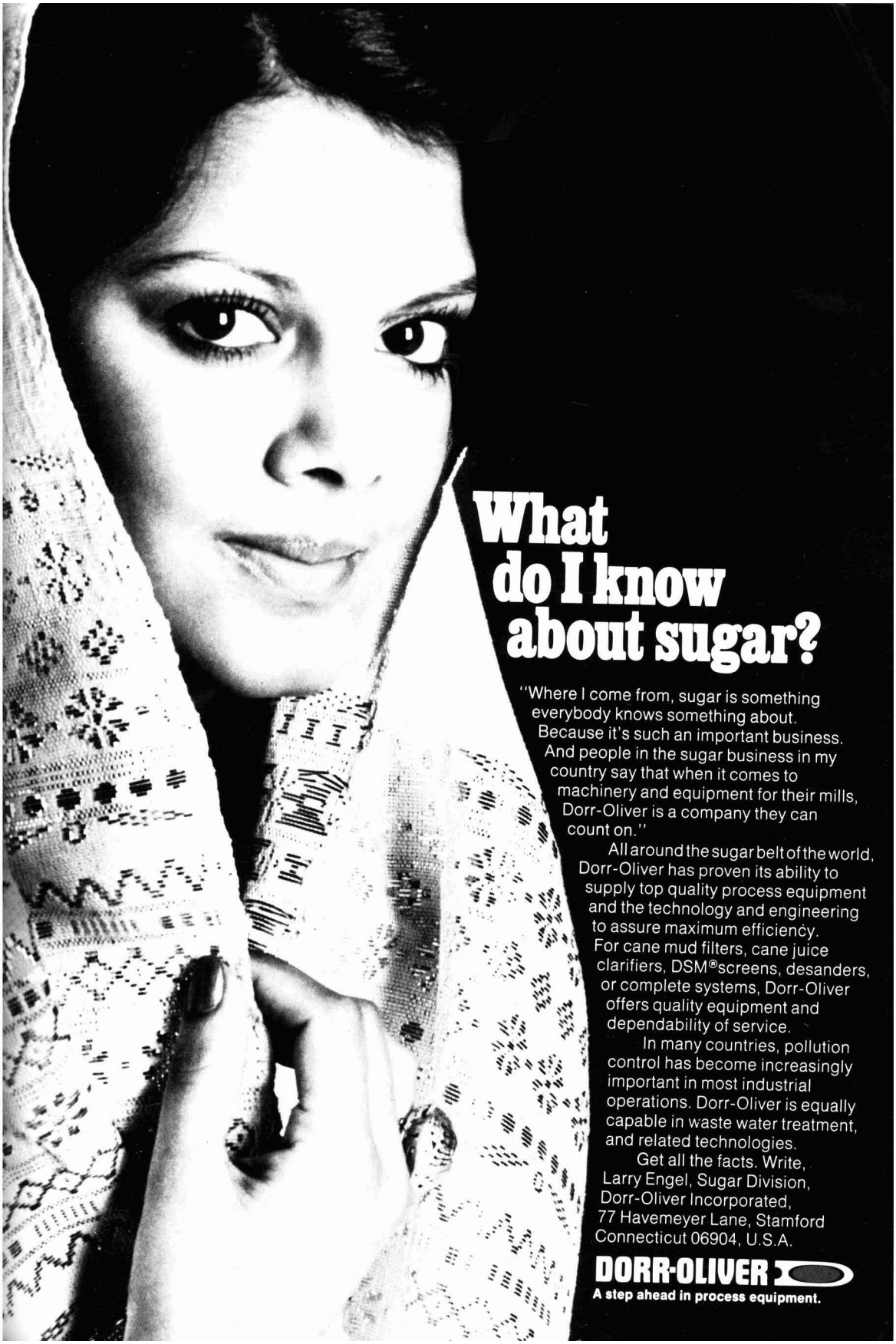
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NOTES AND COMMENTS

USDA views on the sugar situation

At its 1981 Agricultural Outlook Conference in Washington in November, A. E. Gilbert of the Foreign Agricultural Service of the US Dept. of Agriculture, noted that a world sugar output estimated at 87.5 million tonnes, raw value, for 1980/81 represented an increase of almost 4% above the 84.2 million tonnes of 1979/80 but nevertheless meant a further reduction of stocks by about 3 million tonnes. High prices brought about by the tight supply position could further reduce demand as they seem to have done in 1979/80 but it appears that the upward trend in prices will continue at least until mid-1981 and perhaps longer, depending on the then prevailing crop prospects for 1981/82.

The most important factors in the world situation are conditions in the Soviet Union and Cuba; both are indicated as being poor and the USSR is likely to have to import heavily. While officials in Brazil maintain that the alcohol program will continue no matter what the world sugar situation, the lure of foreign exchange earnings could bring about a change in that policy; on the other hand, Brazil has publicly indicated that, in the event of any permanent shut-off in its oil supplies from the Middle East, it might have to divert more of its cane to alcohol, leaving less sugar for export.

R. Barry and F. Gray, of the USDA Economics & Statistics Service, indicated that the tide of world sugar prices will continue to rise over the next few months and that US prices would be swept with that tide. The crest could come next summer, depending on world production prospects, but if 1981/82 world production does not rise enough to cover consumption, prices will maintain momentum and a downswing in the sugar cycle may not start until 1982. Even if there were an approximate balance of production and consumption in 1981/82, US raw sugar prices would still be expected to average substantially above the 1980 average of around 30 cents/lb; it would not be surprising to see raw sugar prices averaging over 40 cents for the year.

EEC sugar regime proposals and the sugar market

The EEC Farm Ministers met on November 11 and discussed the Commission's proposals for the new sugar regime to start in July 1981. Most were unacceptable to one member or another for different reasons and further discussions were postponed until another meeting in December. Most members are reported, however, to support in principle the idea of applying for Community membership of the International Sugar Agreement, but France remains firmly opposed to the notion, except on specific conditions, including adequate information on stocks held by producers and a sufficient overall stock level. At the meetings on December 9 and 18 the deadlock continued over the new regime proposals, the Farm Ministers being unable to reach agreement.

World Sugar Journal recently commented[1] that the Commission's proposals did not aim to increase sugar production as in the early 1970's when a similar supply situation to the present existed. They do not, however, attempt to remedy the situation whereby the EEC exports considerably more sugar than it imports from the ACP countries so that, in the normal times of ample supplies, it contributes to depressed prices which harm the economies of developing countries including those which it is supposed to be aiding by buying their sugar.

"On the contrary, the EEC wishes to acquire about 20% of the world sugar market more or less on a permanent basis. This is clearly implicit in the conditions which the EEC put forward in order to enable it to join the ISA. The internal consequences of the Commission's sugar proposals primarily refer to the refining of and outlets for ACP sugar within the EEC. Almost all of the ACP sugar is imported by the UK. Plenty of refining capacity is at the moment available to refine the ACP raw sugar. The question, however, is what to do with that sugar after it has been refined? If domestic sugar is produced in increasing quantities, in this case in the UK, would this not reduce the outlets for refined ACP sugar? If there are only limited outlets for ACP refined sugar would it be reasonable to assume that the existing refining capacity could be maintained on a permanent basis? If the EEC forces the closure of the refineries by the sugar policies which it adopts how does it intend to continue to fulfil its obligations to the ACP countries under the Lomé Convention of 1975?

"The solution to the questions raised above is for the EEC to set its domestic production at such a level that it will be fair and remunerative to all sectors of the sugar industry, both within and outside of the EEC. Proposals put forward by the Commission are heavily balanced in favour of the domestic producers and against the tax-payers and refiners of the ACP sugar, as well as all other exporters to the free market. Furthermore, implementation of these proposals is likely to create almost insurmountable problems for the EEC to join the ISA."

World sugar balance 1980/81

F. O. Licht GmbH have published their first estimate of the world sugar balance for 1980/81[2] and this is reproduced below, with corresponding figures for the two previous crop years, extending between September and August in each case.

	1980/81	1979/80	1978/79
	tonnes, raw value		
Initial stocks	25,610,000	31,438,000	30,358,000
Production	86,570,000	84,755,000	91,337,000
Imports	27,583,000	29,777,000	27,149,000
	139,763,000	145,970,000	148,844,000
Exports	27,192,000	30,173,000	27,603,000
Consumption	90,359,000	90,187,000	89,803,000
Final stocks	22,212,000	25,610,000	31,438,000
Production increase or decrease	+1,815,000	− 6,582,000	+ 285,000
(%)	(+2.15)	(−7.20)	(+0.32)
Consumption increase	+ 172,000	+ 384,000	+4,333,000
(%)	(+0.20)	(+0.43)	(+5.08)
Final stocks % consumption	24.58	28.40	35.01

This initial forecast suggests a deficit of 3.8 million tonnes in 1980/81 and a final stock figure at a near-critical level. There are very many unknowns included, however, since detailed statistics of production and stock levels are not readily available from many countries. But conditions indicated by the balance

[1] 1980, **3**, (5), 4-5.
[2] *International Sugar Rpt.*, 1980, **112**, 671.

would favour high sugar price levels and these will affect consumption in many countries, particularly of the third world. While some of the fall in per caput consumption, revealed by the tiny rises in total consumption from 1978/79 to 1980/81, will undoubtedly be true reductions by diversion to HFCS, the bulk will be a price-induced restraint which will be released when prices return to lower levels.

Corn sweetener use in the USA

A survey of the outlook for corn sweetener use in the USA[1] was presented to the 1981 Agricultural Outlook Conference in Washington by Steve Vuilleumier of McKeany-Flavell Co. Inc., a prominent sweetener broker. He included a table, based on McKeany-Flavell's information and Census Bureau data, which indicates that of a total per caput sweetener usage of 130.9 lb in 1985 (against 122.7 lb in 1970 and 129.9 lb in 1980), sucrose usage will have fallen to 68.7 lb (against 103.2 and 87.6lb, respectively). Corn sweetener usage will reach 47.5% of the total against only 15.9% in 1970 and 32.6% in 1980. Almost all of this is accounted for by the growth in HFCS consumption.

The pattern of the HFCS generation product is also changing; in 1978 the 42% levulose product was 89% of total usage and reduced to 67% in 1980; it is expected to fall to 41% in 1985, the balance in all cases being the second generation 55% levulose syrup. Sales of 90% HFCS are very limited, mostly to the health food industry, whereas the other two products are used in the beverage, baking and canning industries. In 1980, HFCS was used as sweetener in 31% of the beverage market in the US, equivalent to 1,100,000 short tons out of 2,460,000 tons total usage; in the long term it is expected to take 90% of this market.

Another market opening for corn sweeteners in the US is as a feedstock for alcohol production, which is being encouraged by the government. Three plants are in construction which will be able to produce a total of 360 million US gallons per year and others are projected. With a potential for sales of one-tenth of US gasoline usage (110,000 million gallons in 1979), the 500-700 million gallons of alcohol which may be produced for fuel usage in 1983/85 would represent only 5% of this market. Future development will depend on government incentives for production, the development of the synthetic fuels program and the economics involved.

Greece and the EEC

From January 1, Greece became a member of the European Economic Community and a last-minute agreement was reached in December on the precise terms of the new member's accession. These terms have been approved by all members except France and approval from Paris was expected to be received by the beginning of the year. In respect of sugar, Greece had asked for a higher quota than the Nine had originally proposed.

Enlargement of the Community can only compound the difficulty which has arisen in a number of areas, and particularly in respect of the sugar regime, where agreement has to be reached among all members on conditions to apply to the Community as a whole. Because of the clash of national interests, the new regime, which should have taken effect in July 1980, has been postponed until July 1981 and no progress has been made in resolving the different national views of members so that the situation remains deadlocked. Addition of a tenth interest (and two more when Spain and Portugal become members, anticipated in 1983) can only complicate matters. It is to be hoped that some way will be found to get round the problem before the resultant delays make the idea of "community" a poor joke.

World sugar prices

December was one of the most spectacular months ever in respect of sugar prices. Having started the month £100 down from the year's highs, at £313, the LDP sank to £245 on December 12 but had recovered in two days to £295 and then to £310 by December 22, followed by another fall to end the month at £280. The LDP(W) which started at £340 on December 1 fell to a low of £269 with the LDP, recovered on December 16 to £317 and to £332 on December 23, finishing the month at £310.

With no changes in the statistical situation or major news affecting the market, it was apparent that other factors were causing the violent fall during the first two weeks of the month, and the rise in US interest rates is considered to have been largely responsible because of the greater attractiveness of money holdings and the higher cost of holding long-term market positions. Speculators moved out of sugar but this was virtually complete by the middle of the month, as evidenced by the lack of response when US interest rates moved to yet higher levels.

At the end of the month, the lower prices are likely to have been due to increased strength of sterling, lack of physical enquiries over the Christmas period and perhaps by reports of likely reductions in offtake by Japanese and other consumers as a consequence of high prices. The statistical situation may not be quite as bad as has been considered in recent months, since consumption is proving surprisingly elastic. Nevertheless, most observers see a further reduction of stocks in 1980/81 to critical levels and higher prices in the period up to the autumn of 1981 when more information on prospects for 1981/82 becomes available.

Portugal and the EEC[2]

Portugal is optimistic that it has persuaded the EEC to consider its application for membership of the Community separately from that of Spain. The country's chief EEC negotiator has presented a dossier which spelled out why the two applications should be treated separately. Agreement has been reached on cane sugar imports into Portugal; the Nine recognised that Portugal traditionally relies very heavily on such imports in agreeing to exempt the country from paying a levy on such imports after it has joined the Common Market. As Portugese sugar consumption represents only 2.5% of EEC production, forcing Portugal to substitute Community beet sugar would have little effect on the EEC's surplus.

Cuba sugar expansion plans

Cuba plans to produce 20 – 25% more sugar in the Five-year Plan to 1985, by comparison with the total of 35 million tonnes produced in 1976/80, according to President Castro. Milling capacity is to be raised by 13½ – 15%.

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[1] *MF Sweetener News,* November 18, 1980.

[2] *Public Ledger's Commodity Week,* December 27, 1980.

Ultrafiltration of cane juice

Influence of flux and quality of permeate

By SHIRO KISHIHARA, SATOSHI FUJII and MASAHIKO KOMOTO
(Department of Agricultural Chemistry, Faculty of Agriculture, Kobe University, Rokkodai 1, Nada-ku, Kobe 657, Japan)

Introduction

Raw juice obtained by crushing sugar cane contains various impurities including reducing sugars, organic acids, amino acids, protein, starch, gums, colouring matter and other suspended materials, along with sucrose. Clarification of juice in raw sugar manufacture is mainly done by liming, while in refineries a combination of purification processes such as affination, carbonatation, phosphatation and treatments with active carbon, bone char and ion exchange resin is practised. Purification of refinery liquor is mainly focused on elimination of colour which impairs the quality of the final product. The sugar industry still faces problems with polysaccharide impurities such as starch, dextran and arabinogalactan which exist in granulated cane sugar as reported by Roberts *et al.*[1]. It was reported by Clarke *et al.*[2] that these substances form floc on combination with protein in carbonated beverages. Liuzzo *et al.*[3] suggested that the floc-causing substance is primarily an amylose-related substance which can form complexes with a number of other compounds. Roberts *et al.*[4] and Miki *et al.*[5] concluded that polysaccharides of arabinogalactan type may be implicated in floc formation. These polysaccharides being insoluble in ethanol, the alcohol floc test[6] may be used to measure the floc or turbidity. Shinohara & Kadoda[7] reported that a similar sugar component was to be found in the acidified-ethanol-insoluble substances isolated from raw cane sugar and granulated cane sugar and showed a similar infra-red spectrum to those of floc isolated from carbonated beverages.

Bottlers have always wanted to acquire a superior grade of sugar free from the floc-causing substances. Recently purification and/or concentration by ultrafiltration has been gaining in importance and its use in the food industry is being extended, owing to its low consumption of energy and simplicity of operation. It is thought that ultrafiltration of sugar cane juice effectively eliminates macro-molecular impurities such as protein, starch and colouring matter. Madsen[8,9] reported that mixed juice and cold-limed juice (pH 7.2) were efficiently clarified by ultrafiltration and the permeation flux of cold-limed juice was the same as that of mixed juice, but ultrafiltration of clarified juice from simple defecation was impossible owing to a sharp decline in the flux caused by a yellowish-red deposit, possibly a wax, on the membrane.

It is thought that wax from the cane stalk and suspended materials in the juice could affect unfavourably the flux during ultrafiltration. It is very important to obtain high flux for commercializing the ultrafiltration technique. The present study was undertaken to improve the flux in ultrafiltration by various pre-treatments of the sugar cane stalk and of expressed raw juice. Colouring matter, starch and acidified-ethanol-insoluble substances in the ultrafiltrate, which are not so easy to eliminate by means of conventional juice purification, were further examined and compared with those in the juice clarified by lime defecation.

Materials and methods

Sugar cane varieties N:Co 310 and Ni-1, grown in a greenhouse of Kobe University, were used. The pretreatments were as follows:

(1) Treatment of sugar cane

The sugar cane was divided into 3 lots which were treated as below:

(i) Intact.

(ii) Wax removed by rubbing the sugar cane stalks with chloroform-soaked cotton.

(iii) The epidermis removed with a knife.

(2) Treatment of raw juice

The juice was expressed separately from each lot using an experimental mill and filtered through muslin cloth. The raw juice obtained from the first lot (intact sugar cane) was further divided into 5 parts and treated as below:

(i) Untreated.

(ii) Suspended matter partially removed by centrifuging at 21,000 g for 30 minutes.

(iii) Addition of sodium polyacrylate (Aronvis, Nihon Zyunyaku Co., Tokyo, Japan) (0.5 g per litre).

(iv) Addition of α-amylase (Neospitase, Nagase Sangyo Co., Osaka, Japan) (20 mg per litre) followed by heating for 1 hour at 60°C.

1 *Sugar J.*, 1978, **40**, (9) 21-23.
2 *I.S.J.*, 1978, **80**, 197-202.
3 *J. Food Sci.*, 1977, **42**, 834-838.
4 *I.S.J.*, 1976, **78**, 163-165.
5 *ibid.*, 1975, **77**, 67-69.
6 *Proc. 14th Session ICUMSA*, 1966, 113.
7 *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1976, **26**, 53-60.
8 *I.S.J.*, 1973, **75**, 163-167.
9 U.S. Patent 3,799,806; *I.S.J.*, 1975, **77**, 252.

S. Kishihara,

S. Fujii

M. Komoto

(v) Addition of powdered lime. (a) Liming the juice to pH of 8.0. (b) Liming the juice to pH of 8.0 followed by boiling. (c) Boiling the juice followed by liming to pH of 8.0. (d) Liming the juice to adjust pH to a range between 5.4 and 12.

(a), (b) and (c) were used for comparison with other pre-treatments and (d) for examination of the effect of quantity of lime added on the flux.

Operation and conditions for ultrafiltration

The apparatus used for ultrafiltration is shown in Fig. 1 and membranes used during the test are listed in Table I. The effective membrane area was 36.3 cm^3. The sample juice was ultrafiltered at 30°C or 60°C with stirring speed of 1100 rpm and operating pressure from 1 to 4 $kg.cm^{-2}$. Flux was calculated on basis of the first 20 cm^3 of permeate in all the cases. The permeate collected after discarding the first 20 cm^3 was used for further analyses in order to avoid the effect of presence of water under the membrane at the start of ultrafiltration.

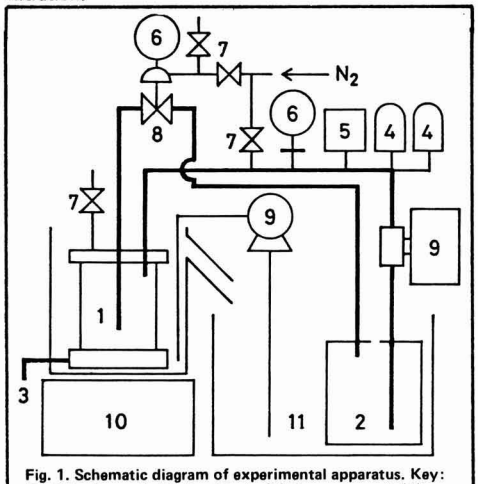


Fig. 1. Schematic diagram of experimental apparatus. Key: (1) Filtration cell, (2) Feed tank, (3) Permeate port, (4) Accumulator, (5) Pressure switch, (6) Pressure gauge, (7) Valve, (8) Back pressure regulator, (9) Pump, (10) Magnetic stirrer, (11) Constant temperature bath.

Table I. Characteristics of membranes used

Membrane	Manufacturer	Molecular weight cut-off	Water permeability*
G-05T	Bio-Engineering	5,000	0.029
PM-10	Amicon	10,000	0.055
PM-30	Amicon	30,000	0.111
UK-200	Toyo Roshi	200,000	0.153
XM-300	Amicon	300,000	0.467

* Flux [$cm^3.cm^{-2}.min^{-1}.(kg.cm^{-2})^{-1}$] of water at 15°C and at 1 $kg.cm^{-2}$

Determination of Brix and purity

Brix of the juice was measured using an Abbé refractometer. Pol was measured using a saccharimeter after clarification with dry basic lead acetate in the case of raw juice and juice clarified by lime defecation, and without clarification in the case of ultrafiltered juice. Purity was calculated from the Brix and pol.

Determination of colour value

The absorbance (E) of the juice at 560 nm was recorded and the colour value was calculated using the following formula:

$$\text{Colour value} = \frac{E}{l \times C}$$

where l is thickness in centimetres of the absorbing solution and C is solids concentration in grams per millilitre of the solution.

Determination of starch

Starch was determined iodometrically as recommended by ICUMSA[10].

Determination of acidified-ethanol-insoluble substances[7]

Five volumes of acidified ethanol (5 parts of 95% ethanol + 1 part of 1:1 HCl) were added to the pre-adjusted 50°Brix sample solution, mixed thoroughly and allowed to stand for 1 hour. Acidified-ethanol-insoluble substances were measured from the turbidity which appeared. This turbidity was expressed as transmittance of the solution at 720 nm and a calibration curve was prepared by using acidified-ethanol-insoluble and hot water-soluble substances isolated from granulated cane sugar as reference materials.

Precipitation test with lime

A precipitation test was carried out in a 16mm dia. test tube by placing 20 cm^3 of the raw juice in it and adjusting the pH between 5.4 and 12 by adding lime, followed by allowing to stand for 24 hours. The height of precipitate attained in the test tube was divided by the total height of solution and plotted against the pH.

Results and discussion

Crushing in the experimental mill gave an extraction of 57% on a weight basis. The juice so obtained was of 21.7° Brix, pH 5.4 and 90.3° purity.

Effect of cane stalk treatments on the flux

Effect on the flux of wax and epidermis removal is shown in Table II. The epidermis removal treatment was in order to ensure complete removal of wax. The fluxes of juice from de-waxed and derinded sugar cane were almost identical with that of juice from the intact cane. This indicates that the wax has no significant effect on the flux of raw juice, and contrasts with Madsen's observation[8] that a sharp drop in flux was due to a wax deposit on the surface of the membrane when juice from simple defecation was used.

Table II. Effect of treatment of sugar cane on flux (Ni-I, PM-10, 30°C)

Pre-treatment	Flux ($cm^3.cm^{-2}.min^{-1}$)
No treatment	0.027
Wax removal	0.025
Epidermis removal	0.027

Effect of treatments of raw juice on the flux

The fluxes of variously treated juices are summarized in Table III. The fluxes of untreated raw juice through PM-10 membrane were approximately 25% of those of a 22% sucrose solution which were 0.107 and 0.202 $cm^3.cm^{-2}.min^{-1}$ at 30° and 60°C, respectively. Partial removal of suspended materials by centrifugation showed minor positive effect on the flux. Addition of

[10] *Proc. 15th Session ICUMSA*, 1970, 317-320.

sodium polyacrylate, which insufficiently coagulated colloidal substances, had no effect on the flux. Addition of α-amylase to hydrolyse starch in the raw juice also showed no effect on the flux. The flux increased almost double on liming the juice to pH 8.0 in all cases. The results showed that the addition of lime was effective for the improvement of flux.

Table III. Effect of treatment of raw juice on flux (PM-10)

	Pre-treatment	Flux ($cm^3.cm^{-2}.min^{-1}$) at 30°C	at 60°C
Ni-1	No treatment	0.027	0.055
	Centrifugation	0.034	—
	Addition of sodium polyacrylate	0.027	—
	Addition of α-amylase	—	0.055
	Liming	0.054	0.103
	Liming followed by boiling	0.056	0.099
N:Co 310	Liming followed by boiling	—	0.110
	Boiling followed by liming	—	0.111

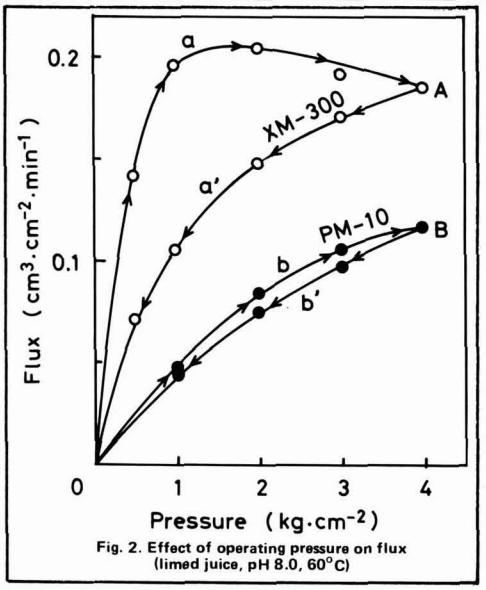


Fig. 2. Effect of operating pressure on flux (limed juice, pH 8.0, 60°C)

Raising the temperature of juice from 30 to 60°C nearly doubled the fluxes of both untreated and limed juice. This increase in flux might be due to a decrease in viscosity as seen in the case of sucrose, affined sugar or caramel solution in a previous paper[11]. The higher temperature may also depress microbial activity which causes spoilage of the juice while accelerating some browning reactions. These suggest that ultrafiltration at the highest possible temperature at which browning caused is tolerable is to be preferred and a heat-resisting membrane should accordingly be used.

The effect of operating pressure on the flux is shown in Fig. 2. The arrows in Fig. 2 show the history of the changes. The curve "b" in Fig. 2 shows that the flux through PM-10 membrane continued to increase until the pressure reached 4 $kg.cm^{-2}$, although its rate of increase gradually decreased. The curve "a" shows that the flux through XM-300 membrane initially increased with the increase in pressure to a maximum at 1.5~2.0 $kg.cm^{-2}$ and gradually decreased on further increase in pressure. On dropping the pressure after it reached 4 $kg.cm^{-2}$ ("A" or "B" in Fig. 2) the flux decreased through a course (the curve "a'" or "b'") different from that (the curve "a" or "b") of the change of flux with the increase in pressure. Since in sucrose solution the relationship between flux and pressure was linear and the line passed through the origin[11], the results obtained with juice showed that a gel layer of macro-molecular impurities was formed on the membrane surface. Curves "a" and "b" show that gel layer formation on XM-300 membrane was more prominent owing to its higher flux and that the gel layer became more compact at higher pressure. Since the curves "a'" and "b'" stand apart from the curves "a" and "b" respectively, and are non-linear, it is suggested that the compact gel layer loosened somewhat with the release in pressure but still remained intact on the membrane surface.

As mentioned earlier, addition of lime proved effective for increasing the flux. The relationship between quantity of lime added and increase in flux is shown in Fig. 3. The results show that the flux remained unchanged up to pH 7.0. Then the flux increased almost double at pH 7.5 and then remained approximately constant almost up to pH 10. Further increase beyond pH 10 resulted in drop of the flux.

The precipitation test (Fig. 4) showed that transparency of supernatant was related to the quantity of precipitate. The shape of the graph resembles that of flux change with pH. This suggests that liming could precipitate the membrane-blocking impurities within a certain pH range, resulting in the increased flux.

Decomposition of reducing sugars in alkaline solution results in the so-called "browning" reaction to form

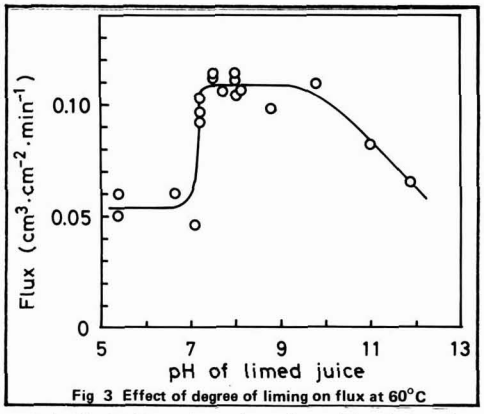


Fig 3 Effect of degree of liming on flux at 60°C

undesirable highly coloured products. The destruction of reducing sugars in limed juice increases rapidly with increase in pH although it is relatively small at pH levels below 7.5, as demonstrated by Payne[12]. This information and Fig. 3 suggested that sugar cane juice should be

[11] Kishihara, Fujii & Komoto: *Membrane*, 1980, 5, 51-58.
[12] "Principles of Sugar Technology" Ed. P. Honig (Elsevier, New York), 1953, pp.519, 533.

ultrafiltered at pH 7.5 to get maximum flux and to

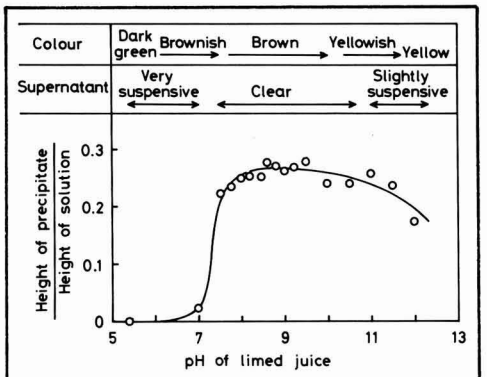


Fig. 4. Effect of degree of liming on clarification of raw juice

ultrafiltered at pH 7.5 to get maximum flux and to prevent excessive destruction of reducing sugars. Honig[13] also reported that pH of the juices should be maintained above 7.0 to prevent inversion of sucrose and below 8.5 to prevent destruction of reducing sugars. Consequently, hot liming is generally carried out at pH 7.0~7.2 and cold-liming at pH 7.4~7.8[14]. The results obtained showed that the best pH for ultrafiltration agreed with cold-liming pH.

Madsen[8] ultrafiltered a factory cold-limed juice (pH 7.2) and a mixed juice, and found no difference between their fluxes. However, he did not use limed juices at various pH as a feed. Liming to various pH in this study showed that liming the juice to pH 7.5 doubled the flux of original juice. In order to improve the flux, lime should be added until the pH is raised above 7.5.

Fluxes and rejections of Brix of the limed juice (pH 7.5) and sucrose solution through five membranes are shown in Table IVa. The rejections of Brix of limed juice were higher than those of sucrose solution in all the cases. This showed that the ultrafiltrability of juice changed with formation of a gel layer on the membrane and/or plugging of the membrane pores as reported by Madsen[8].

Purity, colour value, acidified-ethanol-insoluble substances and starch content of the permeates through five membranes are given in Table IVb. Corresponding figures for the raw juice and the juice clarified by lime defecation are presented together. The lime defecation was a procedure that was carried out by adding lime to the juice to give a pH of 7.8, boiling and filtering through Toyo filter paper No. 131. The juice obtained by the lime defecation had considerably higher colour and lower purity than those of the ultrafiltered juice, and contained a considerable amount of starch and acidified-ethanol-insoluble substances. Results suggested that juice purification by ultrafiltration was superior and the sugar manufactured from the ultrafiltered juice might solve to a considerable extent the floc problem in carbonated beverage manufacture.

The colour values of the permeates through UK-200 and XM-300 membranes were much higher than those of the other membranes. Starch contents were 0.004% and 0.009% on dry matter basis in the permeates through UK-200 and XM-300 membranes, respectively, whereas starch could not be detected in permeates obtained through other membranes. Acidified-ethanol-insoluble substances were absent from all the permeates. Purities in the case of UK-200 and XM-300 membranes were also lower than those of the other membranes.

The results shown in Tables IVa and IVb suggested that membranes with molecular weight cut-off level from 10,000 to 30,000 were more suitable for ultrafiltration of sugar cane juice.

If sugar cane juice ultrafiltrate is subsequently treated with adsorbents, the decolorization will be better, because according to our experience[15], the ultrafiltrate of coloured refinery liquors was more easily decolorized than the original liquors. Fouling of adsorbents might also be prevented as reported in the case of beet juice by Landi *et al.*[16].

Table IV. Ultrafiltration of limed juice at 60°C

(a) Flux and rejection

Membrane	Operating pressure ($kg.cm^{-2}$)	Limed juice (21.7° Bx) Flux ($cm^3.cm^{-2}.min^{-1}$)	Rejection* (%)	Sucrose solution (22° Bx) Flux ($cm^3.cm^{-2}.min^{-1}$)	Rejection* (%)
G-05T	4	0.040	4.9	0.063	2.8
PM-10	4	0.112	3.9	0.202	1.9
PM-30	4	0.172	3.0	0.402	1.6
UK-200	1	0.066	1.6	0.169	<0.5
XM-300	1	0.162	1.3	0.436	<0.5

$$*\text{Rejection} = 1 - \frac{\text{Brix of permeate}}{\text{Brix of feed}} \times 100$$

(b) Colour value, starch, acidified-ethanol-insoluble substances (AEIS) and purity

	Colour value	Starch on dry basis (%)	AEIS on dry basis (ppm)	Purity
Ultrafiltered juice				
G-05T	0.21	0	0	93.0
PM-10	0.25	0	0	93.3
PM-30	0.29	0	0	93.2
UK-200	0.98	0.004	0	92.5
XM-300	1.32	0.009	0	92.2
Clarified juice by liming	1.74	0.139	857	91.6
Raw juice	—	0.409	—	90.3

Acknowledgement

The authors wish to thank Professor Tadashi Yamaguchi, Kobe University, for supplying the sugar cane used in this study.

Summary

The effect of several kinds of pre-treatments on ultrafiltration flux of sugar cane juice was studied. The efficiency of clarification through different membranes was also examined. Results showed that: (1) flux was not improved by removal of wax from sugar cane stalks, (2) liming was the most effective pre-treatment to improve the flux, (3) liming the juice to pH 7.5 gave the highest flux and might be safer for countering any chemical degradation of the juice, (4) increase in temperature of the juice from 30 to 60° C almost doubled the flux, (5) membranes with molecular weight cut-off levels

[13] *ibid.*, p.500.
[14] Hamaguchi & Sakurai: "Sugar Handbook" (Asakura-shoten, Tokyo), 1965, pp.25-26.
[15] Kishihara, Fujii & Komoto: Unpublished data.
[16] *Zeitsch. Zuckerind.*, 1974, **24**, 585-591.

of 10,000 – 30,000 were more suitable for purification of the juice, and (6) clarification by ultrafiltration proved to be superior to ordinary lime defecation because it gave juice of higher purity and lower colour, free from starch and acidified-ethanol-insoluble substances.

L'ultrafiltration du jus de canne. Influence du débit et qualité du filtrat

L'effet de différérentes espéces de prétraitement sur l'ultrafiltration du jus de canne à sucre a été étudié. L'efficacité de la clarification à travers différentes membranes fut également examinée. Les résultats ont démontré que: (1) le débit n'était pas amélioré par l'élimination de la cire des tiges de canne, (2) le chaulage était le prétraitement le plus efficace pour améliorer le débit, (3) le chaulage du jus à pH 7,5 donna le débit le plus élevé et pourrait être d'une plus grande sécurité pour éviter toute dégradation chimique du jus, (4) l'accroissement de la température du jus de 30 à 60°C doubla presque le débit, (5) les membranes de la gamme de retenue des poids moléculaires de 10.000 – 30.000 étaient plus appropriées pour l'épuration du jus et (6) la clarification par ultrafiltration a prouvé sa supériorité par rapport à la défécation ordinaire à la chaux, vu qu'elle a fourni un jus de pureté plus élevée et de coloration moindre, exempt d'amidon et de substances insolubles dans l'éthanol acidifié.

Ultrafiltration von Rohrsaft. Einfluß von Durchfluß und Qualität des Permeates

Die Wirkung von verschiedenen Arten der Vorbehandlung auf die Ultrafiltration von Zuckerrohrsaft wurde untersucht. Die Wirksamkeit der Klärung durch verschiedene Membranen wurden auch untersucht. Die Ergebnisse zeigten: (1) der Durchfluß wurde durch die Entfernung des Wachses von den Zuckerrohrstengeln nicht verbessert, (2) Kalken war die wirkungsvollste Vorbehandlung, um den Durchfluß zu verbessern, (3) Kalken des Saftes bei pH 7,5 ergab den höchsten Durchfluß and könnte sicher sein zur Vermeideung jedes chemischen Abbaues im Saft, (4) die Temperaturzunahme des Saftes von 30 auf 60°C verdoppelte fast den Durchfluß, (5) Membranen mit einer Durchlässigkeitsgrenze für ein Molekulargewicht von 10 000-30 000 waren am geeignetsten zur Reinigung des Saftes, und (6) die Reinigung durch Ultrafiltration erwies sich als überlegen gegenüber der üblichen Kalk-Defäkation, weil der Saft eine höhere Reinheit und weniger Farbe hat, frei von Stärke und in sauerem Ethanol unlöslichen Stoffen ist.

Ultrafiltración de jugo de caña. Influencia de pre-tratamiento sobre flujo y calidad del permeado

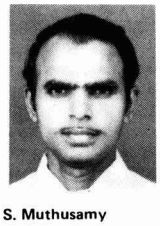
Los efectos de varios tipos de pre-tratamiento sobre el flujo en ultrafiltración de jugo de caña se han estudiado. La eficiencia de clarificación por diferentes membranos se ha examinado también. Los resultados indican que: (1) el flujo no es mejorado por separación de la cera de los tallos de caña de azúcar, (2) adición de cal es el pretratamiento el más efectivo para mejorar el flujo, (3) adición de cal hasta pH 7.5 produce el flujo el más alto y puede asegurar obviación de degradación química del jugo, (4) aumento de temperatura del jugo de 30° hasta 60°C casi dobla el flujo, (5) membranos con un limite de separación de pesos moleculares de 10,000 – 30,000 están más conveniente para purificar el jugo, y (6) clarificación por ultrafiltración resulta superior a defecación normal con cal a causa de la producción de un jugo de pureza más alta y color reducido, libre de almidón y de componentes insoluble en etanol acidificado.

Effect of aerated steam treatment on the incidence of sugar cane smut

By S. NATARAJAN and S. MUTHUSAMY
(Sugarcane Experiment Station, Cuddalore, Tamil Nadu, India 607001)

Sugar cane smut (*Ustilago scitaminea* Syd.) is a serious disease in all cane growing countries. It causes heavy losses both in yield and quality and the loss is even more severe in ratoons[1]. Control of the disease by chemical treatments is difficult. Recently, heat treatment techniques have been widely advocated for the control of virus and mycoplasma diseases in cane and are also being tested for the control of fungal diseases, particularly smut and red rot (*Colletotrichum falcatum* Went). No conclusive evidence has been achieved so far of the control of fungal diseases in cane through heat therapy[2,3,4]. In order to ascertain the effect of aerated steam treatment (AST) on the control of smut, a field trial was laid out during 1978-79 at this station and the results are presented here.

S. Natarajan



S. Muthusamy

Materials and methods

The trial used the variety Co 1287 which is highly susceptible to smut. One lot consisted of infected material, i.e. canes with smut whips while another comprised apparently healthy canes. Two-eyed setts were treated in a commercially available AST unit at 50°C for 4 hours, and then removed and planted in the field. The plot size adopted was 48 m^2 with 0.8 m between rows. The trial layout was a randomized block design, replicated three times. The trial was planted in mid-season, i.e. during February, following the recommended practices. Smut incidence was recorded from the 35th day on at fortnightly intervals up to 9 months,

[1] Raja *et al.: Sugarcane Pathologists' Newsletter,* 1972, (9),9-10.
[2] Anon: *Ann. Rpt. Sugarcane Breeding Inst.* (Coimbatore), 1976, 89.
[3] Anon: *Ann. Rpt. Expt. Sta. S.African Sugar Assoc.,* 1976-1977, 79.
[4] Gupta: *Indian Sugar,* 1977, **27**, 385-386.

after which the incidence could not be assessed because of lodging of the entire crop owing to severe monsoon rains and high winds during November. Yield was recorded at harvest (11 months).

Results and discussion

The data on germination, disease incidence and yield are given in Table I. It may be seen that maximum germination of 62.59% was recorded in treated healthy cane while the healthy control recorded 57.03%, indicating thereby that the treatment had a beneficial effect in increasing germination. The same trend was more marked in the case of infected seed material. Treated infected cane recorded 61.07% germination while only 45.74% of buds germinated in the infected control. Hence it is clear that the treatment was effective in increasing the germination of seed cane material, especially infected cane. A similar phenomenon has also been observed when RSD infected material was treated in moist hot air treatment units[5].

Table I. Effect of aerated steam treatment on germination, smut incidence and yield of sugar cane

Treatment	% Germination	% Smut incidence	Yield, tonnes .ha^{-1}
Apparently healthy cane			
Aerated steam treatment	62.59	23.12	117.64
Bavistin sett dip	53.01	26.44	111.25
Control	57.03	30.09	107.64
Infected material			
Aerated steam treatment	61.07	27.46	98.96
Bavistin sett dip	45.42	33.60	90.00
Control	45.74	46.48	89.72
CD	10.05	5.34	7.21

With regard to smut, AST had a significant effect in reducing disease incidence, the healthy control recording 30.09% smut incidence while treated healthy cane recorded only 23.12%. However the treatment had positive effect on greater infected materials where it reduced incidence from 46.48% to only 27.46% i.e. a relative reduction of more than 40%. Gupta[4] observed that hot water treatment of cane also reduced the smut incidence and increased germination and yield. It has been reported[2,3] that cane treated by aerated steam and hot water showed higher smut incidence than untreated controls, but in the present study the reverse was found.

The yield data recorded at harvest also revealed that maximum yield was in treated healthy cane. The differences in yield between the treated and control healthy cane were significant and the same applied to yields of treated and control infected cane. There were yield differences of about 10 tonnes.ha^{-1} in both cases. Increased yields in heat treated canes have also been observed by other workers[5].

Acknowledgement

Thanks are due to P. S. Sanjeevi, Crop Specialist, and to H. D. Lewin, Plant Pathologist, Sugarcane Experiment Station, Cuddalore, for their interest and guidance in this study.

Summary

Two-budded setts of Co 1287 were treated in an aerated steam treatment unit at 50°C for 4 hours. The treatment increased germination of buds both in healthy and infected cane over the respective controls. There was also about 40% reduction in smut incidence in heat-treated infected material. Yield differences of about 10 tonnes.ha^{-1} due to heat treatment were recorded in both cases.

L'effet du traitement à la vapeur aérée sur l'incidence du charbon de la canne à sucre

Des boutures à deaux yeux de Co 1287 ont subi un traitement à la vapeur aerèe à 50°C pendant 4 heures. Le traitement accroit la germination des yeux à la fois pour la canne saine et pour celle qui est infectée par rapport aux étalons respectifs. Il y eut réduction d'environ 40% dans l'incidence du charbon pour le matériau infecté traité par la chaleur. Dans les deux cas on trouva des différences de rendement d'environ 10 tonnes.ha^{-1} du fait du traitement par la chaleur.

Die Wirkung der Behandlung mit einem Luft-Dampf-Gemisch auf Zuckerrohr-Smut

Zwei-knospige Setzlinge von Co 1287 wurden bei 50°C 4 Stunden lang mit einem Luft-Dampf-Gemisch behandelt. Die Behandlung beschleunigte das Keimen der Knospen von gesundem und infiziertem Rohr in Vergleich mit den entsprechenden Kontrollen. Außerdem ergab sich eine 40%ige Verringerung des Auftretens von Smut bei hitzebehandeltem infiziertem Rohr Ertragsunterschiede von etwa 10 t/ha auf Grund der Hitzebehandlung wurden in beiden Fällen festgestellt.

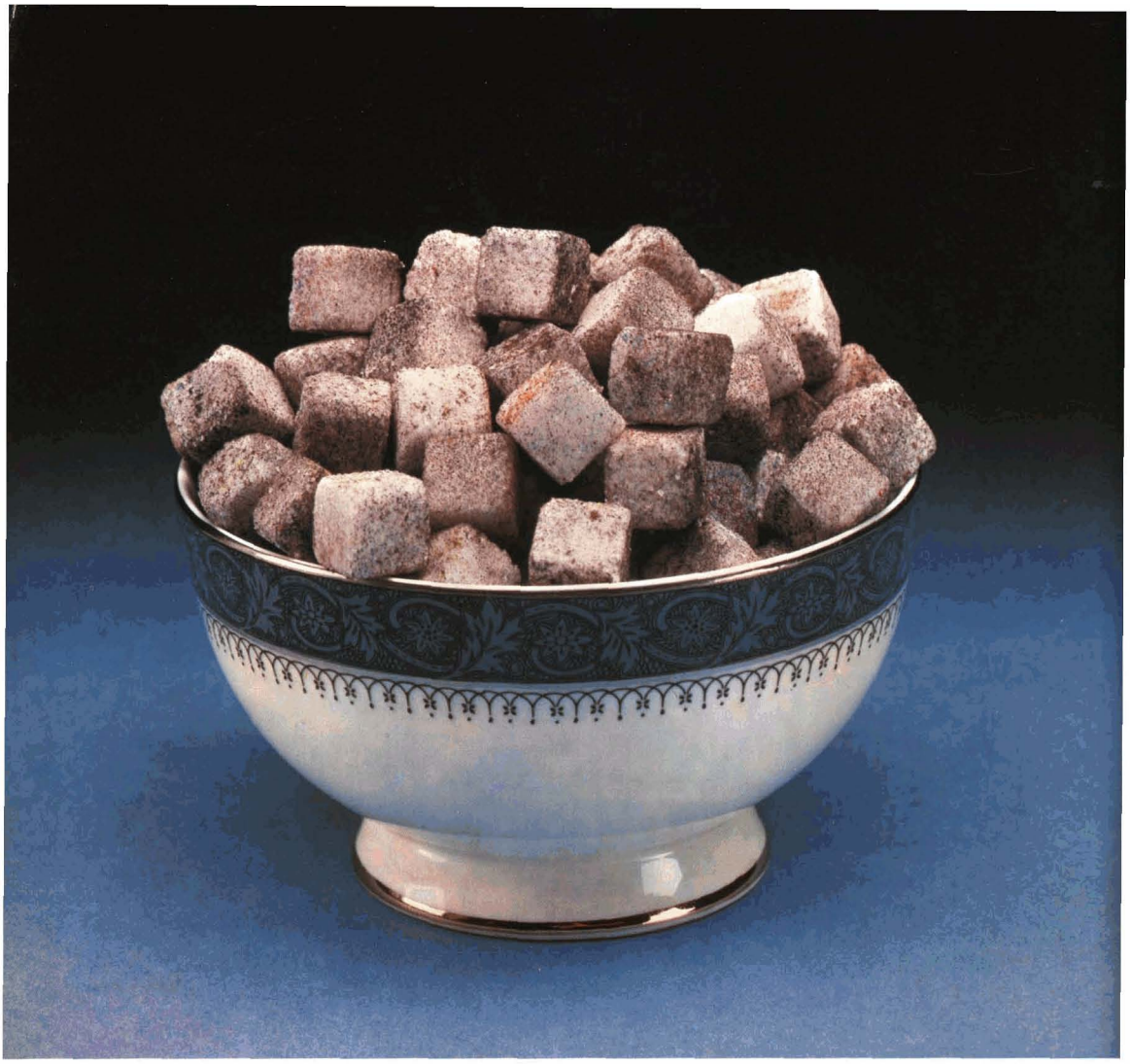
Efecto de tratamiento con vapor aereado sobre la incidencia del carbón

Trozos con dos brotes de caña de la variedad Co 1287 se han tratado con vapor aereado en un equipo a 50°C durante 4 horas. El tratamiento creció germinación de los brotes en caña sana y infectado en comparación con los controles respectivos. Había también una reducción de casi 40% en la incidencia del carbón en la caña infectada que se ha tratado. Diferencias de producción de acerca de 10 toneladas por hectárea se han notado en ambos casos que resultan del tratamiento con calor.

Australia-South Korea long-term contract[6]. — Agreement has been reached under which Australia will supply South Korea with 250,000 tonnes of raw sugar during the next four years. This supply is additional to those already agreed, i.e. 1.2 million tonnes over the period 1980 — 1984.

Bolivian sugar production, 1980[7]. — By November 10, the 1980 crushing season was virtually over, with a production of 283,289 tonnes, raw value, or 37,670 tonnes below the production target because of a shortage of cane cutters and transport problems in the main growing area of Santa Cruz province. Of the total, 187,000 tonnes will be set aside for domestic consumption and the remainder exported. In 1979, there were exports of 98,000 tonnes from a production estimated at 287,300 tonnes.

[5] Shukla *et al.*:*Ann. Rpt. Indian Inst. Sugarcane Research* (Lucknow), 1974, 72-74.
[6] C. Czarnikow Ltd., *Sugar Review,* 1980, (1518), 225.
[7] F.O. Licht, *International Sugar Rpt.,* 1980, **112**, 686.



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Transport water mud thickener problems*

By O. A. NEEDHAM (British Sugar Corporation Ltd., Cantley, Norfolk)

Foreword

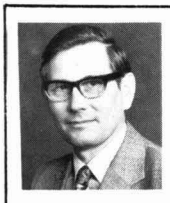
Continuous mud thickeners usually perform as their name suggests and with few problems. The continuous thickening of solids from beet transport water is well documented and the principles well researched. This paper is an account of the efforts of Cantley Factory staff to determine the cause of a problem affecting the removal of those thickened solids and discusses the solutions.

Introduction

The Cantley factory was constructed in 1912 and was the first successful factory to operate in the UK. This historic plant had been extended and modernized over the years to reach 5000 tonnes daily slicing capacity by the 1960's. Since that date further large-scale reconstruction has taken place to enable the daily factory capacity to be increased to 6350 tonnes by 1979/80.

The present 61-metre diameter thickener is the third on the site. The first, installed in 1927, served the factory well with few problems but became overloaded as the throughput of the factory increased. This thickener was of Bamag design.

The second, installed in 1968, of Dorr design, also gave few problems other than those associated with motor failures or pump wear. The mud underflow extraction pumps were situated in a cellar underneath the thickener and on occasions this cellar became flooded after the bursting of a mud discharge pipeline and caused severe problems. We determined that any new thickener we built would not suffer from this weakness (Figs. 1 and 2). The opportunity came in 1976 as the first stage of reconstruction started. For geographical reasons, amongst others, it was decided to build a completely new beet reception and handling area on the other side of the main Norwich-Yarmouth railway line. This new site would receive beet, store, wash and convey clean beet over the rail-line into the factory for processing. It follows, of course, that a new thickener had to be constructed on this new site to handle the recirculated transport water. The concrete basins of the original Bamag and the 1968 Dorr thickener were adapted to serve as an aerobic effluent treatment plant.



O. A. Needham

The new 61-metre thickener

The new thickener was to have a design capacity of 10,000 g.p.m. dirty water input and be capable of removing 1000 tonnes of solids per 24 hours. The underflow extraction pumps were to be mounted above the centre annulus of the thickener and, therefore, there was to be no cellar underneath (Appendix I and Fig. 2). Dorr-Oliver Co. Ltd. were awarded the contract for the mechanical design and construction of the project with Tarmac Construction Ltd., the main new site civil engineers, constructing the basin.

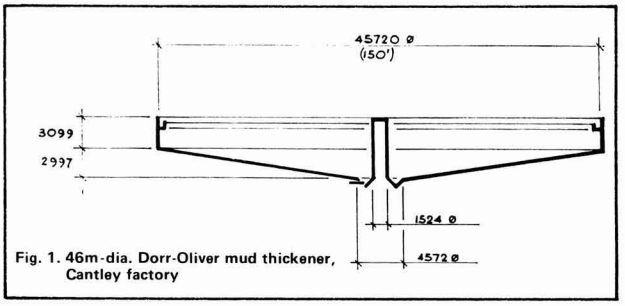


Fig. 1. 46m-dia. Dorr-Oliver mud thickener, Cantley factory

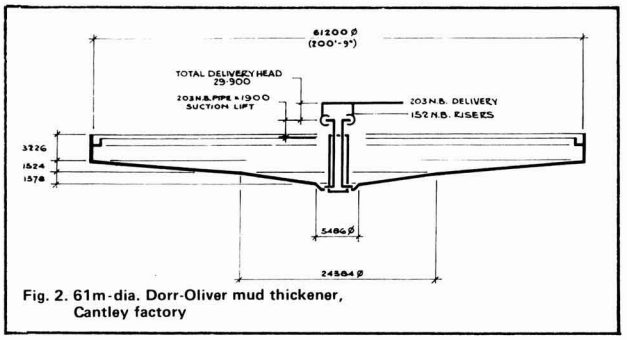


Fig. 2. 61m-dia. Dorr-Oliver mud thickener, Cantley factory

The civil design gave many problems owing to the marshy nature of the site and a special foundation had to be designed consisting of a ring of sheet piles hammered into the marsh, with the thickener walls constructed on top of this ring of piles. This has been a success as there has been no movement or settlement after two seasons' use.

Apart from the decision to mount the underflow extraction pumps above the centre of the thickener there were two other major differences between this new design and the old 1968 Dorr thickener. These were:

(1) provision was made for a concrete clear water storage tank instead of a lagoon, and

(2) the bottom of the thickener basin was constructed with a slope in two dimensions, the so called double bottom (Fig. 2).

* *Paper presented to the 25th Tech. Conf., British Sugar Corp., Ltd., 1980.*

Transport water mud thickener problems

The capacity of the underflow pumps is as given in Appendix II and they are equipped with both separate suction and delivery pipelines.

Solids are removed to the centre of the thickener by the standard Dorr-Oliver scraper system revolving at three complete revolutions per hour and driven by a 5.5 kW motor.

Liquid input is screened for beet particulate material which is returned to process. These screen assemblies, three in number, are of a scraper type designed and fabricated by British Sugar Corporation Ltd. In 1978/79 the wedge bar screens themselves were of 3mm gap.

pH control of the transport water system is effected by introducing powdered lime into the beet flume just prior to the suction of the beet pump. The powdered lime is stored in a bulk bin of 40 tonnes capacity. Addition is controlled by a suitable scroll conveyor and Roedean interval timers.

Protective devices and alarms

Thickener and associated pumps have local and Central Control Room running lights and amp-meters, as does the stirrer drive motor. In addition, the underflow delivery pipelines are fitted with Döppler flow registers which give both audio and visual alarms if the flow drops below a pre-set rate. All other important drives in the system have audio-visual alarms which have to be cancelled by the operator. The stirrer motor also has an overload alarm set somewhat below tripping point. During the first campaign of operation (1978/79) it was not intended to record in chart form the stirrer or underflow pump current. However, a portable recording ammeter was installed as soon as problems arose. This proved a most valuable aid to understanding the thickener behaviour and a special recorder was, therefore, installed in 1979 to record both the stirrer drive and the underflow pump current. Hourly records of mud pumps and thickener stirrer current and slice rate are kept by the appropriate operator in the Control Room so that operations can be correlated to the mud load on the thickener (Appendix III).

Campaign operations 1978/79

As expected, there were many problems connected with the vast amount of new plant installed prior to the 1978 campaign, which kept the factory staff very busy during the first few weeks. These problems were mostly minor and were dealt with as they arose. There were no problems with the new thickener at that stage and none was expected. We did have initial difficulty in priming the underflow mud pumps but this was soon solved by repiping the priming source from one of greater volume.

All went well for several weeks; the only incident concerned a bearing in the thickener stirrer primary drive which showed signs of failure. Plans were made at once to remove the primary drive box for repair and to substitute the drive from our old thickener at a convenient time as this would result in the least loss of throughput. The factory staff made the change, the stirrer being stopped for two hours while this was done. Of course no beet was flumed at this time to prevent solids build-up in the thickener, and only clean water circulated. The thickener ran quite happily on the old primary drive, although the box was not of the same ratio and gave a scraper arm speed of 4.2 r.p.h.

Some few days later the new drive repairs were completed and it was refitted in the same manner as it had been removed.

Some days after this operation it was noticed that the current demand of the stirrer was showing signs of rising to around 5.5 amp and at this point we started to run two underflow mud pumps,on the assumption that this would remove the backlog of mud causing the load to rise on the stirrer. This did not happen as expected. Both mud pumps pumped well, but the density of the mud being pumped away was only 50% of the solids that we believed were entering the system – a recipe for disaster!

At this point we started to log the current of both the stirrer and the pumps on an hourly basis and instituted a regular system of backflushing the mud pumps as we were of the opinion that perhaps a scraper had collapsed or tramp metal was blocking the pump suction.

We commenced probing the mud level on the bottom of the thickener using a light metal rod. Access was restricted to the gantry bridge but we were able to probe at intervals along this. To our discomfiture we found that there appeared to be a complete ring of solids round the centre well over one metre thick at a position about 2 metres from the centre annulus. This ring of solids tapered off towards the outside of the thickener and did not exist at a point 4 metres from the centre. The stirrer current had by now reached 6.0 amp from a normal 5.1.

We were convinced that something must be blocking the suctions of the pumps because at intervals they would pump mud of a very high density for an hour or so before returning once more to pumping almost clear water. We hoped, therefore, that we would be able to pump the fancied obstruction through the system or displace it where it could do no harm. For a few days we thought that this had happened as a stable point was reached with no further current increase on the stirrer. Then we started to record high peaking on the ammeter twelve times per hour. This was due, we reasoned, to the sweeps catching the assumed obstruction. Subsequent events proved this assumption to be in error.

The build-up in amperage continued until, at 10.30 p.m. on Christmas night, the stirrer tripped on overload for the first time on a peak of 12.00 amp. The stirrer was restarted and all available labour assembled to pull it round by hand and keep the load off the motor. The underflow pumps were repeatedly backflushed but refused to pump any solids, although they pumped water above their rated capacity. The bottom of the thickener was probed and two metres of mud deposit found in the usual configuration which by now we were calling a "doughnut".

The decision was taken to empty the thickener and see what was causing the problem. It was by now the early hours of Boxing Day. We knew that the underflow pumps could not pump beyond 6 metre suction lift and that we would require at least four portable 6-in suction lift pumps to remove the accumulated solids from the thickener bottom. It was not an easy task to mobilize specialized equipment of this nature on a national holiday, not to mention the excavator and crawler forward-loading shovels which we also suspected we would require. Nevertheless, we obtained the equipment and further details are not relevant; suffice it to say that when the water had been emptied out there was our "doughnut" of heavy solids in the expected ring around the centre annulus (Figs. 3 and 4).

Both pump suctions were clear and there was no damage to the scraper mechanism beyond a cracked weld and some 'droop' on the scraper arms caused by the weight of material imposed on them by the "doughnut". The arms were lifted up to a clearance of around 60mm from the concrete base and checked for balance. We still had a problem as no evidence had been found to explain the cause of the failure.

Fig. 3

Fig. 4

We had no alternative but to refill the thickener with water and restart operations on January 1, 1979. Several hypotheses were advanced but with no substantial evidence in support. We ran the thickener as before, monitoring the stirrer current and relating it to the beet sliced to obtain an idea of solids entering the system. We decided to run both underflow mud pumps alternately for a start, but eventually had to run them both as long as possible, although this gave problems since the return water pumps from the settlement ponds had a total capacity of only 1000 g.p.m. which was inadequate for continuous running of both underflow pumps.

After three days the current again started to rise, the "doughnut" started to form, and the underflow pumps once more pumped only clear water away with a low solids content. Desperate situations call for desperate measures, so we tried the experiment of grabbing mud out of the centre of the thickener with a 22 R B Excavator, taking care, of course, to avoid the scrapers as it was obvious serious damage could be caused. After only three throws into the thickener we abandoned the operation pending the arrival of a larger 'stick' for the excavator to increase the area that could be reached.

A curious event then took place. Both underflow pumps lost suction and when flushed out and reprimed pumped almost solid mud and continued to do so. Little thought was required to conclude that the "doughnut" had been disturbed and started to break up. After 48 hours of pumping heavy mud the stirrer amps had returned to normal.

This happy state was not to last as, before long, the amount of solids pumped went down to 50% of input, and the "doughnut" reformed. Of course, we tried our excavator trick again but this time with no success. The build-up of the current demand on the stirrer drive continued and experiments were hindered by the exceptionally severe weather which froze pipelines and even the froth on the top of the thickener itself, but not, happily, the underflow pumps. On the night of February 2 the transport water temperature reached a low of 3½°C. The stirrer amps continued to rise until the drive motor tripped at 8.00 a.m. on February 6; restarted, it tripped once more at 6 p.m. the same day at a peak of 12 amp.

A quick calculation assured us that we could run the thickener without the stirrer and use the thickener as a primary settlement basin for about 10 days before mud would overflow into the clear water tank.

The campaign came to an end on February 14, rather hurriedly, as the worst blizzard for many years struck the UK, rendering all communications between the factory and the outside world impossible for three days, except by river and telephone.

1979 investigations and alterations

Owing to the exceptional weather the untreated effluent storage ponds were all full and it was early May before we were able to pump the water away from the thickener and dig the mud out. Meetings were held with Dorr-Oliver personnel to decide what alterations were needed to make the thickener work as designed and solve the persistent problem of removal of mud from the basin. It seemed logical that we should establish the differences in design from our previous thickener and attempt to isolate those differences into possible causes of the problems.

We considered the following questions:-

(1) *Were the solids to be removed by the new thickener any different in character or volume from those removed by the old?*
No difference; the factory slice rate in 1978 was as previous years and the factory beet catchment area was identical so there could be no difference in volume or specification of the muds produced.

(2) *Were the tails screens before the thickener inlet different?*
Yes; the screen aperture size had been reduced to 3mm from 4.7mm. This must be beneficial and as detailed in the specification in Appendix I.

(3) *Was the thickener feed the right design?*
We were not sure and were of the opinion it created turbulence.

(4) *Were the scrapers the wrong design, angle or speed?*
Only Dorr-Oliver, we felt, could answer that question with certainty.

(5) *Were the top-mounted underflow mud pumps effective?*
This arrangement was far different from the old thickener and was worthy of careful investigation.

(6) *Did the double bottom of the new thickener adversely affect settlement?*
We had no reason to believe that it did. It was intended to be beneficial to the collection of thickened mud prior to pumping.

A meeting was arranged by the factory staff attended by Dorr-Oliver technical representatives at which the whole operation of the thickener was discussed with particular reference to investigating Questions 3, 4 and 5.

Meanwhile, all the mud was dug from out of the thickener and as expected the weight of material on the scraper arms had once again forced them into contact

with the concrete bottom. The scrapers support steelwork was not designed to take this type of load and such was the downward pressure on the scraper blades that the contact with the concrete bottom had curled many of them back like watch springs in the opposite direction of their travel.

After consultation had taken place, as arranged, with interested parties, the following points were agreed:

The underflow mud pumps were of the right type and there should be no special problem caused by them being mounted above the thickener. Moreover, the delivery pipelines were the same as used in the preceding thickener except that they were some 100-metres shorter.

The view of the Dorr-Oliver company, that no alteration was needed to the design of the scraper assembly, was accepted; it was a well tried standard concept which they would not be happy to have altered in any way (Fig. 5).

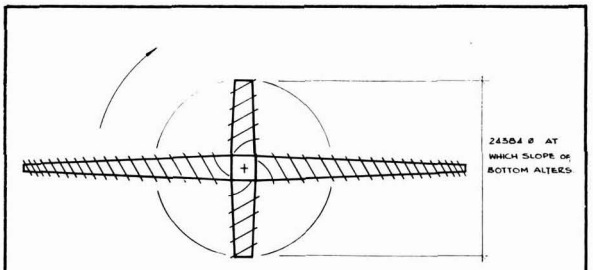


Fig. 5. Scraper arm arrangement; speed of rotation 3 rph, motor size 5.5 kW

It was the general view of us all, at the end of the discussions, that the main problem area was the feed system.

From Figs. 6 and 7 it will be seen that the input feed water chute is bifurcated and delivers into the feed well

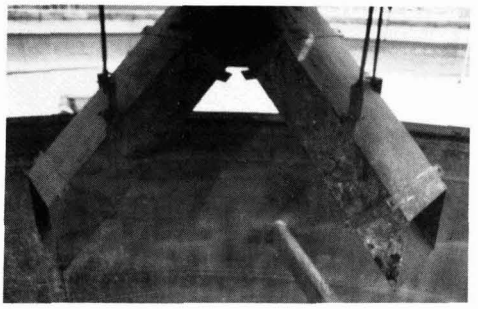


Fig. 7

at a comparatively steep angle. We believed that the velocity of the feed projected into the feed well was high enough to cause turbulence. We concluded that this turbulence was severe enough to inhibit the settlement of the larger particles and cause them to settle out in the "doughnut" ring formation. Dorr-Oliver concurred with this view and commenced designing a new type of feed distributor which absorbed the kinetic energy of the inflow on itself (Fig. 8). These alterations were put in hand and fitted in time for the forthcoming campaign (1979-80) (Fig. 9).

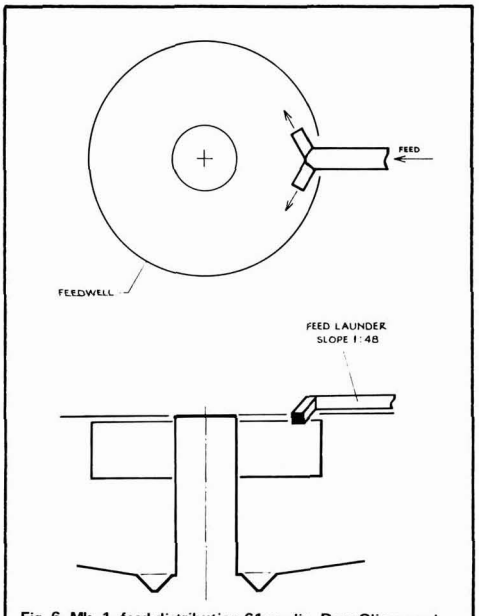


Fig. 6. Mk. 1. feed distribution 61 m-dia. Dorr-Oliver mud thickener, Cantley factory 1978/79

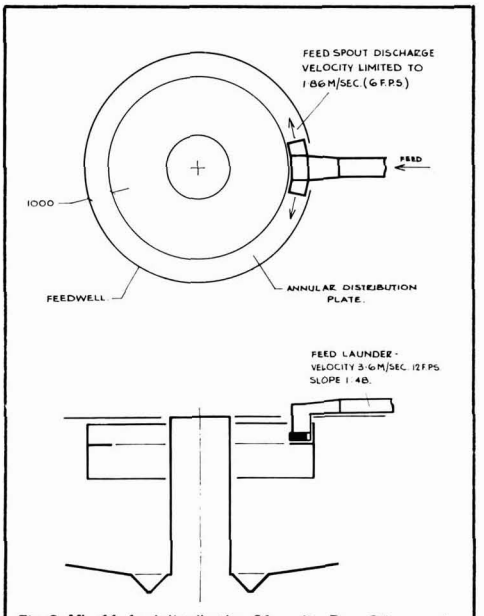


Fig. 8. Mk. 11. feed distribution 61 m-dia. Dorr-Oliver mud thickener, Cantley factory 1979/80

Fig. 9

Meanwhile, the writer had contact with Dorr-Oliver sedimentation engineers in the USA, who were most informative and recognised at once the description of our observed "doughnut". They also cleared up a point of local dispute and informed us that the "doughnut" was a complete ring of solids which went round with the scrapers and was not lifted up by each set of scrapers and deposited again behind them, which, in our ignorance, we had imagined happened. This information convinced us beyond doubt that we had made the right decision with our proposed alterations.

Convinced that we were right in our analysis we nevertheless decided, very wisely, as it turned out, on additional security in the form of a bypass system for the thickener for the coming campaign. This consisted of a redundant beet pump which was valved off the bottom of the thickener feed pipeline after the trash screens. The unthickened water was to be pumped direct to the mud pond system along a suitably sized plastic pipeline, bypassing the thickener.

We had also determined that we required to fit larger return water pumps from the mud ponds into the clear water tank for two reasons. One was to enable us to run two underflow mud pumps 24 hours a day if we felt it necessary, and the other to allow us to run the thickener bypass pump in an emergency and still enable enough water to be returned to the system to continue processing. We calculated that two pumps, each of 2500 g.p.m., would be sufficient and, therefore, fitted Sala design vertical pumps of that capacity. The tail drag conveyors were also fitted with new 3mm mesh screens, and 1.5mm screens ordered for experimentation in the campaign. Under these conditions we started the 1979/80 campaign full of hope that we had solved our problems.

1979/80 campaign

Slicing started on October 11. The thickener had been filled for some few days but not tested for longer than an hour or so as, owing to the massive reconstruction that had taken place during the summer, we had not been able to run the factory turbo-alternators for any length of time. This did not cause us any concern once slicing started as all was well at first. We decided to run one mud underflow pump. This pumped well at the rate of 355 $m^3.hr^{-1}$. By October 21 we were recording the odd higher stirrer current of 5.6 or 5.7 amp but one hour later the amperage returned to around the normal 5.1 – 5.2 amp.

This situation continued for some days until October 25 when the stirrer amps did not return to normal after a peak of 5.8 amp. We decided at once to run two mud pumps as we were sure that this proved one pump was not adequate. We were confident that the stirrer current would return to normal in a few hours, but this did not happen. The current continued to hover around 5.8 amp for some days. By this time the slice rate was varying between 5000 and 6000 tonnes per day and we formed the opinion that perhaps this was the normal current load for the thickener at that particular factory capacity. We were soon made to think again because during the night of October 30 the stirrer current increased steadily to 6.0 amp. The laboratory conducted tests on the underflow which once more caused concern as it was evident that only 50% of the mud entering the thickener was in fact being pumped away.

A sensitive amperage recorder was fitted to the stirrer motor to give a chart record in the Central Control Room. A compressed air lance was built to attempt to break up the "doughnut" which we knew, by careful probing, had started to form.

The mud flow from both underflow pumps was regular but fluctuating from a visibly high density mud to a low density, almost clear water; some pieces of beet material up to 9.5mm in section were also observed in the discharges.

The tail screens prior to the thickener were of course inspected at once and found to be sound. However, we had only thought it necessary to use two of the three screens available and it was observed that at certain times the level of unscreened water in these two screen drags was almost at overflow point. Each screen was provided with a high level overflow connexion which

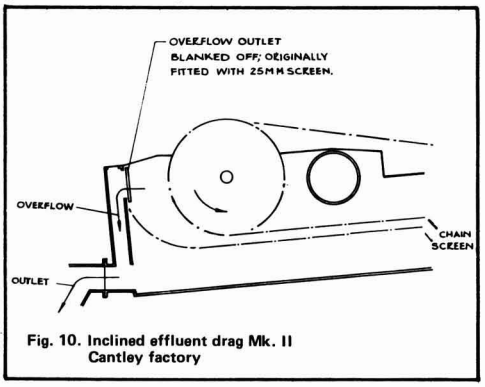


Fig. 10. Inclined effluent drag Mk. II Cantley factory

bypassed water directly to the thickener. This connexion was protected by a 25mm screen to prevent large pieces of beet material passing through but, of course, was allowing pieces of beets and weeds up to 9.5mm in section to go straight into the thickener (Fig. 10). How often this happened we were not sure, but we assumed that each time the beet pump load fluctuated there must be extra water progressing through the system. We were sure this was the source of the comparatively large pieces of beet material observed in the underflow. We were aware that fibrous matter could act as a 'binder' in conjunction with settled mud and, as a possible cause of the problem, had to be eliminated. The overflows were completely blanked off by welding steel plate over the orifices.

The stirrer current continued to rise despite the efforts of the men operating the compressed air lances 24 hours a day. We had little faith that they would achieve a breakthrough as they were unable to move the mud from where it mattered, in between the scraper blades. By November 9 the stirrer current had slowly progressed to trip-out point and this occurred around

12.00 noon. The by-pass system was commissioned; it ran well and continued to do so while we emptied the thickener for inspection. This time we were able to keep the stirrer running as we emptied out and were also able to run both mud pumps.

The stirrer was on overload for some hours but as the water level dropped the current came down to below danger level. The mud pumps both performed very well and did not lose suction until a suction lift of around 6.00 m had been exceeded. We felt this performance eliminated any doubts as to the suitability of the pumps, their siting, or the configuration of any of the pipework.

As the water continued to recede in the thickener basin the "doughnut" became visible; it consisted of a complete ring of mud, some two metres thick in places, going round with the stirrer, packed tightly in the scraper blades at about the point in the thickener just below the position where the angle of the bottom changed and became steeper (Fig. 5). It was evident that this mud consisted of the heavier fractions of soil, clay and beet material.

There was evidently "slip" between the "doughnut" of mud and the bottom of the thickener and adhesion between the mud and the scraper blades. Normally the reverse is true, so that the blades can scrape the settled material to the centre of the thickener for subsequent removal.

Dorr-Oliver had been contacted, of course, and they were asked to check the following points while the thickener was empty:

(1) *That the angle of the scraper blades was correct and had been fabricated to their drawings?*
Dorr-Oliver concluded after measurement that angles were correct and stressed again that they should not be altered from the standard 55°.

(2) *That the sweep arm speed was correct?*
We thought long and hard about whether it could, with advantage, be speeded up but concluded that the sweep arm speeds matched the calculated deposition rate of the mud and we had no reason to believe that this was any faster than expected.

From this incident we learned two things; we now had proof that the underflow pumps were not a cause of the problem because they had performed so well whilst emptying the thickener. Our by-pass system proved its worth because the factory was able to operate at two-thirds of capacity.

Before refilling the thickener we inspected the scraper arms and as expected they had drooped once more owing to the weight of mud that they had had to carry. We retensioned them above our normal clearance of 60 to 80mm to between 200 and 225mm, and also cut some relief slots just below water level in the centre feed annulus. These slots were 300mm x 75mm in area and sited 600mm apart. They were suggested as an extra safeguard in case the volume of water entering the feed well at certain times was greater than could be passed down the feed well through the distribution ring fitted in the summer of 1979 (Fig. 8).

Instructions were given to the operating staff that as soon as the bypass pump was stopped and unsettled water was once more entering the thickener *no current rise at all* must be permitted without one or other of two courses of action being taken. These were

(a) to run two mud pumps until the stirrer current returned to normal 5.0 or 5.1 amp, or

(b) if this did not reduce the current and it rose above 5.4 amp, the thickener should be bypassed until the current did go down.

By this time we had received some of our ordered 1.5mm screens for the beet tail drag conveyors and as the 3mm screens were showing signs of wear they were replaced with 1.5mm before restarting the thickener.

After some few days use of the thickener with one underflow mud pump running, the current rose slowly to 5.3 amp. We ran two pumps for 24 hours and the current returned slowly to near normal and the extra pump was stopped. Again, after a few days, the current started to rise. Instructions were given to run two pumps for four hours per day and one for the remainder as a routine. The current did not rise any further but neither did it go down.

Instructions were then given to run two pumps for eight hours in 24 and one pump for the remainder, again as a routine. The current slowly went down to a norm of 5.0 – 5.1 amp and there were no more problems for the rest of the campaign which ended in early February.

Conclusions

The turbulence in the feed well, coupled with a possible mud build-up because of the problem with the gearbox, caused the establishment of the "doughnuts" formed during the 1978/79 campaign, and led to the stirrer trips on high current. The modification to the feed well in the summer of 1979 eliminated turbulence as a cause and this need not be considered as an element in the October 1979 problems.

The large pieces of beet material entering the thickener via the tails screens overflow pipe, coupled with beet particulate material passing through the 3mm screens, no doubt acted as a mud binder and helped mud to consolidate between the scraper blades in the area of "doughnut" formation.

We do not believe this was the main cause of our trouble, however. The old 1968 thickener had operated for years on similar feed material, which had passed through screens having an aperture of 4.8mm! Even with these larger apertures there had been no thickener problems. Nevertheless we believe that the quantity of beet material entering the thickener should be kept to a minimum, which is why 1.5mm screens are now standard at Cantley factory.

For the answer, we believed that we should continue to look at the differences between the two models of thickener on site. All differences had been taken into account in our investigations so far except the double bottom angle to the basin of the new thickener (Fig. 2). This, we are now sure, was the main contributory factor. It is possible for the depth of mud to build up in the centre of the thickener, unaccompanied by any great rise in current demand by the stirrer motor, as the build-up takes place in the area which transmits the lowest torque to the stirrer. There is, therefore, little warning of a developing problem. This, if not remedied by extra pumping, can blind the exit end of the scrapers along the line of change in the bottom profile. A mixture of hard mud bonded by fibrous material can then accumulate. Once the mud movement towards the centre stops, it becomes even more compacted by the scrapers forcing more mud towards the centre.

This explains how the "doughnut" can form and the observed oddity of underflow pumps pumping low density mud. We have had no problems since the November 1979 incident as we have not allowed the stirrer motor current to rise above 5.3 or 5.4 amp. There have been good, heavy, mud discharges, and no "doughnut" formation.

The problems with the thickener appear to have been

solved although the factory target slice is such that in the 1980/81 campaign 1300 tonnes more beet will need to be sliced daily and averaged for a campaign – only then shall we be certain that we have all the answers.

Acknowledgements

The help given by senior technical staff of British Sugar Corporation Ltd. based at Central Offices, and also by Dorr-Oliver personnel both in the UK and Stamford, Conn., USA, was invaluable in solving the problems. However, the main burden was carried by the local staff at Cantley Factory and to them I am especially grateful.

Cantley Factory — **Hourly Slice Log** — **D.E. 6am 12.12.1979**

	Time	Tonnes Sliced	Remarks– Cause of delay	Pump No. 1	Pump No. 2	Stirrer
	7 am	187	Trash in Slicers	98	–	5.2
	8 am	218	Trash in Slicers	98	142	5.2
	9 am	251		96	140	5.2
6-2	10 am	255		96	140	5.2
Shift	11 am	258		98	140	5.4
	12 noon	262		96	140	5.2
	1 pm	258	1689	96	138	5.2
	2 pm	263		96	138	5.4
	Shift Total	1952				
	3 pm	259		97	138	5.2
	4 pm	262		98	–	5.5
	5 pm	256		99	–	5.2
2-10	6 pm	257		97	–	5.1
Shift	7 pm	267		97	–	5.3
	8 pm	260		98	–	5.2
	9 pm	261	1822	98	–	5.2
	10 pm	258		98	–	5.1
	Shift Total	2080				
	11 pm	258		98	–	5.1
	12 midnight	253		98	–	5.0
	1 am	262		98	–	5.1
	2 am	265		98	–	5.2
10-6	3 am	260		98	–	5.1
Shift	4 am	259		98	–	5.1
	5 am	261	1818	96	–	5.8
	6 am	261		98	–	5.3
	Shift Total	2079				
	Daily Total	6111				

Summary

An account is given of an operational problem that arose with a new thickener for transport water mud and steps by which the problem was overcome.

Problèms avec l'épaississeur à boues des eaux de transport

Un problème d'exploitation ayant surgi avec un nouvel épaississeur pour boues des eaux de transport est décrit, ainsi que les mesures par lesquelles le problème fut résolu.

Absetzbecken-Probleme mit dem Schwemmwasserschlamm

Ein Bericht wird gegeben über ein Betriebsproblem, das sich bei einem neuen Absetzbecken für Schwemmwasserschlamm ergab, und über Maßnahmen durch die das Problem überwunden werden konnte.

Problemas con un espesador para cachaza de agua de transporte

Se da cuenta de una problema en operación que occurró con un nuevo espesador para agua de transporte y medidas tomado para superarla.

Appendix I

Specification for 61-metre diameter mud thickener

Supply and erect a complete 61-metre nominal diameter thickener mechanism for installation in a concrete tank supplied by others. The thickener will be required to remove continuously approximately 1000 tonnes/day of suspended solids from beet transport water.

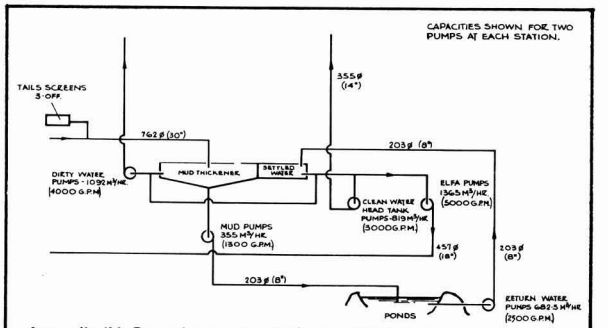
The flow rate of this water will be a maximum of 10,000 g.p.m. containing 1½-2% solids which will have passed through a 3.175mm aperture wedge bar screen. The solids will vary from sand to clays and fine beet particulate material. The mechanism to include centre drive with overload alarm, bridge, feeder launder, feed well, sludge removal scrapers, adjustable overflows, weir, scum skimmers and scum box, walkways, handrails and guards. Also included should be a cylindrical steel centre column suitably protected against corrosion and fitted with two underflow connections at the base of the column. Underflow pumps and piping to be supplied by others but platforms for underflow pumps to be provided, attached to the side of the bridge, to give a maximum suction lift of 1.83 m.

Appendix II

		Quantity
Warman Pump Type:	Series 'A' Heavy Duty Slurry	one
Size:	8/6 EAM	
Liners Nihard	Impeller: 5 vane closed suction Nihard	
Shaft seal:	Flushed Gland	
Combination bedplate		one
Overhead motor support c/w support bolts		
Vee Rope Drive complete		one
Drive Guard		one
Electric Motor:	Frame D250S H.P. 75 pole 4	
Foot mounted c/w motor Slide rails	Enclosure TEFC Volts 440 Hz 50 pH 3	one
Suction conditions based on 1.83m lift 10.5m of 200mm pipe and two bends		

Appendix III

Operating Conditions			
Carrying Liquid:	Water	Solids:	Silt
Specific Gravity:	1.0	Specific Gravity:	2.6
Viscosity	.....	Concentration by Weight:	20%
pH	.....	Specific Gravity Mixture:	1.15
Temperature	.....	Max. Particle Size:	62mm
NPSH required:	3m	NPSH available:	5m
		Av. Particle Size	....
Mixture Capacity:	900 g.p.m. 246 t/h	Total Head:	28m
Inlet Head:	1.8m lift	Corrected Total Head	30m (allow. for solids)
Pump Speed:	800 r.p.m.	Absorbed Horsepower	58



Appendix IV. General arrangement of mud thickener and associated pumps

SUGAR CANE AGRONOMY

Seed-cutting program at Honokaa Sugar Company. Y. Kawawaki. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 57-59. – The system used at Honokaa Sugar Co. involves mechanical cutting of seed cane for replanting, while manual cutting is used to provide plant cane. Problems occur with both types of harvesting, and these are discussed. Future prospects are also briefly examined.

The Benchmark Soils Project and its impact on Hawaii. J. A. Silva. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 64-68. – Details are given of the title project established in 1974 by the University of Hawaii in collaboration with the US Agency for International Development (AID) and based on the fact that similar soils, regardless of their location, have similar management needs and production potentials. A companion project set up by the University of Puerto Rico and AID in 1975 works in close cooperation with the Hawaiian project. A table lists the taxonomic names of soils within the project, the corresponding inherent soil family characteristics and management requirements. Use of the "transfer" concept (transferability of agrotechnology to soils in the same family) will permit practices used in cane fields of one sugar company to be applied to cane fields of other companies, provided the soils belong to the same family. The important part played by climate in soil taxonomy is discussed in relation to the occurrence of particular diseases and weeds.

The effect of saline irrigation water on sugar cane ripening. G. Prothero. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 69-71. – Salinity is a widespread problem in fields irrigated with pump water at Pioneer Mill Co., where drought conditions over the 10 years up to 1978 caused increase in the salt concentration. Studies have shown that cane yield falls with increasing water salinity, but, in addition, difficulty in ripening of cane has been observed under saline conditions. Investigations showed that the conductivity of irrigation water affected the absolute juice conductivity of prepared samples of 50-7209 cane; increase in the juice conductivity was accompanied by a significant fall in pol % cane, while Brix % cane remained fairly constant over a wide conductivity range, so that juice purity fell. Decrease in cane moisture apparently leads to an increase in pol % cane, suggesting increased ripening with decreased moisture, although no significant correlation was found between conductivity and moisture.

Sugar cane response to Zn fertilization. D. L. Marzola and J. A. Silva. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 72-76. – Increase in Zn application to plant cane on two Zn-deficient soils was accompanied by increase in Zn uptake and cane yield up to maximum values at 12.1 lb.acre^{-1} Zn, after which both parameters fell when the application rate was doubled. Ratoon yield was not significantly affected by Zn application, suggesting that the available Zn was adequate, particularly at the low pH of the soil (3.8-5.2) at which Zn availability is high; moreover, the more extensive root system of ratoons would permit greater Zn extraction. Application of P, by promoting cane rooting, has been found to correct Zn deficiency. Comparison of three Zn extractants showed that 0.1N HCl extracted the most; critical for this extractant was a Zn soil content of 9.5-12.6 lb. acre^{-1}. Highest correlation between Zn content in plant tissue, total Zn uptake and extractable soil Zn was found for internodes 3, 4 and 5 (the immature stalk), and further research is therefore suggested to evaluate this tissue as an indicator of Zn nutritional status in the plant.

Ripening cane through small mill sampling. G. C. Schattenburg. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 77-78. – A lever-type sampler to express juice from the top and bottom internodes (8-13 and 16-18, respectively) was used in a system designed to determine cane maturity. The juice is analysed for Brix, pol and conductivity. From each sample (comprising 5-7 stalks) leaves 3-6 are separated and analysed for N, while the moisture is determined in their sheaths. Statistical analysis indicated a correlation of 0.69 (at the 99% confidence level) between the purity of juice in the bottom internodes and that of juice from prepared cane sampled in the mill; for top internodes, the correlation was 0.55 at the 95% confidence level. The scheduling of sampling, irrigation and harvesting is outlined.

Plant physiology. *Ann. Rpt. Sugar Ind. Research Inst., Agric. Divn.* (Jamaica), 1975, 7-15.– Filter press mud from five Jamaican factories contained some 40% C, 3% P_2O_5, 3% Ca + Mg, 1.4% N and 0.3% K_2O. Applied at up to 15 tons.acre^{-1} to plant cane, it increased yield but had very little long-term effect on soil chemical properties. It did not interact with muriate of potash applied to the soil surface 7 weeks after planting. Controlled-release sulphur-coated urea (SCU) applied at 60 and 120 lb.acre^{-1} N to the soil surface increased cane yield, but there was no difference between the results for SCU and ammonium sulphate. Application of potash as a split dressing or later in the cane growth period has no advantage over application as a single dressing early in the growth period, which is considerably less expensive than the other two operations. Details are given of N-P-K factorial trials. Polaris ripener increased cane sugar content in field trials; in greenhouse trials, Ethephon (CEPA) applied to setts at 10,000 ppm a.i. profoundly affected the subsequent growth habit of the seedlings; some of these effects could be of benefit under field conditions, while others would be of disadvantage.

Herbicide trials. *Ann. Rpt. Sugar Ind. Research Inst., Agric. Divn.* (Jamaica), 1975, 23-28.– Changes in the general pattern of herbicide use in Jamaica are noted and reasons given for the changes. The most troublesome weeds are indicated, and details are given of herbicide trials. The excellent performance of Roundup (Glyphosate) is mentioned.

Effects of the use of vinasse as fertilizer for sugar cane. G. M. A. Silva, L. J. P. de Castro, A. C. Sanches *et al. Bol. Tec. Copersucar* (Brazil), 1978, (7-78), 9-14, 16; through *S.I.A.*, 1979 **41**, Abs. 79-1021. – Tests on the use of vinasse on ratoon cane grown in dark red latosol soil are reported; cane yields and compositions are

FS in the Philippines

Fletcher and Stewart have been actively engaged in the supply of plant and equipment to the Philippine sugar industry for over a decade.

We have recently completed our fourth turnkey project in the islands namely the Batangas sugar refinery located on the island of Luzon.

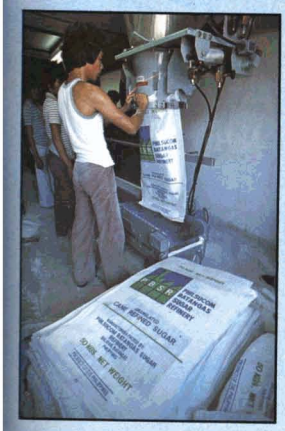
The refinery process, capable of producing 550 tonnes of high quality refined sugar per day, also incorporates a self-contained recovery plant to convert refinery reject liquors to raw sugar for recycling with the incoming raws.

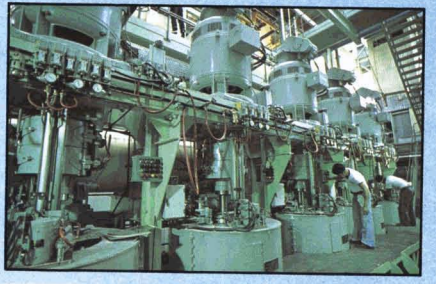
The Batangas refinery will play an important role in the Philippine Sugar Commission's (PHILSUCOM) strategy for improving the quality of sugar produced in the islands and so encourage the further development of local industries such as soft drinks and fruit canning without the need for importing the special grades required by these users.

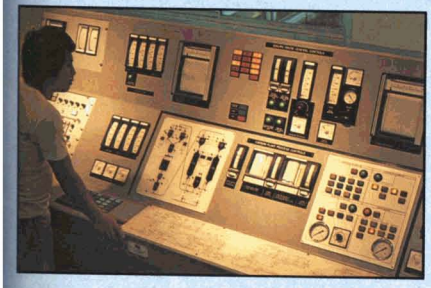
FS Turnkey Projects in the Philippines

- **Northern Cotabato Sugar Factory 4000 MTCD—raw**
- **Davao Sugar Factory 4000 MTCD—raw**
- **Bicolandia Sugar Factory 4000 MTCD—raw**
- **Batangas Sugar Refinery 550 MTCD—high quality refined granulated white sugar**

Fletcher and Stewart also have manufacturing and associate business companies, both solely concerned with projects planned for the islands - offering on-the-spot localised knowledge.







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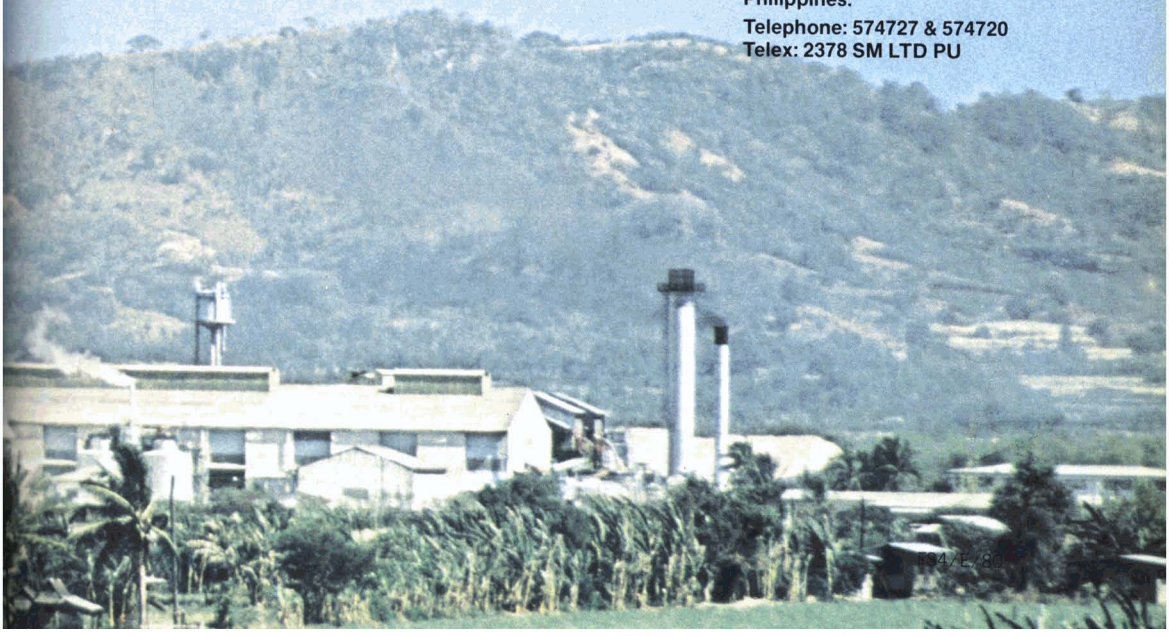
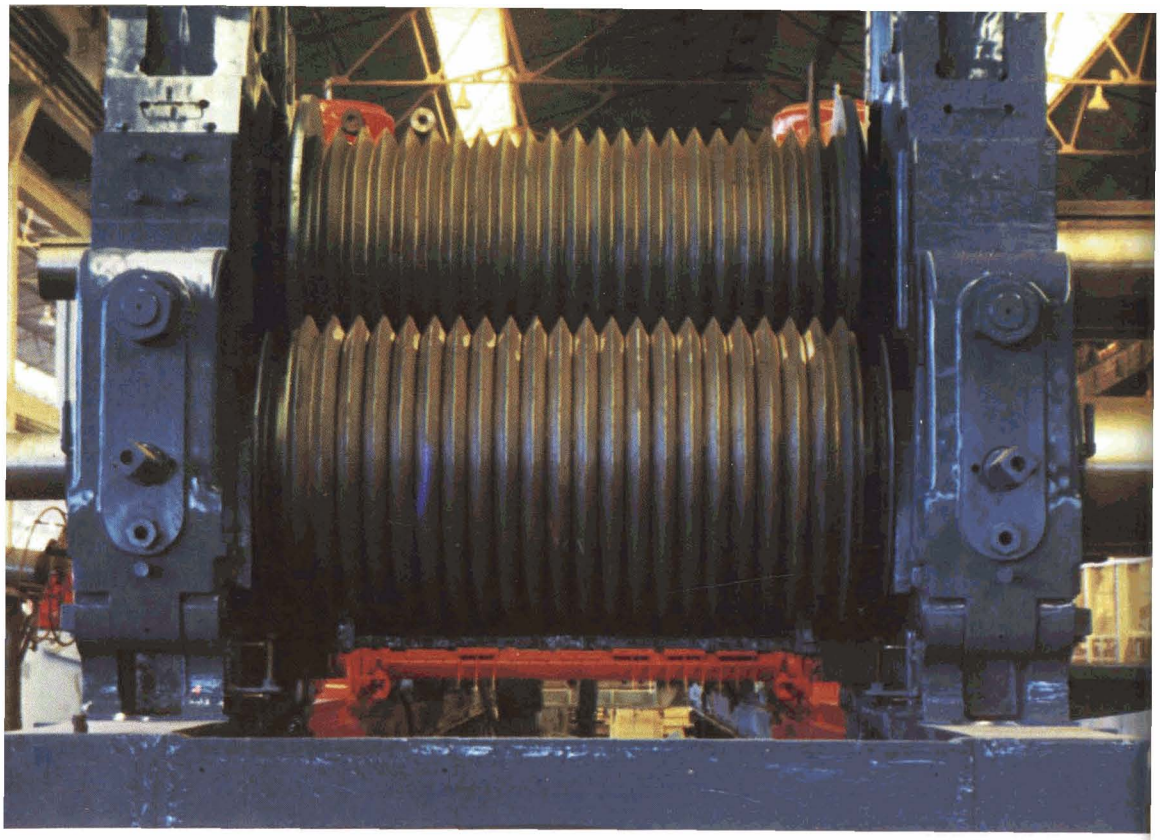


IN AUSTRALIA

Western States' reputation for dependability is an important consideration to Australian sugar processors when they specify centrifugals. That's one of several reasons why there are so many Western States batch and continuous centrifugals there. A second big reason is profitability ... resulting, in part, from high efficiency, low maintenance, extra long life and quick payback. Want to talk about it? Contact your local Western States representative or Mr. James Coleman, General Sales Manager.



Trapiches Zanini, el dulce sabor del suceso.

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

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

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compared for nine combinations of 0-60 m^3 vinasse/ha with or without conventional fertilizers. Application of 30 $m^3.ha^{-1}$ alone considerably improved the yields of cane and sugar per ha, with little effect on ash content.

Use of rotary filter cake as fertilizer in the planting of sugar cane. V. Bittencourt *et al. Bol. Tec. Copersucar* (Brazil), 1978, (6-78), 12-15, 16; through *S.I.A.*. 1979, **41**, Abs.79-1050.– Current methods of using filter cake as fertilizer are considered to be inefficient, since most of the nutrients are leached away, never reaching the plants; before application to the furrows, the cake should be enriched with phosphate and allowed to ferment for 60-80 days in piles, e.g. 4-6 m wide, for fixation of nutrients by soil micro-organisms. In comparative tests on N-P-K and/or castor oil seed cake or filter cake, N-P-K + filter cake had the best effect on cane and sugar yield per ha.

Nutrient deficiencies in relation to yield and quality of sugar cane. A. S. Marok. *Indian Sugar,* 1979, **28**, 741-743.– Symptoms of deficiency in cane N, P, K, S, Fe and Mn are briefly described and remedial measures discussed.

Assessment of the water requirement of a seasonal crop of sugar cane (*Saccharum officinarum* **L.**). D. A. Chavan, K. R. Pawar and N. T. Sarnaik. *Indian Sugar*, 1979, **28**, 805-808.– Field experiments on a well-drained soil of medium N status showed that irrigation scheduled at 75 mm cumulative pan evaporation (CPE) gave the highest cane yield and juice sugar content, both of which fell with increase in CPE. For maximum results, 28 irrigations were required, corresponding to a total consumptive use of water of 2102.78 mm, a mean daily consumptive use of 6.33 mm and a water utilization efficiency of 53 kg per mm. The total water requirement for the season was 2800 mm. Differences in response were found between the three varieties grown, Co 740 giving the highest yield but lowest sugar content.

The consumption and conservation of diesel fuel in the production of sugar cane. A. G. de Beer and T. J. Murray. *S. African Sugar J.,* 1979, **63**, 288, 291, 295. – The consumption of diesel fuel in the different cane agriculture operations and in cane transport by various means in South Africa is indicated, and recommended measures to reduce consumption are described.

Availability indices of soil nitrogen during the growth period of sugar cane in a mollisol of northern India. C. N. Rao, R. S. Sachan and T. A. Singh. *Indian Sugar*, 1979, **29**, 89-95.– A field experiment to study the changes in N availability during the crop growth period is reported. The contents of organic C, nitrate nitrogen and available N (as determined with $KMnO_4$) were established at three soil levels (0-15, 15-30 and 30-45 cm) and at six stages. The available N fell by some 10% over the period.

Dry matter accumulation pattern of three varieties of seasonal crop of sugar cane as influenced by various levels of irrigation. D. A. Chavan, K. R. Pawar and D. N. Borulkar. *Indian Sugar*, 1979, **29**, 97-103.– In a field experiment, the rate of dry matter accumulation in cane was increased significantly at all stages of crop growth when irrigation was applied at 75 mm cumulative pan evaporation (CPE) by comparison with 125, 175 and 225 mm CPE. The rate of increase in dry matter was low in the initial growth stage, very rapid during the subsequent 220-250 days and thereafter low until maturity. Differences were found in the rate between the three varieties studied.

The results of frost simulation studies on sugar cane in the Rhodesian lowveld. K. E. Cackett and R. J. Haslam. *Proc. S. African Sugar Tech. Assoc.,* 1979, 129-136. In a study of the effects of mild and severe frost damage on cane of different ages, varying amounts of terminal buds and stalks were cut off in mid-winter. The effects of the simulated frost damage on cane and sugar yields and cane quality were assessed. The deterioration between the time of damage and normal harvest is discussed in relation to decisions on whether to cut back the cane after iniury or leave it standing until maturity at 12 months. While yield is an important guide to such decision, it is stressed that the final choice must include a more detailed evaluation of quality factors in relation to the value of the harvested crop for the producer.

Research into soil and water losses from sugar cane fields. G. G. Platford. *Proc. S. African Sugar Tech. Assoc.*, 1979, 152-157.– A research program to measure soil and water losses from cane fields is described; it comprises four separate projects, covering (1) rain erosion potential, (2) soil loss from run-off, (3) the effect of field layout on soil loss and run-off, and (4) the effect of gradient (where slopes exceed 20%) on the factors studied. The aim is to establish acceptable soil loss limits for each of the different soil types in the South African cane belt. Mathematical modelling will be used to permit application of the data collected from a limited number of sites to other areas.

Effects of photoperiod and temperature on the rate of elongation of sugar cane leaf sheaths. E. Edwards and J. G. Paxton. *Proc. S. African Sugar Tech. Assoc.,* 1979, 163-164.– Measurement of the rate of sheath elongation of flowering cane stalks, using five varieties and six photoperiod treatments, showed that the rate was lowest and the period from flower initiation to emergence longest when the daylength was held constant at 12.5 hours by comparison with a declining daylength. The fastest leaf sheath elongation was achieved by reducing the daylength by 50 sec per day after initiation; the other treatments involved a 30 sec/day reduction in daylength. Temperature affected both elongation rate and final length of the leaf sheath.

The effect of lime on release and plant uptake of nitrogen from soils of the Natal Midlands. R. A. Wood. *Proc. S. African Sugar Tech. Assoc.,* 1979, 173-176. Soil samples from the cane areas of the Natal Midlands were treated with $CaCO_3$ at rates of 5 and 10 tonnes.ha^{-1} and then incubated for 2 and 4 weeks at 30°C. Significant linear correlation was found between the amount of N mineralized and soil organic matter content in the absence or presence of lime; N mineralization was greatly increased by the lime, the quantity of N released being greater with increased lime. These results were confirmed by a glasshouse trial in which N uptake was increased by liming when sorghum was grown on the soils tested. However, it is possible that increased N mineralization following the liming of acid soils could lead to a reduced cane sugar content, so that N fertilizer recommendations for the region would have to be adjusted.

CANE PESTS AND DISEASES

New chemicals for nematode control in the Bundaberg district. R. M. Bull. *Proc. Australian Soc. Sugar Cane Tech.,* 1979, 99-103. -- Root nematode damage has been responsible for reduced cane yields on extensive areas of sandy soil in the Bundaberg district. Temik and Mocap were found to increase crop yields when applied as row dressings to affected young cane. Adequate soil moisture soon after application was necessary for significant responses, and these were better when the chemicals were applied before winter. Optimum rates appeared to be 2.5 and between 4 and 6 $kg.ha^{-1}$ a.i.

Observations on incidence and effects of rat damage in sugar cane crops of the Macknade area. B. T. Roach and S. J. Evans. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 105-109. -- Records available since 1930 were used to examine correlations between spring rainfall and the extent of rat damage to cane, as well as other factors. The association between the two, as suggested by Gard[1] and McDougall[2], seemed to be confirmed for certain periods, especially for 1971/78. Assessment of the effects of rat baiting failed to produce evidence of its effectiveness, and the admittedly low cost is estimated at slightly more than half the loss in c.c.s. caused by rat damage in 1978.

Insect pests of sugar cane in Punjab and their control. I. Sucking pests. D. O. Garg and J. P. Chaudhary. *Indian Sugar*, 1979, **28**, 697-701. – Information is given on the leaf hopper *Pyrilla perpusilla*, two species of white fly (*Aleurolobus barodensis* and *Neomaskellia bergii*), the black bug (*Macropes excavatus*), two species of mealy bug (*Saccharicoccus sacchari* and *Pseudococcus saccharifoli*) and three species of mite (*Oligonychus indicus, Schizotetranychus andropogoni* and *Aceria* sp.). Means of control are indicated.

Studies on the biology of *Marasmia trapezalis* Guen. (Pyraustidae: Lepidoptera) on sugar cane. T. A. V. S. Raghunanth and T. A. V. S. Ramakrishna. *Indian Sugar*, 1979, **29**, 19-21. – The life history and stages of *M. trapezalis*, a leaf roller recently recorded on sugar cane in India, are described. A larval parasite, *Bracon* sp., has been observed during studies on the pest.

A preliminary study on chemical control of the white grub, *Holotrichia serrata* F., damaging sugar cane. H. David and K. Ananthanarayana. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.27-Ag.31. – See *I.S.J.*, 1978, **80**, 272.

Is it difficult to control the white grub (*Holotrichia serrata* F.) in Maharashtra state P. R. Moholkar, S.J. Ranadive and B. S. Shewale. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.33-Ag.40. – See *I.S.J.*, 1978, **80**, 272.

A review on causes and remedies of iron chlorosis in sugar cane. A. K. Garg and K. D. Agarwal. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.41-Ag.46. – See *I.S.J.*, 1978, **80**, 272.

Studies on *Sturmiopsis inferens* Towns. – a promising parasite of the sugar cane stalk borer, *Chilo auricilius* Ddgn., at Jagadhari. O.P. Singh and S.R. Yadav. *Indian Sugar Crops J.*, 1979, **6**, 27-28. – Laboratory studies concerning the general biology, multiplication and sex determination from the pupal stage of the tachinid fly, *S. inferens*, are reported.

Rust of sugar cane in Louisiana. L. L. Lauden. *Sugar Bull.*, 1979, **57**, (19), 3. – Reference is made to the discovery of rust, tentatively identified as *Puccinia melanocephala*, on a number of varieties at test stations in Louisiana. A brief description is given of the symptoms.

A name change for the rust pathogen. B. T. Egan. *Sugarcane Pathologists' Newsletter*, 1979, (22), 1. Since the pathogen found on *Erianthus* sp. and described in 1907 as *Puccinia melanocephala* was later proved to be identical to the pathogen responsible for a major rust epidemic in India in the 1940's and 1950's (identified as *P. erianthi*), the name should now be used to describe the common rust of sugar cane in place of *P. erianthi*. *P. kuehnii* is still the valid name for another rust disease, and it is suggested that a name for the disease should be coined to distinguish it from the common rust.

Rust: a new sugar cane disease in Puerto Rico. L. J. Liu. *Sugarcane Pathologists' Newsletter*, 1979, (22), 2-3. – See *I.S.J.*, 1980, **82**, 340.

An outbreak of sugar cane rust in Jamaica. R. A. Burgess. *Sugarcane Pathologists' Newsletter*, 1979, (22), 4-5. Reference is made to the occurrence of rust in the humid western area of Jamaica in September 1978. (See also Koike *et al.*: *I.S.J.*, 1980, **82**, 340)

Sugar cane rust in the Dominican Republic. L. J. Liu and F. Bernard. *Sugarcane Pathologists' Newsletter*, 1979, (22), 5-7. – The outbreak of *P. melanocephala* in the Dominican Republic in 1978 is described. B 4362 was the variety affected, and its replacement by resistant varieties is considered the most economical way of controlling the disease. The fact that the disease incidence was greater at some locations than at others is attributed to the heavy rainfall combined with a temperature below the critical for urediospore germination, which favoured the disease, while the heaviest incidence was found where the rainfall was more moderate but the heavy clay soil had a high water retention capacity. The susceptibility and resistance ratings of varieties are given.

Rust in Guatemala. A. L. Fors. *Sugarcane Pathologists' Newsletter*, 1979, (22), 8. -- *P. melanocephala* was found on B 4362 cane in Guatemala in 1979, infection being most severe on the taller young ratoons which had not yet developed stalks; it is probable that the cane was infected during the humid, cool season by urediospores coming from southern Mexico where the disease has also been reported. Red stripe was also found together with rust on the ratoons.

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[1] *Proc. 5th Congr. ISSCT*, 1935, **594** - 603.
[2] *Queensland J. Agric. Sci.*, 1946, **3**, 1 - 43.

Sugar cane rust in Haiti. A. L. Fors. *Sugarcane Pathologists' Newsletter*, 1979, (22), 9. – Rust was found on B 4362 and Citadelle 1 cane, which formed part of a variety bank growing in northern Haiti; it also occurred in less severe form on other varieties. However, the varieties mainly grown in the northern part of Haiti appear to be rust-resistant.

Susceptible indicator varieties for rust disease *(Puccinia melanocephala)*. B. T. Egan. *Sugarcane Pathologists' Newsletter*, 1979, (22), 10-11. – A table is given of seven cane varieties found to be susceptible to rust (mostly *P. melanocephala, P. kuehnii* being probably confined to the Asia-Australasia-Pacific region and having been endemic for at least 30 years at Meringa Sugar Experiment Station in North Queensland). The canes listed have been widely distributed throughout cane-growing countries because of certain superior qualities as commercial canes or as parents. The countries in which they have shown susceptibility to rust are indicated. It is stressed that the list is not exhaustive.

Sugar cane rust in South Africa. R. A. Bailey. *Sugarcane Pathologists' Newsletter*, 1979, (22), 12-13. – Rust probably causes some 100,000 tonnes of cane to be lost each year in South Africa, but the disease is not considered to pose a major problem. N 55/805, highly susceptible to rust, constitutes some 10% of the total crop, but planting of it is likely to decline for other reasons as well as its rust susceptibility. The disease is most severe in the cooler, more southerly and high-altitude areas, climatic variations within and between growing seasons also having a marked effect on incidence, which is favoured by long periods of cool, wet weather, especially when these coincide with a young stage of growth. While excellent control has been obtained with Mancozeb applied at intervals of up to 2 weeks from one month after planting or harvesting, it is thought that a fungicide spray program would not be economically justified.

Identity and importance of sugar cane rust in Mauritius. C. Ricaud and J. C. Autrey. *Sugarcane Pathologists' Newsletter*, 1979, (22), 15-16. – The situation regarding rust (*P. melanocephala*) in Mauritius is described. The disease is not considered a cause for concern, and is no more important than other minor leaf spots such as brown spot. Of commercial varieties, M 442/51, M 124/59 and Triton have shown the greatest susceptibility to rust; however, the first has been almost completely removed, while the other two have only recently been released. The disease is most severe in young cane shortly after planting. Plant cane is usually more severely affected than ratoons. Infection decreases as the cane ages, particularly after the canopy has closed, and very severe infection has been found to disappear almost completely by harvest time. High atmospheric humidity seems to be the most important factor favouring the disease. It is not considered necessary to select for rust resistance in the local breeding program.

Effect of sugar cane mosaic virus infection on the energy content of sugar cane. K. Shukla and R. D. Joshi. *Sugarcane Pathologists' Newsletter*, 1979, (22), 17-18. – In a study of the effect of mosaic on the calorific value (kcal per g dry weight) of leaf, stem and root, cane seedlings were raised in pots filled with sterilized soil and inoculated at the 2-leaf stage, samples then being collected 10, 20, 30, 40 and 50 days later. Comparison with healthy cane showed that the infected cane had a lower calorific value, which rose with time in both healthy and diseased plants.

Loss of aphid transmissibility in an isolate of sugar cane mosaic virus Strain H. H. Koike. *Sugarcane Pathologists' Newsletter*, 1979, (22), 19-20. – Strain H is the dominant mosaic strain in the Louisiana cane belt. Of seven aphid species identified as mosaic vectors, *Dactynotus ambrosiae* is considered the most efficient. Studies were carried out in 1974-77 to compare the transmissibility, both mechanical and by aphids, of several mosaic isolates; freshly collected isolates were compared with a freeze-dried isolate, an isolate that had been maintained on cane in the greenhouse since 1963 and isolates of A, B and D strains that had been maintained in the greenhouse on cane for at least 40 years. The aphid readily transmitted the freshly collected isolates and the freeze-dried isolate, but not that which had been maintained in the greenhouse since 1963; isolates of A, B and D strains were transmitted, but at a low rate by comparison with the freshly isolated H strain isolates. The results indicate that the virus mutated to a form that was not aphid-transmissible, after which the mutant became dominant.

Recent survey of sugar cane mosaic virus strains from Colombia, Egypt and Japan. A. G. Gillaspie and R. G. Mock. *Sugarcane Pathologists' Newsletter*, 1979, (22), 21-23. – Strains of mosaic identified were: A, B and D in Colombia, D and three variants of it in Egypt, and B, H, and I in Japan. The cane varieties from which the virus was isolated are indicated for each strain.

Ratoon stunting disease – a new record in Bangladesh. H. U. Ahmed, M. A. Khan and M. H. Rahman. *Sugarcane Pathologists' Newsletter*, 1979, (22), 23-24. Details are given of the incidence of RSD in second ratoon crops grown at the Sugarcane Research Institute, Ishurdi, Pabna, Bangladesh. Of 51 varieties, 20 were uninfected, 10 had an incidence of 1-15%, 5 were 16-25% affected, 9 were in the range 26-50%, 3 were in the range 51-75%, 2 had 76-90% infection and 2 had 91-100% incidence. The most widely grown varieties, Co 1158 and Co 975, were 27% and 29% infected, respectively.

Limitations of ELISA for detection of the RSD-associated bacterium in sugar cane and Sudan grass. A. G. Gillaspie and R. W. Harris. *Sugarcane Pathologists' Newsletter*, 1979, (22), 25-28. – Experiments involving the enzyme-linked immunosorbent assay (ELISA) are reported. In the method, the virus is selectively attached to an enzyme-coupled specific antibody with which the viral antigen is then reacted. After washing, the anti-body that has been combined with the antigen is detected colorimetrically by adding a suitable enzyme substrate. However, for various reasons which are stated, the studies showed that the method is not suitable for detection of the ratoon stunting disease bacterium.

Screening of sugar cane clones for resistance to red rot. M. S. Beniwal, K. L. Behl and -. Satyavir. *Sugarcane Pathologists' Newsletter,* 1979, (22), 42-43. – Details are given of the red rot resistance of 134 cane varieties screened during the 1976-77 and 1977-78 crop seasons. Only 10 proved resistant, while 43 were moderately resistant, 21 moderately susceptible, 18 susceptible and 42 highly susceptible.

BEET PESTS AND DISEASES

Virus infections of sugar beet in Czechoslovakia in 1975-77. J. Polak and H. Bernardova. *Listy Cukr.*, 1979, **95**, 1-6 *(Czech)*. – A survey is presented of the incidence of beet virus yellows, mild yellows and mosaic in Czechoslovakia in 1975, 1976 and 1977. The data are broken down from national values to factory region and provincial figures.

Protection of sugar beet seedlings against pests. E. Szafarek. *Gaz. Cukr.*, 1979, **86**, 41-42 *(Polish)*. Trials with insecticides for control of aphids and the beet leaf miner in various countries including Poland are reported. Two-year experiments have shown that application of granular systemic pesticides in the furrow gives as good results as two sprayings.

Problems and prospects of the chemical control of fungal diseases, with particular reference to sugar beet Cercospora. S. Georgopoulou. *Hellenic Sugar Ind. Quarterly Bull.*, 1979, (36), 356-365 *(Greek)*. – The value of systemic fungicides for control of beet diseases is discussed, with particular reference to *Cercospora beticola* (leaf spot). The mechanism of the action of fungicides is explained, and the problems created by inherited resistance and host plant tolerance are examined.

Results of beet nematode control. E. Szafarek. *Gaz. Cukr.*, 1979, **87**, 94-95. *(Polish)*. – Trials on beet nematode control with various preparations are briefly reported. Tabulated results showed that Vydate 10G and Temik 5G were the most effective pesticides, giving 43.3 and 42.4 tonnes of beet per ha, respectively, compared with 13.5 tonnes.ha^{-1} for the control, although all treatments gave much higher yields than the control. The numbers of cysts found in samples of soil after each treatment are also tabulated and compared with the control plot.

Late season control of sugar beet powdery mildew. R. L. Forster. *Plant Disease Reporter*, 1979, **63**, 239-241. Tests were conducted on powdery mildew *(Erysiphe polygoni)* control in beets that had become infected shortly before treatment (the disease usually occurring in late August-early September in Idaho). Results showed that one application of flowable sulphur at 3 lb in 20 gal water per acre between August 19 and September 6 significantly reduced disease severity. Root yields were 0.3-7.7% higher than in untreated controls when harvesting was carried out 3-7 weeks after treatment. The effect of treatment on sucrose content varied from a non-significant to a significant increase. Thorough coverage of leaf surfaces is very important for powdery mildew control. On the basis of the tests, it is considered economically justifiable to treat beets when initial infection occurs before September 1.

Field tests on control of *Erysiphe betae* (powdery mildew). W. Hrubesch. *Zuckerind.*, 1979, **104**, 497-503 *(German)*. – Tests were conducted in Austria on control of the title disease by fungicides known for their action against *Cercospora beticola* (leaf spot) as well as fungicides having a specific action against powdery mildew. Best results were obtained with a double application of 1300 g Brestan or 360 g Cercobin M with 750 g Karathane, 100 g Bayleton or 4000 g Cosan; spraying should be carried out immediately the first symptoms appear (the use of mildew-susceptible varieties as a warning system is recommended). Treatment increased beet yield by comparison with the controls.

Aerial photography of nematode attack. Anon. *Die Zuckerrübe*, 1979, **28**, (4), 32-33 *(German)*. – The value of infra-red aerial photography as a means of identifying fields infested with beet cyst nematodes is discussed with the aid of colour photographs showing, for each location, the actual film and level of incidence as interpreted by an electronic film analyser using colour coding.

Investigations on infection and pathogenesis of sugar beet infected with *Phoma betae* (*Pleospora betae* Björl.). F. Koch and M. Panagiotaku. *Zuckerind.*, 1979, **104**, 611-618 *(German)*. – Investigations of beet rot caused by *P. betae* are reported. These showed that the inoculum potential of a soil contaminated with the residue from seed-bearing beet is of greater epidemiological importance than the degree of incidence of the disease in seed to be sown. Seed disinfection increases seedling emergence considerably, but can only reduce the incidence of the disease in a heavily contaminated soil, not eliminate it. Pathogenesis of the causal fungus evidently follows a systemic course. Infection resulting from soil or seed contamination may appear at any time during the growth phase, whereas during the generative phase the pathogen will become more and more apparent on seed-bearing beet only after the flowering period, when ripening will increasingly allow a saprophytic existence.

Combating the pygmy mangold beetle. E. Szafarek. *Gaz. Cukr.*, 1979, **87**, 164-165 *(Polish)*. – Tests on control of *Atomaria linearis* are reported. A number of granular products proved suitable and could be mixed with certain herbicides. No data are given on numbers of the pest destroyed or on beet yields.

Investigations on field diagnosis of viral root fanginess (Rhizomania) of sugar beet. W. R. Schäufele, C. Winner and D. E. Lesemann. *Zuckerind.*, 1979, **104**, 731-736 *(German)*. – Root fanginess in an area of West Germany has been attributed to beet necrotic yellow vein virus (BNYV) caused by *Polymyxa betae.* While infection causes considerable falls in beet yield and quality, characteristic symptoms such as irregular yellow spots along the leaf vein are found only occasionally. Experiments were carried out to determine how accurate would be estimation of the damage to individual plants and rate of infection of the entire crop based on field diagnosis, i.e. without evidence of the presence of the virus. Of the parameters selected for study, darkening of the vascular bundles in the roots of relatively young beets proved to be the most suitable indicator of infection. Close correlation was found between it, degree of root fanginess, beet weight and sugar content, and presence of the virus in sampled plants.

CANE SUGAR MANUFACTURE

On the use of steel tubes in heat transfer equipment in the Indian sugar industry. N. A. Ramaiah, K. K. Gupta, K. H. Rao and M. U. Ovaisi. *Sharkara*, 1975, **14**, (4), 5-33. – Comparison is made between steel and brass tubes as used in juice heaters, evaporators and vacuum pans, showing that steel tubes have a longer life and cost less than brass tubes; while operational parameters are the same for both types of metal, steel tubes must be dried-off at the end of the season in order to prevent rusting.

An improved design of a juice sulphitation unit for a double carbonatation sugar factory. B. D. Chinchawade and R. P. Sharma. *Sharkara*, 1975, **14**, (4), 43-50. A description and diagrams are given of a continuous sulphiter design.

A new device for cane preparation. P. N. R. Rao, H. N. Gupta and K. C. Garg. *Sharkara*, 1976, **15**, (1), 5-15. See Garg *et al.: I.S.J.*, 1978, **80**, 245.

Clarification characteristics of Co 1148 variety of cane – a case study. K. K. Gupta, K. H. Rao, K. P. Sinha and S. B. Nazeer. *Sharkara,* 1976, **15**, (2), 3-10. – Juice from Co 1148 cane is characterized by a high ash, silica and colloid content and low phosphate content, so that it is refractory and creates problems in clarification. Investigations are reported in which different clarification methods were compared. Highest apparent purity rise, lowest mud volume and second lowest colour content were achieved by preliming to pH 6.7 followed by heating to 75°C, liming and sulphitation, total milk-of-lime usage being 2% by volume at a density of 12°Bé.

Some observations on the use of phosphate in the double carbonatation process. K. H. Rao and K. P. Sinha. *Sharkara*, 1976, **15**, (4), 5-8. – Addition of phosphate to 2nd carbonatation juice to make the P_2O_5 content up to 80 mg. litre^{-1}, followed by heating to 70°C, filtration and sulphitation to pH 7.0, reduced floc formation in the clear juice as well as the lime salts and colour contents, while raising the clarification efficiency by comparison with results obtained without phosphate 1addition. Details are given of laboratory- and factory-scale experiments.

Thermal efficiency and its economy in sugar plants. S. K. Ghosh. *Sharkara*, 1976, **15**, (4), 9-15. – See Ghosh: *I.S.J.*, 1979, **81**, 119.

Fifty years of Hawaiian sugar factory contributions. R. E. Beiter. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 85-88. – Developments in equipment and processes as used in Hawaiian sugar factories in the period 1928-78 are reviewed.

Lihue power plant project. W. E. McCraw. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 92-93. – The nine boilers and three turbo-generators at Lihue were to be replaced with one generator and a single dual-fired boiler having a maximum continuous rating of 336,900 lb of steam per hr. This will provide process steam and sufficient electricity to meet the needs of the factory while providing excess for sale to the local utility. The fibrous fuel will include bagasse, cane leaf trash and municipal refuse.

On-line sealing of high-pressure leaks. L. Myers. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 94-95. Details are given of pressure injection of a sealant for the repair of leaks. Ranges of application of the process and advantages resulting from it are indicated.

Update of sulphitation at Puna Sugar Company. R. De Francisco. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 96-97. – Reference is made to the sulphitation scheme introduced in 1978 in order to reduce the high colour content of sugar. Predicted monetary savings resulting from reduction in colour (and hence reduced penalties from the refiners for high-colour sugar) and from increased sugar recovery are calculated. Performance data are to be discussed later.

Sulphitation to improve recovery. G. Takenouchi. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 98-99. High soil salinity after years of drought conditions has led to highly viscous massecuites and so reduced recovery at Pioneer. Trials on the use of sulphitation to improve factory performance indicated a reduction in sugar colour and an increase in recovery as a result of better massecuite circulation in the vacuum pans.

Effect of ripeners on molasses purity and sugar recovery. G. E. Sloane. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 103-106. – It is shown, by means of data from an investigation of factors affecting sugar yield per acre from cane treated with a chemical ripener, that the increase in sugar, when allowance was made for the reduction in cane weight per acre and the increase in molasses purity resulting from a lower reducing matter content by comparison with untreated cane, was substantially lower than when calculated on the basis of tons sugar per ton of cane. It is stressed that the higher molasses purity would be of minor importance if the increase in sugar yield per acre were considerable, but would become relatively more important as the drop in cane yield largely offset any gain in sugar. Hence, only calculation of the sugar yield per unit area will give a valid indication of the economic effectiveness of ripeners.

A material balance study of a cane diffusion plant. G. E. Sloane, G. R. Webster, H. Tanaka and B. J. Somera. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 107-112. – Weekly material balances of diffusion and clarification at Paia sugar factory over a 7-week period (after balances in the previous year had given inconclusive results) showed that no abnormal losses occurred; earlier high losses were attributed to unauthorized dumping of clarifier muds. However, total flow balances were distorted by leakage of significant amounts of water through seals of pumps in the system, while increase in refractometric dry solids in diffusion was ascribed to dissolution of cane fibre components. The value of chloride measurement in the various process streams as an aid to calculation of balances is discussed.

Potential energy economies in the factory. J. Carruthers. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 113-114. – Means of reducing energy consumption in sugar factories are surveyed, including good boiling house control so that no steam is unnecessarily vented to the atmosphere and syrup is maintained at constant Brix (thereby benefiting both evaporator and pan operation), efficient recovery and treatment of 1st evaporator effect condensate (2nd effect, heater and pan condensates not being recommended for use because of ease of contamination), establishment of an optimum maceration rate at which the cost of evaporation of the water does not outweigh any increase in mill extraction resulting from extra dilution, optimum utilization of pumps and motors, care in the use of lighting, efficient use of mechanical power equipment such as a screw press for bagasse dewatering, efficient heat insulation, frequent inspection of steam traps, and checking for compressed air leaks.

Steam and power generation control program at Hawaiian Commercial & Sugar Company Puunene mill. G. R. Webster. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 120–122. – Details are given of the steam and power generation and distribution systems at Puunene, where 60% of the power generated is used to pump irrigation water, and there is always need to supplement bagasse with oil as fuel.

Use of juice conductivity to control diffuser operation. G. A. Matthesius. *Proc. S. African Sugar Tech. Assoc.*, 1979, 45-48.– Preliminary tests on the possible use of conductivity measurements for diffuser control showed that Brix and conductivity profiles along a diffuser are very similar in pattern. The effect of temperature, concentration, pH, insolubles and sulphated ash on juice conductivity was investigated, and simultaneous on-line measurements were made of conductivity at four points in the diffuser. Variations due to changes in cane quality and hence fall in conductivity were transmitted along the diffuser stages with very little delay, while changes occurred in the curves with time, although the curves remained almost parallel. The absence of any sharp changes in conductivity with fall in cane quality were attributed to the smoothing effect of continuous dilution of the scalding juice in the circulation trough, while juice recirculation would also further dampen rapid changes. Hence, it is considered possible and practical to use conductivity as a guide to diffuser performance.

Pre-curing: a method of increasing *A*-massecuite exhaustion. A. D. Robertson, R. D. Archibald, W. R. van Duyker and R. G. Hoekstra. *Proc. S. African Sugar Tech. Assoc.*, 1979, 49-56.– The theory of massecuite pre-curing as a means of allowing the boiling of very high Brix strikes is discussed and factory tests are reported. Results showed that boiling at a very high Brix to increase exhaustion was possible without major problems if 30% of the massecuite was spun directly on dropping and the "heavy" fraction of the molasses then returned to the rest of the massecuite in the crystallizers. There was no evidence to suggest that sugar quality would be adversely affected.

Clarification and the non-pol ratio: statistical analysis. A. Rouillard. *Proc. S. African Sugar Tech. Assoc.*, 1979, 57-61.– Statistical analysis of data from South African factories over six years has shown that the non-pol ratio (non-pol in sugar and molasses/non-pol in mixed juice, where non-pol is the difference between Brix and pol) is valid as an indication of the trends in the non-sugars balance during clarification and that it is adversely affected by a low juice phosphate content and overloading of the clarifier. It was also found that the quantity of ash going to molasses is a function of the non-pol ratio.

A preliminary investigation into factors affecting gas formation in massecuite and molasses. G. M. Newell. *Proc. S. African Sugar Tech. Assoc.*, 1979, 62-65. Investigations of gas formation in massecuite showed that it was most prevalent in *C*-massecuite and *C*-molasses, but may also occur in syrup and *A*- and *B*-massecuites, although at relatively high temperatures. Of a number of factors studied, temperature was found to have the greatest effect on the rate of gas evolution, followed by the total solids content and purity; a high temperature and total solids content coupled with a low purity promoted gas formation. The reaction leading to gas formation is probably a Maillard reaction (involving an amino-acid and a reducing sugar). The gas evolution is accompanied by loss of some sucrose, some levulose and a relatively large quantity of dextrose.

A cane core sampling installation at Umfolozi. G. G. Ashe. *Proc. S. African Sugar Tech. Assoc.*, 1979, 76-77.– Two core samplers mounted on a platform are used with Company cane trucks; the rotating corer travels horizontally halfway into the cane, stops rotating, withdraws the sample and places it over the hopper feeding a pre-breaker at the other end of the platform. The sample is ejected by piston and collects in a tray below the pre-breaker. The sample is then sub-divided, placed in a bucket marked with the farmer's code number, and conveyed to the laboratory. A similar system with an inclined core sample is used for cane delivered in rail trucks belonging to South African Railways. Results were to be compared with those obtained using a hatch and a grab sampler, although pol and Brix values obtained when the core samplers were used were within 0.50% of the factory balance.

Survey of cane yard equipment and operation. M. R. Kedian. *Proc. S. African Sugar Tech. Assoc.*, 1979, 78-81.– See *I.S.J.*, 1980, **82**, 181.

New type cane off-loading grab. G. G. Ashe. *Proc. S. African Sugar Tech. Assoc.*, 1979, 82-83.– A cane grab, which can be operated by the crane driver from his cab without the need for another man to guide it, is briefly described.

Measurement of the power split on a five-roller milling unit. J. M. Moult. *Proc. S. African Sugar Tech. Assoc.*, 1979, 90-93.– The power split between the pressure feeders and a No. 1 and No. 5 five-roller Walker mill was determined by measuring the input torque on the tail bars of the respective sections of each unit, each of which has a single steam turbine as power source; the pressure feeder section and mill section are fed by separate shafts after two reduction gear boxes. It was found that approx. 73% and 14% of the developed turbine power was fed to No. 1 mill and pressure feeder, respectively, and 73% and 6% to No. 5 mill and pressure feeder, respectively. The equipment used and some of the problems encountered are described.

BEET SUGAR MANUFACTURE

Large sugar factories with columnar equipment. E. Walerianczyk. *Gaz. Cukr.*, 1979, **87**, 130-132 *(Polish)*. The problems associated with large beet sugar factories[1] are discussed, particularly the considerable quantities of material handled, the very high fresh water and chemicals requirements, and the difficulties of treatment and disposal of the large volumes of waste material. Some analogy is drawn between the chemical and sugar industries.

Dolna Mitropolia sugar factory – an example of good Polish-Bulgarian collaboration. Z. Nitschke and Z. Nowak. *Gaz. Cukr.*, 1979, **87**, 132-136 *(Polish)*. – Information is given on the processes and equipment at Dolna Mitropolia sugar factory in Bulgaria, and some results are presented for the 1978/79 campaign.

Conveyor for removal of exhausted cossettes from diffusers to pulp presses. G. N. Stepanov. *Sakhar. Prom.*, 1979, (7), 23-25 *(Russian)*. – Details are given of a "home-made" steeply inclined conveyor built along the lines of an elevator; the cossettes are carried on metal sections at right angles to the base of the conveyor, and side sections form a trough.

Multiple-speed induction motors for sugar centrifugals. J. Szczurek. *Gaz. Cukr.*, 1979, **87**, 149-153 *(Polish)*. Details are given of a Polish-designed, patented 5-speed motor, the SC54, which is intended for use with centrifugals of 750 and 1000 kg massecuite capacity.

A float-type flowmeter for polluted liquids. T. Bogumil and A. Bujanowski. *Gaz. Cukr.*, 1979, **87**, 156-159 *(Polish)*. – A patented float-type flowmeter is described which proved sufficiently accurate in tests on sugar factory effluent flowing at 3 $m^3.hr^{-1}$; measurement error was $< \pm 2.5\%$.

Experience in treatment of Class I and II recycle waste waters at Kozova sugar factory. A. I. Sorokin, A. P. Parkhomets, V. Z. Nakhodkina, V. V. Tikhii, V. I. Chernyi and V. V. Yushchak. *Sakhar. Prom.*, 1979, (8), 29-33 *(Russian)*. – A system of periodical treatment of highly polluted waste water is described in which sufficient chlorine gas and sodium hypochlorite are injected, in accordance with the COD level, to maintain the numbers of specific categories of bacteria within set limits. Chlorine consumption is thus kept at an optimum, which is much lower than the quantity previously used for waste water treatment.

Investigation of the microflora in thick juice. A. A. Muntyan, K. N. Kornovak, G. A. Mazurenko, N. Z. Prudnik and O. S. Stepanova. *Sakhar. Prom.*, 1979, (8), 33-35 *(Russian)*. – The microbial composition of beet thick juice stored for up to 6 months in a sterilized tank after treatment with different amounts of formalin is discussed. Considerable increase in the total bacterial population took place during storage, differences developing between the 30 types of micro-organism. The most abundant were those normally soil- and airborne: *Bacillus subtilis, B.mesentericus, B.saccharaliticus, Sarcina flava, S. alba, S.rosea, Leuconostoc mesenteroides, Staphylococcus album, S.aureus* and *S.flava*. Since the juice was practically sterile when analysed before storage, the bacterial development is attributed to secondary infection from other sources such as the equipment used to feed the syrup to the tank. Hence the need for strict sterilization of all vessels and equipment; treatment of the juice itself and application of a surface layer of bactericide are only to be regarded as supplementary measures.

Reduction in injury to beet roots and improvement in their storage – a task of greatest importance. N. N. Gorbunov and M. I. Povalyukhin. *Sakhar. Prom.*, 1979, (8), 39-43 *(Russian)*. – Investigations at Ramon factory highlighted the adverse effect of damage sustained during harvesting on beet storage losses and processing properties. Comparison is made between undamaged beets and beets suffering from injuries to their crowns, tail sections and sides in terms of physico-chemical parameters and processing parameters after 91 days' storage with forced ventilation and with and without moistening of the injected air.

The new Dimitrije Tucovic sugar factory near Belgrade. A. Milovanovi c. *Zuckerind.*, 1979, **104**, 618-621 *(German)*. – Details are given of the title factory constructed in Yugoslavia for a daily slice of 6000 tonnes of beet, with provision for expansion to 9000 tonnes/day. A full list is given of the equipment and its suppliers.

New high-capacity sugar factories. M. Skrabal. *Czechoslovak Heavy Ind.*, 1979, (8), 2-12. – The construction of larger beet and cane sugar factories by Czechoslovakian concerns is described, with diagrams and photographs of equipment.

The temperature conditions in rotary diffusers. N. V. Pogorelova and V. M. Lysyanskii. *Izv. Vuzov, Pisch. Tekh.*, 1979, (3), 104-106 *(Russian)*. – Investigations have shown that the absence of suitable prescalding arrangements in many cases leads to an inadequate cossette temperature in the diffuser, so that the diffusion temperature up to the tail section will be below optimum. Raising the temperature in the tail section by adding condenser water will merely increase pectin peptization. It is recommended: to provide rotary diffusers with suitable prescalders to permit maintenance of an average temperature of 72°C throughout the diffuser length, to reduce the temperature in the tail section to 55°C, to install pumps for juice recirculation, and to raise the circulation juice temperature to 85-90°C by heating with 2nd effect vapour.

Heat transfer in crystallizers having a rotary cooling surface. A. I. Gromkovskii and V. M. Fursov. *Izv. Vuzov, Pisch. Tekh.*, 1979, (3), 107-112 *(Russian)*. The effect of massecuite hydrodynamics and physical properties on heat exchange in crystallization is discussed, and equations are developed for calculation of the heat transfer coefficient for crystallizers having rotary tubular or disc-type cooling elements. It is shown that the coefficient for the tubular type is 1½ times that

[1] Wozniakiewicz: *I.S.J.*, 1980, **82**, 123.

of the other type under identical conditions.

The dependence of heating surface requirement on heating surface area and raw juice draft. P. Valentin. *Zuckerind.*, 1979, **104**, 695-701 *(German)*. – The dependence of the heat requirement for heating purposes at the juice end of the sugar factory on the heating surface area of the evaporators and heat exchangers and on raw juice draft is investigated, enthalpy balances being established for diffusion, juice purification, thin juice heating and evaporator at juice drafts of 100% and 140%. An example is given of the positive effect of reduction in the temperature of raw juice on the heat balance, demonstrating the improvement that can be brought about without any changes in the process technology. Details are given of the scheme for Appeldorn sugar factory, where the heat requirement for heating purposes was optimized so that any increase with high juice draft would be minimal; in practice, the consumption of 26 kg per 100 kg beet corresponded to a campaign average juice draft of 123%. Three examples are presented showing unsatisfactory adjustment of heating surface areas to heat flow, and hence increase in the consumption of heat for heating purposes, as calculated with a mathematical model of a heat scheme; establishment of alternative optimum conditions, as in the Appeldorn example, is demonstrated. The relationships between heat production, capital costs of the heat equipment and overall costs at varying juice draft are indicated.

Practical aspects of improving molasses exhaustion. D. Schliephake, K. Austmeyer and U. Gerber. *Zuckerind.*, 1979, **104**, 702-710 *(German)*. -- See *I.S.J.*, 1980, **82**, 381.

Theoretical considerations on the growth of thermophilic sporulating bacteria in beet diffusers. A. Dziengel and W. Mauch. *Zuckerind.*, 1979, **104**, 711-719 *(German)*. The theory of continuously growing bacterial cultures is combined with technical and kinetic data for diffusion. The microbiologically active juice volume V_o, i.e. that quantity in which bacteria develop and are metabolically active, is calculated for a BMA tower diffuser. From the total feed f, which takes into account juice draft, beet throughput and juice density, is calculated the dilution rate ($D = f/V_o$). This dilution rate must be added to the measured growth rate of the bacteria in order to arrive at a true growth rate, which may be as high as 4.0 hr^{-1}. The significance of these findings for microbial adaptation and mutation processes and hence for bacteriological control is discussed, and a true picture is painted of the growth stages of thermophilic sporulators. A disinfectant dosing scheme is suggested on the basis of measured lactic acid levels, and reasons for rejecting pH as a measure of infection are listed.

Measures to control the odour levels from sugar factory storage ponds. B. Johannson. *Zuckerind.*, 1979, **104**, 744-748 *(German)*. – The odour from waste water storage ponds at sugar factories can be reduced by the use of aerators from the very start of storage; at least 1 W per m^3 of effluent should be used, although 2 $W.m^{-3}$ gives even greater certainty of odour reduction. The sole use of aerobic activated sludge treatment leads to problems in the handling of the sludge and consumes a lot of energy. Pretreatment by anaerobic processes with production of methane gas, as in the CSM and ANAMET systems (developed, respectively, in Holland and Sweden), reduces the energy consumption in the aerobic stage. Details are given of both schemes, with costs of aeration for an existing pond. The legal requirements of waste water treatment at West German sugar factories are indicated.

Investigation of beet delivery on the basis of sugar content at selected factories. L. Schmidt and E. Schellerov. *Listy Cukr.*, 1979, **95**, 145-151 (Czech). Details are given of beet analyses at nine Czechoslovakian factories where deliveries in 1978 were scheduled on the basis of maturity. Results showed that extension of the campaign to November 10 helped increase root yield and sugar content; scheduling of the deliveries reduced the quantity of beet stored by 20% and also reduced the average storage period, thereby cutting losses. The close inverse correlation between molasses production (% on white sugar) and beet sugar content is indicated.

Transport of sugar in flexible containers (bags). K. Ciz and J. Gebler. *Listy Cukr.*, 1979, **95**, 152-154 (Czech). A description is given of a specially designed flexible container having a capacity of 1 tonne of sugar which is quickly filled and can be transported and loaded by means of a conventional lifting device (such as a fork-lift truck) or palette system.

The effect of cossette quality and technological parameters on raw juice purity. E. Morova, B. Aranyossiova and J. Studnicky. *Listy Cukr.*, 1979, **95**, 161-165 *(Czech)*.– Results are given of laboratory experiments in which the effect of cossette length and shape on raw juice purity was investigated, and of factory investigations in which juice purity was found to be dependent on cossette length, marc content and the Swedish number.

Intensification of storage in the sugar industry. G. Marten. *Lebensmittelind.*, 1979, **26**, 353-355 *(German)*.– The effect of storage of sugar beet, thick juice, white sugar and molasses on the economics of sugar production in East Germany is examined.

Improving the technological performance of DDS diffusers. J. Brüning. *Lebensmittelind.*, 1979, **26**, 355-357 *(German)*.– Technological aspects of DDS diffuser operation are discussed in relation to the machines of Polish manufacture that have been installed in East German factories, and a number of recommendations are made whereby performance can be improved.

Experiences with DDS diffusers in Hungary. K. Hangyal. *Lebensmittelind.*, 1979, **26**, 357-359 *(German)*. Reference is made to DDS diffuser operation in Hungary, where no major problems arise now that teething troubles have been overcome. Modifications to the design and operation of the machines are indicated. Important for good results are a high beet quality, high loading of the diffuser and a low cossette marc content.

Application of the FPAKM automatic filter press in the sugar industry. J. Malczewski and Z. Szaniawski. *Gaz. Cukr.*, 1979, **87**, 176-177 *(Polish)*.– Reference is made to the advantages of the automatic filter press manufactured under licence by Eberhard Hoesch & Söhne GmbH & Co. and installed in Appeldorn and other West German sugar factories. The unit is also produced in the USSR (where it was patented) and sold in four sizes up to 25 m^2 filtration area.

SUGAR REFINING

The small programmable calculator in a sugar refinery. W. Reed. *Sugar J.,* 1979, **41**, (8), 13-20; (9), 13-20. See *I.S.J.,* 1978, **80**, 54.

White sugar crystallization by a three-phase boiling scheme. J. N. Richards. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 39-47. – See *I.S.J.,* 1979, **81**, 133.

Sucrose reactions in phosphatation. M. A. Clarke and M. A. Brannan. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 102-112. – See *I.S.J.,* 1979, **81**, 134.

Effect of temperature upon filtration efficiency. E. J. Roberts and M. A. Godshall. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 113-123. – See *I.S.J.,* 1979, **81**, 134.

The air oxidation of granular carbons and bone charcoal. V. R. Deitz, J. B. Romans and P. Rongpat. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 182-197. – See *I.S.J.,* 1979, **81**, 134.

Cane sugar refiners short course at Nicholls State University. R. N. Falgout. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 205-212. – See *I.S.J.,* 1979, **81**, 134.

Recent developments in refinery technology in Belgium. A. Genart and L. Sué. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 213-236. – See *I.S.J.,* 1979, **81**, 134.

Low-temperature regeneration of granular carbon. W. L. Reed. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 237-290. – See *I.S.J.,* 1979, **81**, 134.

Sucrose process for evaporative continuous crystallization. M. Dmitrovsky. *Proc. 38th Ann. Meeting Sugar Ind. Technol.,* 1979, 291-302. – See *I.S.J.,* 1979, **81**, 134.

Waste water treatment station for removal of carbohydrate and nitrogenous pollution in a beet sugar refinery. F. Heitz. *Proc. 16th Gen. Assembly CITS,* 1979, 79-117 *(French).* – Details are given of the activated sludge scheme at Nassandres and its performance to comply with official daily limits of discharged water of 750 kg COD, 250 kg BOD_5, 200 kg NO_3^- and 50 kg NH_4^+. The station basically comprises a anaerobic tank provided only with a slow-moving mixer for water and mud, to which P is added to give an initial BOD_5: N:P ratio of 100:5:1. The water is next treated in an aeration tank provided with four surface aerators, and is then discharged into a channel where degasification is effected and some of the water recycled to the non-oxygenation tank at 400% on initial feed. The remainder is treated in a clarification tank from which some mud (100% on initial feed) is recycled to the anaerobic tank, while the rest passes to a thickener. The system reduces the COD by 95% and organic and ammoniacal N by 85%. The economics are discussed.

Sugar losses in refinery processes. B. C. Goodacre, K. J. Parker and R. H. Tilbury. *Proc. 16th Gen. Assembly CITS,* 1979 541-554. – Losses in the form of sucrose degradation by micro-organisms or chemical reactions are discussed. Bacterial losses are probably confined to sweetwaters of low Brix; they can be reduced by concentrating light sweet waters and maintaining them above 75°C, or by use of disinfectants. Chemical degradation causes only low losses in the main process streams when the pH is between 8 and 10, whereas low pH, particularly at higher temperatures and in dilute syrups, causes high losses.

The kinetics of thermal radiation drying of consumption refined sugar. Yu. P. Lutsik and A. F. Bulyandra. *Izv. Vuzov, Pishch. Tekh.,* 1979, (2), 99-102 *(Russian).* Investigations of infra-red heating as a means of drying tablet refined sugar are reported. At a suitable wavelength of 2.5-50 μm and an initial sugar moisture content no greater than 2.0%, irradiance should not exceed 5000 $W.m^{-2}$. In most cases the temperature at the surface of the tablets was no higher than 110°C, so that the quality of the sugar was unimpaired.

Behaviour of phosphoric acid-activated carbon from bagasse in respect of industrial liquors. M. Blanco C., R. Menéndez G. and G. Almarales A. *Revista ICIDCA,* 1978, **12**, (1), 4-17 *(Spanish).* – Sugar refinery liquors were treated by shaking in a flask with an active carbon obtained from bagasse, varying the amount of carbon, temperature and pH. Colour was measured as the difference between A_{420} and A_{700}, and the % removal calculated from a blank experiment carried out at the same time. The bagasse carbon performed better than two commercially sold carbons (76.5-80% colour removal *vs.* 71-74%) and was more effective in eliminating residual colour, while the physical properties of the carbons were comparable. Performance increased when the temperature was raised to 80°C at a pH of approx. 8.

Experience in regeneration of granular active carbon at Khodorov sugar combine. Ya. O. Kravets, M. V. Dvornichenko, V. A. Podlesnyi, L. S. Pavlovskii and E. F. Demkiv. *Sakhar. Prom.,* 1979, (6), 17-20 *(Russian).* Information is given on thermal regeneration of active carbon in a shaft kiln at Khodorov; comparison of the decolorizing efficiency of the regenerated carbon with fresh commercial carbon showed that the former was as good as the latter and sometimes better. While the shaft kiln proved more efficient than a rotary kiln, compliance with basic instructions is necessary in order to avoid certain problems which are mentioned.

A "new" cane sugar refinery in California: a beet sugar factory is converted. E. Hine. *Sugar y Azúcar,* 1979, **74**, (5), 77-79. – Information is given on the processes and equipment used at Santa Ana for cane sugar refining in contrast to previous beet sugar manufacture. The plant is owned by Holly Sugar Corporation.

C and H refinery overview. W. E. McCraw. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.,* 1978, 89-91. – A survey is presented of operations at the Crockett refinery of California & Hawaiian Sugar Co., with particular mention of the measures used to remove colour, to recover spilt liquor and sugar, and to conserve energy.

LABORATORY STUDIES

Factors affecting the deterioration in processing quality of sugar beet. W. Drewnowska, A. Butwilowicz and A. Chelstowska *Gaz. Cukr.*, 1979, **87**, 147-149 *(Polish)*. The chemical composition of beet and physico-chemical properties of the corresponding raw juice and thick juice, as well as purification efficiency and molasses losses, were determined and compared for mechanically and manually harvested beet, for beet topped mechanically and by hand, for beet suffering from virus yellows and free from the disease, and for beet that sprouted and did not sprout during storage. Tabulated data indicate the adverse effects of mechanical harvesting, disease and sprouting on processing quality.

Resistance of the coagulate of colloidally dispersed substances in raw juice to peptization. N. S. Fedorova and L. D. Bobrovnik. *Izv. Vuzov, Pishch. Tekh.*, 1979, (3), 74-77 *(Russian)*.– Tests at Yagotin experimental sugar factory are reported in which filtered raw juice was centrifuged to remove suspended matter and the clear juice aliquots then brought to pH 4.5 with HCl and SO_2, respectively, heated for 10 min at 70°C, and the settled mud then separated by centrifuging. A third aliquot was limed to pH 11 before heating and centrifuging. Addition of equal quantities of the concentrated coagulate to aliquots of juice was followed by heating at 90°C for 10 min with stirring, filtration to remove the mud and determination of the colloid content in the filtrate. The lowest re-dispersion was found with colloids coagulated at pH 4.5 with HCl; but where limed juice at pH 11 was used for re-dispersion, colloids coagulated by SO_2 treatment gave the lowest content, while the juice produced also had a lower colour and its filtration coefficient was higher than with the other materials. Hence, where beets have a high reducing matter content, it is recommended to subject the raw juice to sulphitation to pH 4.5 without heating, and add only a small quantity of lime.

The effect of various factors on the degree of beet albumin precipitation. L. P. Reva, G. A. Simakhina and B. M. Logvin. *Izv. Vuzov, Pishch. Tekh.*, 1979, (3), 78-81 *(Russian)*.– In studies on albumin removal from raw juice, juice samples from beets of varying quality were treated with anion exchange resin in OH^- form before mixing with added reagents and centrifuging. Freshly prepared calcium oxalate (to simulate recycled carbonatation mud or juice) and carbonate were added, as well as caustic soda and calcium chloride. At pH_{20} of 11.4-11.5 (found to be optimum for albumin removal), 70-90% separation was achieved, of which 30-38% was the effect of Ca^{++} ions, 18-22% was the effect of OH^- ions, 10-17% was caused by adsorption on almost insoluble lime salts formed from organic acids, and 10-15% was a result of temperature rise to 80°C. With increase in alkalinity beyond pH_{20} 11:5, Ca^{++} ions caused peptization of up to 8% of the albumin precipitated.

Analysis of mixtures of glucose, fructose and mannose by high-performance liquid chromatography. H. van Olst and G. E. H. Joosten. *J. Liq. Chromatogr.*, 1979, **2**, (1), 111-115; through *Anal. Abs.*, 1979, **37**, Abs. 2F16.– A simple HPLC system for the separation of these sugars is described. A column (25 cm x 2.1 mm) of Li-Chrosorb Si 60 packed by the balanced-slurry method [with CBr_4-CCl_4-dioxan (2:1:1) as medium] was used, with acetonitrile modified with water (0.1 to 1%, w/w) as mobile phase and refractometric detection. Optimum separation was obtained at 50°C with a mobile phase containing 0.1% water. The method was devised for use in studying mixtures obtained in the production of high-fructose syrup from glucose.

Determination of sucrose in sugar beet juices by nuclear magnetic resonance spectrometry. D. W. Lowman and G. E. Maciel. *Anal. Chem.*, 1979, **51**, (1), 85-90; through *S.I.A.*, 1979, **41**, Abs. 79-878. – A rapid, accurate technique which has been developed for the determination of sucrose in aqueous media is described; it has been applied to the analysis of beet press juice. It is based on a time-resolution approach, in which a paramagnetic relaxation reagent, Cr^{+++} (aqueous), preferentially relaxes the water protons faster than the sucrose protons. With *t*-butyl alcohol as internal standard, the technique gave a linear response over the sucrose concentration range examined, 0-0.810M (0-26.0 weight %). Raffinose interfered when its concentration was $< 3.75\%$ that of sucrose. With press juice, the accuracy was in general $> 0.5\%$ absolute compared with results obtained by gas-liquid chromatography. Precision for a single sample was $> \pm 0.65\%$ abs. at a sucrose concentration of 15.00 weight %.

Sugar boiling – the syrups in the vacuum pans. J. Ziegler. *Sugar J.*, 1979, **41**, (12), 11-14; **42**, (1), 27-31. The literature on sucrose solubility in pure and impure solutions is surveyed in an attempt to find values sufficiently accurate for use in conversion of boiling point elevation to supersaturation. For beet syrups, the values established by Grut are used as basis, those corresponding to purities in the higher range being reduced by about 3% to agree with tentative ICUMSA standard values. By plotting curves of the Wiklund equation for saturation coefficient *C* over the temperature and purity ranges of practical interest in boiling, the best average solubility coefficient was found to be given by $C = 0.20\ N/W + 0.79$, where *C* is the sucrose:water ratio in a saturated impure solution divided by the ratio in a saturated solution of pure sucrose at the same temperature, and *N/W* is the non-sugars:water ratio. For cane syrups, the solubility data of Thieme were selected as the most suitable, with a slight upward adjustment at higher purities. Solubility charts are presented to demonstrate the changing conditions of a syrup during boiling. Supersaturation is discussed, and the ratio of total solids:water in a syrup divided by the total solids: water ratio in a saturated solution at the same temperature and purity used as suitable definition; the concepts of VanHook and Claassen are also explained. BPE values of Vavrinecz were considered suitable for use in construction of BPE charts; however, values found by other authors are in good agreement with them, those of Batterham & Norgate[1] (slightly higher at higher purities) being adjusted to bring them into agreement. Comparison is made between the charts for saturated beet and cane syrups and the same syrups at 1.65 supersaturation. Problems in measuring BPE are discussed.

[1] *I.S.J.*, 1975, **77**, 359-364.

BY-PRODUCTS

Waste water as a new raw material in the sugar industry. G. Kaiser, A. Dziengel and W. Mauch. *Sugar J.,* 1979, **41,** (11), 13-16. – See *I.S.J.,* 1979, **81,** 282.

Trials of the ammonification process for distillery effluent treatment. D.S. Dahiya, C.S. Bhatt, K.A. Prabhu and L. Viswanathan. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.59-G.67. – See *I.S.J.,* 1978, **80,** 253.

The effect of maltol on *Saccharomyces cerevisiae* **and** *Aspergillus niger.* N. Banerjee and L. Viswanathan. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.69-G.76. – See *I.S.J.,* 1978, **80,** 286.

Preliminary studies on the feasibility of fermentation of bagasse. K.N. Vaish and L. Viswanathan. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.77-G.82. – See *I.S.J.,* 1978, **80,** 286.

Preliminary studies on the continuous fermentation of dextran. R. Bhatnagar and K.A. Prabhu. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.83-G.90. – See *I.S.J.,* 1978, **80,** 286.

Effect of disinfectants on dextran-producing *Leuconostoc* **bacteria.** R. Bhatnagar and K.A. Prabhu. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.91-G.96. – See *I.S.J.,* 1978, **80,** 286.

Production of kojic acid from molasses. P.K. Agrawal and L. Viswanathan. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), G.119-G.125. Experiments on production of kojic acid showed that highest yield, expressed as % available carbohydrate, was obtained from cane molasses diluted to 5°Bx and cultured with *Aspergillus flavus* for 34-40 days. Other media included 10°Bx molasses, mixtures containing 8.5% and 20% sucrose, and a mixture containing 5% dextrose.

Marketing of dried molassed pulp and some aspects of producing pulp nuts and pellets. II. Some aspects of producing pulp nuts and pellets. N.B. Davis and P. Tory. *Sucr. Belge,* 1979, **98,** 171-181. – See *I.S.J.,* 1979, **81,** 282.

Beet tops for cattle feeding. M. Nuttall. *British Sugar Beet Rev.,* 1979, **47,** (2), 25-27. – The value of beet tops silage as animal fodder is discussed, with details of composition, feeding trials and ensilage costs. It is estimated that about 25% of the sugar beet tops in the UK are used as animal fodder, 18% of it being fed in the field and the rest removed for feeding fresh to cattle or after ensilage.

Commercial manufacture of citric acid by fermentation. IV. Production of citric acid from different carbohydrates by *Aspergillus niger* **and the effect of sucrose concentration on citric acid yield.** P.K. Agrawal, C.S. Bhatt and L. Viswanathan. *Sharkara,* 1975, **14,** (4), 35-41. **V. Production of citric acid from different grades of sucrose by** *Aspergillus niger. Idem ibid.,* 1976, **15,** (1), 17-25. IV. In surface fermentation studies, in which *A. niger* was cultured on a Doelger & Prescott medium containing different carbohydrates, maximum citric acid yield of 37 $mg.cm^{-3}$ (27.1% on initial sugar concentration) was obtained after 12 days with analytical-grade sucrose, whereas commercial-grade sucrose gave only 31 $mg.cm^{-3}$ (22.3% on initial sugar). After sucrose, the following sugars gave yields in a descending order: xylose > dextrose > levulose > maltose > lactose > mannose > galactose.
V. In studies with Doelger & Prescott media containing analytical-grade sucrose and sugar from various sources, the maximum yield was obtained with sucrose (53.14 $mg.cm^{-3}$ after 12 days), followed by refined sugar (46.20 $mg.cm^{-3}$). However, treatment of the fermentation liquors with Amberlite IR-120 cation exchange resin in H^+ form and Duolite A-7 anion exchange resin increased yield in all cases, except for sugar from a carbonatation factory; maximum citric acid yield was thus given by sulphitation white sugar (58.50 $mg.cm^{-3}$), followed by khandsari sugar (55.80 $mg.cm^{-3}$) and refined sugar (53.14 $mg.cm^{-3}$). The medium containing the analytical-grade sucrose was not treated with the resins.

Ethanol from molasses project. W. Gibson and K. Mashima. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.,* 1978, 115-119. – It is proposed to operate a former rum distillery in Hawaii as a pilot plant for production of ethanol from molasses, so as to permit: determination of the economically optimum processes for alcohol manufacture and recovery of yeast protein and potash as the two principal by-products; establishment of steam and power requirements; evaluation of the two by-products by animal feed and fertilizer tests, respectively; establishment of facts needed for evaluation of molasses use for alcohol manufacture by comparison with present use; and determination of the value of ethanol as a motor fuel. Details are given of four processes that are to be tested, each for 2-3 months, and the economics are analysed.

Ethanol from sugar cane. G. D. Thompson. *S. African Sugar J.,* 1979, **63,** 233-235, 238-239. – The suitability of sugar beet, sweet sorghum, maize, cassava and sugar cane as raw material for the manufacture of ethanol is discussed. Of the plants considered, sweet sorghum and cane are thought to be the best under South African conditions; since the agronomy and processing of cane are already well developed, this crop is regarded as the better economically, particularly since it can be harvested over a protracted season, although sorghum could be grown as a supplementary source over a short part of the season. Comparison of varieties of cane for sugar and Brix yields per ha showed little difference in their rankings between the two criteria, from which it is concluded that, while some slight gain might be made by selection for fermentable solids rather than sugar content, large gains would depend on the choice of much more suitable parents, if such exist. A major problem in ethanol manufacture is considered to be disposal of vinasse; distribution over the land is regarded as the best solution.

PATENTS

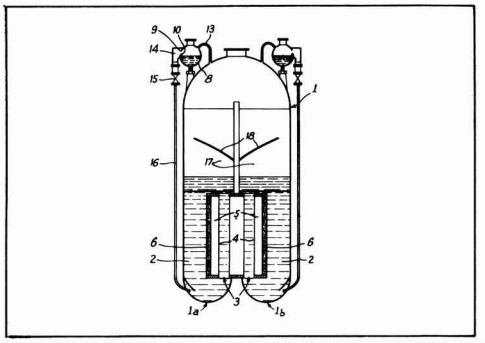
UNITED KINGDOM

Sugar recovery from molasses. Süddeutsche Zucker-AG, of Mannheim, Germany. **1,503,815.** April 29, 1975; March 15, 1978. – The entire bed volume of a (cross-linked) cation exchange resin (of 3 – 20% divinyl benzene and having sulphonic acid groups) in the Ca form is divided in three columns in volume ratios of 25 – 45: 25 – 45: 25 – 45. A molasses solution (at 50 – 99°C) is applied to the first column and eluted with decarbonated water (of pH at least 9) until sugar is detectable in the effluent. The second column is connected to the first and elution continued until sugar is detectable, when the second and third columns are connected and elution continued until sugar is detectable in the effluent. The third column is disconnected and the sugar solution recovered by elution, while non-sugars are recovered by elution of the first two columns. The resins are regenerated with a (sugar-containing) concentrated non-sugar fraction.

Molasses sugar recovery. The Great Western Sugar Co., of Denver, CO, USA. **1,504,483.** June 7, 1976; March 22, 1978. – See US Patent 4,000,001[1].

Continuous vacuum pan. F. Langreney, of St.-Denis, Réunion. **1,508,703.** March 3, 1976; April 26, 1978.

The pan 1 is constructed of two halves Ia, Ib joined together by end plates. Each half-pan comprises an unheated zone 2 and a zone 3 which is heated by means of a longitudinal bank of tubes 4 enclosed in a sleeve 5 which is provided with a heat insulation cover 6. Above the centre of sleeve 5 is a longitudinal wall which carries transverse walls 17 extending from just below the working level of massecuite in the pan to a level sufficiently high to prevent splashing from one side of a wall 17 to the other. Baffles 18 on the longitudinal wall direct splashes from above the heated zone 3 into the unheated zone 2.



Feed liquor is admitted from a container 8 connected to the pan atmosphere through pipe 13, overflows through gap 9, adjustable by a sliding level control 10, into conduits 14, 16 by way of valve 15 and enters the bottom of the pan 1. The liquor in the pan is subjected to a circulating movement between zones 3 and 2 by a thermo-siphon effect and is also subjected to a longitudinal motion because of evaporation, being withdrawn as a massecuite through an appropriate duct from the concentrated end of the pan.

Beet harvester. Deere & Co., of Moline, IL, USA. **1,510,265.** October 25, 1976; May 10, 1978.

Dehydrated molasses. Food Technology Inc., of Chicago, IL, USA. **1,511,469.** July 7, 1976; May 17, 1978. Molasses is blended in a ratio of 2:3 – 4:1 by weight with wheat flour or a mixture of wheat flour with (⋗ an equal weight of) an ungelatinized (wheat, rice) starch having a gelatinization temperature ⋖ 150°F, to form a slurry which is maintained at 15 – 30°F below the starch gelatinization temperature until the starch is conditioned so that it will only partly gelatinize on heating above its gelatinization temperature. The slurry is then dehydrated by bringing a thin film into contact with a heated surface (at 325 – 375°F), thereby producing a crisp, crystalline dehydrated film (containing only 0.5 – 5% water). The mixture may also contain 0.5 – 2% on molasses solids of a soy protein flour and 0 – 1% (0.2 – 0.8%) on total solids of an emulsifier and 0 – 1% of an anti-humectant.

Conditioned bacterial cells containing dextrose isomerase activity. Miles Laboratories Inc., of Elkhart, IN, USA. **1,511,868.** September 2, 1975; May 24, 1978. – The *(Streptomyces olivaceus* NRRL 3583) cells are (treated with glutaraldehyde, dried and) mixed at 10 – 27°C with water or aqueous dextrose solution at a pH of about 8 until the cells are hydrated and pH equilibriated. An aqueous 30 – 50°Bx solution of (93 – 96%) dextrose is then passed through a bed of the cells at 60°C and pH 7.5 – 8.0 (at 1.3 – 1.5 gal.ft^{-2}.min^{-1}) until the effluent is clear and the pH stabilized at 7.5 – 8.0. Alternatively, water at 10 – 27°C and pH 8.0 may be passed through the bed until the effluent is clear and the pH stabilized, followed by passage of the dextrose solution. The dextrose solution contains 0.0005M Co^{++} ion, 0.005 – 0.007 M Mg^{++} ion and 0.01M citric acid, and levulose is produced when it is brought into contact with the conditioned cells.

(Syrup) storage tanks. Salzgitter Stahlbau GmbH, of Salzgitter, Germany. **1,511,879.** December 22, 1975; May 24, 1978.

The periphery of a floating roof of a syrup storage tank comprises a caisson 1 having a side wall 2. This is connected by leaf springs 8 and a spring and lever linkage system 9 to a sliding plate 3 having individual sectors 3a, 3b provided with inwardly-angled sections 5 and carrying sealing elements 7 mounted on arms 6. The upper two elements direct rain water onto the top of the roof while the lower one removes stored syrup from the wall 4 of the tank as the level falls.

Above the leaf springs 8, an open-topped apron 11 of flexible material is supported between the sliding plate 3 and an abutment 10 attached to side wall 2. Any water leaking between the upper sealing elements 7 and wall

[1] *I.S.J.*, 1980, **82**, 226.

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 specification are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

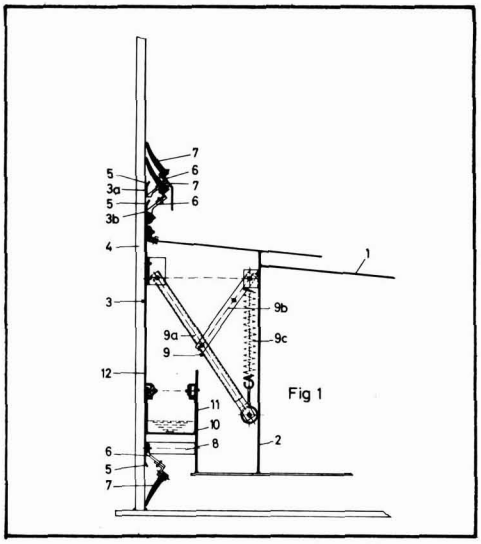


Fig 1

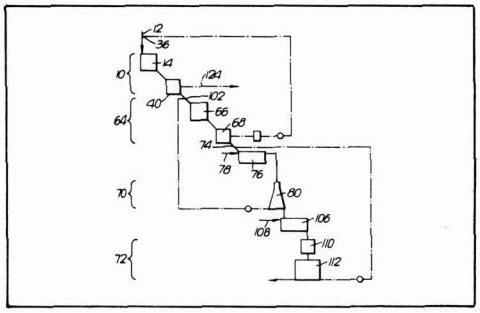
4 of the tank is directed by flanges 5 into the gap between plate 3 and wall 4 and passes through apertures 12 into the apron; a float operated pump removes this water when it reaches a preset level. The system prevents access of air to the syrup in the tank and so protects against deterioration.

Beet cleaner and loader. Wilfred Foulger Ltd., of Norwich, Norfolk, England. **1,512,206.** December 21, 1974; May 24, 1978.

Bagasse pulp digester. American Defibrator Inc., of Minneapolis, MN, USA. **1,512,498.** July 13, 1976; June 1, 1978. – See US Patent 4,039,373[1].

Cane juice extraction. A. Simpson, of Marromeu, Mozambique. **1,512,644.** June 29, 1974; June 1, 1978.

The extraction system includes four stages, 10, 64, 70 and 72, in which cane is comminuted and the juice content separated. The unit 14 of the first stage (10) and the unit 66 of the second stage (64) consist of shredder housings in which are two pairs of toothed rollers. Each pair includes a larger (48 in dia.) roller rotating at 4000 r.p.m. and a smaller roller (24 in dia.) rotating at 12,000 r.p.m. The rollers have intermeshing rows of teeth and the gap between the rollers is adjustable. Cane entering unit 14 is chopped into small pieces and



the mixture of cane and juice passes to unit 40 which is the same as unit 68 of the second stage. This unit is a rotary vacuum filter having an endless perforated nylon belt passing over a cell-type drum filter connected to a vacuum source and two idler rollers so that the cane/juice mixture first falls onto a horizontal section of belt through which free juice drains into a collecting trough. The mixture passes between two light rollers which squeezes out a second amount of juice while the vacuum of the filter withdraws a third amount; the juice fractions are combined and discharged at 124 from unit 14 of the first stage and returned as imbibition 12 for the first stage from unit 66 of the second.

Imbibition is added with the discharged residue from the second stage into a beater-type mixer 76 and the new mixture sent to a cone-type grinder 80 in which the clearance between the internal rotor and the grinder bars on the inside of the stationary casing reduces from the top to the bottom of the cone, so further comminuting the cane. The mixture discharged from unit 80 is collected on a perforated tray from which juice drains, to be returned to the cane entering the second stage, while the cane is again treated in a beater mixer 106 with fresh imbibition water 108, passed through another mixer 110 and fed to a continuous cone-type centrifugal for separation of juice which is returned to the cane leaving the second stage of extraction.

Production of an (alginic acid-like polysaccharide. Tate & Lyle Ltd., of London, England. (A) **1,513,061. (B) 1,513,104.** May 28, 1976; June 7, 1978.

(A) The polysaccharide is produced by continuous aerobic (5 – 20 mmol. oxygen/hr/g cell) cultivation of *Azotobacter vinelandii* in an aqueous culture medium containing at least one mono- or disaccharide (24 – 240 mM sucrose) as carbon source and sources of PO_4, Mo, Fe, Mg, K, Na, Ca, SO_4 ions and N, maintained at pH 6 – 8.2.

(B) The aerating gas in the fermentation as in (A) may contain N_2 and the PO_4 ion content is limiting on the concentration of the bacteria and at least 1.0 millimolar (2.0 – 3.0 mM). Oxygen uptake is 7 – 22 mM/g cell/hour.

Beet harvester. J. D. Dyson and C. R. Dyson. (A) **1,515,504.** May 3, 1974; June 28, 1978. (B) **1,515,505.** August 4, 1975; June 28, 1978.

Beet molasses sugar recovery. Hokkaido Sugar Co. Ltd., of Tokyo, Japan. **1,515,919.** September 22, 1975; June 28, 1978. – To beet molasses (at 20 – 50°Bx) (at 12 – 20 pol) is added α-galactosidase (1 – 16,000 x 10^6 units per g of raffinose present) (at pH 4.5 – 7 and 20 – 55°C) to hydrolyse raffinose present to sucrose and galactose, the product treated with quick lime, (cooled to < 20°C,) and the Ca saccharate which is formed is separated and added to juice to be purified (part is separated and the remainder recycled to the liming stage).

Levulose separation from a mixture of sugars. Toray Industries Inc., of Tokyo, Japan. **1,516,435.** June 8, 1976; July 5, 1978. – Levulose is separated from a 10 – 80°Bx mixture with dextrose by bringing it into contact (at 10 – 60°C) with a crystalline aluminosilicate [of average pore diameter > 5 (but < 15) Angstroms] (containing faujasite types X, Y or L)

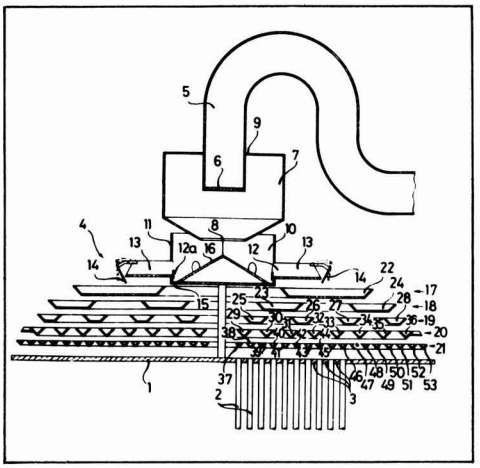
[1] *I.S.J.*, 1980, **82**, 351.

(containing mordenite) (containing an alkali metal, alkaline earth metal, Cu, Ag, Zn, Cd, Al, Pb, Fe or Co cations) and selectively adsorbing and desorbing by e.g. eluting with water, when the dextrose is eluted first and the levulose afterwards.

Immobilizing dextrose isomerase. Novo Industri A/S, of Bagsvaerd, Denmark. **1,516,704.** August 26, 1975; July 5, 1978. – A concentrate of 0 – 75% of intact cells from a micro-organism (*Bacillus coagulans*) having dextrose isomerase activity, with a dry matter content of 3 – 30% (8 – 20%, 10 – 16%) is treated with 0.01 – 1 part by weight of glutaraldehyde per part of cell dry matter, thereby forming a coherent solid product which is separated and dried to at least 80% dry matter content, and shaped.

Evaporator. Maschinenfabrik Buckau R. Wolf AG, of Grevenbroich, Germany. **1,519,079.** December 1, 1976; July 26, 1978.

In a down-flow thin-film juice evaporator it is essential to have uniform feeding of an adequate flow of juice to avoid breaks in the film of juice in the tubes which can result in carbonization or charring. To achieve this distribution, an arrangement 4 is located above the upper tube plate 1 to which the tubes 2 are fitted. Juice enters through the swan-necked feed pipe 5 and passes through the screen 6, any accompanying vapour passing out through the annular vent 9 in the surrounding chamber 7. This chamber has a central outlet 8 of such a size as to maintain a certain low level of juice in the chamber and a uniform rate of discharge through outlet 8.

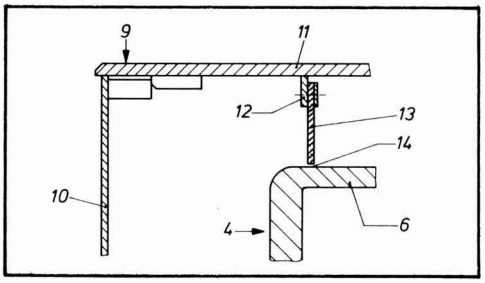


Beneath outlet 8 is a hexagonal distributor 10, each of the six sidewalls 11 being provided with an outlet opening 12 to which is connected a channel 13 having an end baffle 14. A distributor cone 16 on the base 15 of the housing 10 ensures uniform flow of juice towards all six sides and weirs 12a at the openings 12 can be used to adjust the flows to ensure uniformity. A series of channel stages 17 – 21 form a cascade arrangement between the channels 13 and the tube plate 1; the first is formed by six straight-sided channels 22 the ends of which are closed and linked to each other to form a hexagon. The inner and outer edges of alternate channels are provided with overflow rims from which juice flows into the two hexagonal chamber groups 23, 24 forming channel stage 18. The flow is further divided and subdivided from stage to stage, being uniformly distributed over the tube area when it discharges over the rims of the channels forming stage 21.

Beet harvester. F. A. Standen & Sons (Engineering) Ltd., of Ely, Cambs., England. **1,523,283.** October 14, 1974; August 31, 1978.

Batch-type centrifugal. Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **1,524,174.** January 11, 1977; September 6, 1978.

Molasses separated from sugar in a batch-type centrifugal rises up inside the casing 10, owing to the effects of turbulent air flow, and can pass inwardly on the underside of the cover 11 and drip down within the basket 4, so contaminating the sugar. To avoid this, a web or support 12 is fixed to the cover 11 and from this web a cylindrical ring 13 of elastic or flexible material suspended with only a very small gap 14 between its lower edge and the basket 4.



The molasses which passes inwardly underneath cover 11 is directed downwardly along the web 12 and ring 13 and falls onto basket 4 from which it is flung by centrifugal force against the casing 10, so that it cannot enter the basket. As an alternative, the web 12 may be in the form of a horizontal flange mounted near the top of the side wall 10 and carry a number of webs extending radially towards the centre of the machine which support the annular elastic or flexible ring 13 which is vertical and serves the same purpose as in the first instance above.

Sugar beet storage. Great Western Sugar Co., of Denver, CO, USA. **1,527,178.** January 18, 1977; October 4, 1978. Sugar loss during storage of beet due to respiration and invert formation is reduced by injecting ethylene gas (in 1 – 3 applications, totalling 0.31 – 0.61 $kg.ha^{-1}$) into the soil centrally between the rows of growing beet at spaced (1.83 m) intervals and at a depth of 15 – 20 cm beneath the soil when the beets have reached the fifth leaf stage.

Dextrose isomerase production and use. Nippon Oil Co. Ltd., of Tokyo, Japan. **1,527,215.** February 2, 1977; October 4, 1978. – The enzyme is produced by cultivating a *Corynebacterium* species (*C. candidus, C. cerenus*) under aerobic conditions in a culture medium containing sources of assimilable carbon and nitrogen (at 20 – 40°C) (at pH 3.5 – 9.5), and separating the dextrose isomerase-containing cells from the culture broth. They are then brought into contact with a dextrose solution (at 50 – 80°C) (at pH 6 – 10) to produce levulose.

BREVITIES

Brazil alcohol program loan negotiations[1]. — Brazil is negotiating a loan of US $1000 million from the World Bank to finance its alcohol program, according to a spokesman of the Ministry of Trade and Industry. A point of contention is that the World Bank wants Brazil to seek international bids for the program while Brazil wants it to be supplied by firms based within the country.

Bolivian crop damage[2]. — Bad weather and flooding in 1980 reduced cane yields to 40 tonnes per hectare. To help increase production and cut subsidies, prices paid to cane growers were almost doubled to US $21.16 a tonne and wholesale sugar prices rose to 25 US cents per pound.

Louisiana cane alcohol project[3]. — Oasis Petroleum Corporation has begun construction of a US $40 million refinery in New Iberia, Louisiana, which will use sugar by-products to produce ethanol for blending with gasoline. The plant, scheduled to be operational in April 1982, will produce 34,600,000 gallons per year of ethanol as well as 148,000 short tons per year of condensed solids to be sold for livestock and poultry feed. Final molasses, cane syrup and sorghum syrup will be used as feedstocks and about 373,250 tons/year will be needed to produce the alcohol, most of it coming from Louisiana sources.

Peru drought effects[4]. — Three years of drought in the sugar cane growing regions in the north of Peru have reduced production levels from 900,350 tonnes, raw value, in 1977/78 to 695,283 tonnes in 1979/80. Output in 1980/81 is not expected to exceed 550,000 tonnes and imports of 100,000 tonnes will be required in 1981 to meet demand, compared with 70,000 tonnes in 1980.

GEPLACEA meeting[5]. — The 13th plenary session of the Group of Latin American and Caribbean sugar exporting countries (GEPLACEA) was opened on October 27 in Panama City by President Royo of Panama who called for sharing of technology to fight cane diseases. Darien A. Ayala of Panama was elected President of the Group, replacing Hugo de Almeida of Brazil who had served for the previous year. One of the main topics of the meeting was how to increase production of alcohol and how to increase sugar production to meet world demand. Sugar exporting countries are looking for a way to increase the production of alcohol in view of a future possible shortage of petroleum; this could cause a decrease in sugar production, and in 1979/80 world consumption already surpassed production. It was said that there is pressure to increase sugar production at the expense of alcohol production because of increasing profit margins on raw sugar. In a final report GEPLACEA predicted that world sugar prices would rise higher and that this trend would continue for the first half of 1981. 1980/81 production is forecast at 86.8 million tonnes against consumption of 91.2 million tonnes, a deficit of 4.4 million tonnes after a deficit of 7.1 million tonnes in 1979/80.

Tate & Lyle bid for a bigger stake in French beet sugar[7]. Tate & Lyle Ltd. confirmed in November that it is holding talks with European Sugars France, and is believed to be negotiating to buy ESF's indirect 23.7% stake in Beghin-Say, the French beet sugar producer and refiner, held by Raffinerie Tirlemontoise S.A. of Belgium, owner of 43% of ESF. Tate & Lyle have 14% of ESF.

Indian sugar production 1979/80[6]— The 1979/80 crushing season ended on September 30 with an output of 3,895,000 tonnes, white value, reflecting a decline of 2,065,000 tonnes or more than a third from the 5,860,000 tonnes of the previous season. The decline was due to inadequate cane plantings and large-scale diversion of cane to non-centrifugal sugar production, i.e. gur and khandsari. The centrifugal sugar factories crushed only 40 million tonnes of cane from a total crop of 130 million tonnes.

China sugar imports[8]

	1979	1978	1977
		tonnes, raw value	
Argentina	0	0	21,115
Australia	119,274	134,195	271,648
Brazil	41,788	142,185	163,967
Colombia	24,000	0	0
Cuba	485,625	533,853	228,087
EEC	99,760	92,861	326
Guyana	0	0	856
India	22,149	76,873	0
Peru	0	0	25,948
Philippines	119,251	204,923	277,418
Thailand	73,565	253,349	687,826
	985,412	1,438,239	1,677,191

New dextrose plant in UK. — The Cargill Company of the USA acquired Albion Sugar Co. Ltd. two years ago and formed Cargill-Albion Ltd., whose new dextrose plant at Tilbury came on stream in July 1980. It represents one of the biggest investments made by a US company in the UK food processing industry in recent years.

Australian bulk sugar terminal modernization[9]. — A redevelopment project of the Townsville bulk sugar terminal, to cost $A 11.6 million, has been announced and is expected to be completed by late 1981 in time for the 1982 crushing season. It will involve a new sugar receiving station, new rail sidings, a conveyor system and office accommodation and will make Townsville terminal one of the most modern in Australia, able to cope adequately with expected production increases.

Canada HFCS production[10]. — Canada Starch Co. Ltd. (a subsidiary of CPC International) opened Canada's first HFCS production plant at Cardinal, Ontario in September 1979 and is operating at close to full capacity of about 59,000 tonnes per year, with a 25% increase in capacity scheduled for 1982. Zymaize Co., a joint venture of Redpath Industries Ltd. and John Labatt Ltd., will begin producing HFCS at its new plant in London, Ontario, early in 1981 and will be able to produce 70 — 90,000 tonnes of HFCS per year. With a price differential of about 20% against that of sucrose, the Federal Dept. of Agriculture thinks that HFCS could displace 20% of Canada's annual raw sugar imports which amounted to about 1,100,000 tonnes in 1979.

Tate & Lyle Group dextrose and starch production to cease. Over-capacity in the European dextrose industry and the trade recession are the background to Tate & Lyle's decision to stop operations at Gartons, the Howden Glucose Co. and Valentin, Ord & Nagle Ltd. Serious losses have been sustained from these operations during the past four years, and, after allowing for £4.41 million which Cargill has agreed to pay for the goodwill of the businesses, there will be a charge of around £22 million in the 1980 Tate & Lyle accounts embracing the writing-down of assets and related closure costs.

Indian sugar export commitments[11]. — The Minister of Commerce stated in November that India is committed to exporting 357,000 tonnes of sugar in 1981 in spite of having had to import 200,000 tonnes of sugar earlier in 1980. India is contractually obligated to export 200,000 tonnes against the same quantity of imports in 1980 and also to supply 25,000 tonnes to the EEC, which shipments have to be made by June 30, 1981. In addition, 132,000 tonnes will have to be exported next year as part of India's special stocks commitment under the International Sugar Agreement.

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1 *Westway Newsletter,* 1980, (84), 12.
2 *Bank of London & S. America Review,* 1980, **40**, 239.
3 *Westway Newsletter,* 1980, (84), 14.
4 *Bank of London & S. America Review,* 1980, **14**, 264.
5 F.O. Licht, *International Sugar Rpt.,* 1980, **112**, 657.
6 *The Times,* November 27, 1980.
7 F.O. Licht, *International Sugar Rpt.,* 1980, **112**, 690-691.
8 *I.S.O. Stat. Bull.,* 1980, **39**, (11), 26.
9 *Queensland Newsletter,* November 12, 1980.
10 F.O. Licht, *International Sugar Rpt.,* 1980, **112**, 666.
11 Public Ledger's Commodity Week, November 29, 1980.

BREVITIES

Guatemala cane area expansion[1]. — Rising world prices for sugar have induced farmers to replant cane in areas abandoned when prices fell in 1978. Planting is also taking place in new land and the total area for the 1980/81 season is estimated at 94,000 hectares against 80,000 hectares planted to cane for the 1979/80 crop. As a consequence, sugar production could rise from about 400,000 tonnes to 486,500 tonnes.

Continuous fermentation trials in Australia[2]. — CSR Ltd. is to build a $Aust 1.4 million pilot plant at its Sarina distillery to test a new continuous fermentation process developed by Alfa-Laval AB of Sweden. Use of a continuous process rather than the current batch technique could lead to significant savings in capital costs. Planned capacity is 4 million litres per year.

New sugar factory in St. Vincent[3]. — The new Mount Bentinck sugar factory in St. Vincent was scheduled to be completed in November 1980, ready for a trial run, with crushing due to commence in March 1981. The Ministry of Agriculture estimates that the factory will produce 2000 tonnes of sugar in its first year, crushing 700 — 900 tonnes of cane per day, while it is expected to produce 5400 tonnes of sugar from the 1983 crop, replacing annual imports of 4800 tonnes. The new factory has a capacity three times that of the old one which closed down 19 years ago following a labour dispute.

Large new evaporator vessel[4]. — A new evaporator vessel installed at Pioneer Sugar Mills Ltd. in Queensland, Australia, is believed to be the largest in the world. It has a diameter of 9 metres, is 12 metres high and its 4180 m^2 heating surface increases total evaporator heating surface at the factory to 8732 m^2. The vessel was supplied by Bundaberg Foundry Co. Ltd.

Morocco sugar refinery plans[5]. — A $85.8 million sugar refinery is to be built at Zmamra in El-Jadida province, and will meet 8 — 10% of domestic needs.

New South African sugar consultancy. — The expertise of C. G. Smith Sugar Ltd., one of South Africa's largest sugar manufacturers and cane growers, has been combined with that of E. L. Bateman Ltd., the South African engineering contractor, to establish a new company, Sugar Consultants International (Pty.) Ltd. to provide feasibility studies, agricultural management, plant design and layout, etc. to clients outside South Africa. Anton van Hengel, Technical Director of Smith Sugar, is acting Chief Executive of the new company, which may be reached at P.O. Box 194, Durban 4000.

New Indian sugar factories[6]. — Two new cooperative sugar factories at Tilhar (Shahjahanpur) and Belrain (Kheri) were expected to begin crushing in December 1980. The Maharashtra state government has provided some of the finance for these, as it has for modernization of six other factories at Sarsawa (Saharanpur), Sultanpur, Mahmudabad, Majhola, Baghpat and Sakhauti Tanda (Meerut).

Kenana sugar factory inauguration. — Plans are well advanced for the official inauguration of the Kenana Sugar Co. Ltd.'s factory and estate — the largest in Africa — by President Nimeiri of the Sudan in March 1981. The original idea for the estate stemmed from the government's wish to attract foreign investment to the Sudan for agro-industrial schemes such as sugar production. A feasibility study took place in 1972 and its encouraging findings led to the commencement of a pilot project the following year. Subsequent progress was rapid and the foundation stone of the factory was laid in 1976. By 1979 the first phase of production had been completed and the second phase was completed in December 1980. Kenana is situated 200 km south of Khartoum on the east bank of the White Nile near the town of Kosti. Water to irrigate the estate is pumped from this river and distributed by canal to the estate's 33,000 hectares which will eventually produce over 330,000 tonnes of refined sugar per year. The factory complex, which occupies 40 hectares, is one of the largest and most modern installations ever built in a single stage and is designed to crush 17,000 tonnes of cane per day. Production for the current season will be 150,000 tonnes of refined sugar and that for the 1981/82 season is expected to reach 250,000 tonnes. Full production will be reached in the following season, 1982/83.

Egypt sugar imports[7]

	1979	1978	1977
		tonnes, raw value	
Argentina	25,543	43,357	19,565
Austria	0	7,241	0
Brazil	84,950	146,268	49,783
Cuba	111,320	127,054	68,408
Czechoslovakia	0	439	0
EEC	4,527	109,516	0
Germany, East	11,957	21,609	42,374
Greece	6,413	16,304	30,435
India	87,407	46,999	10,741
Poland	0	11,909	0
Other countries	1	2	0
	332,118	530,698	221,306

Beghin-Say ownership change.[8] — The attempt by the Italian Ferruzzi group to take over Beghin-Say, France's major sugar producer, has foundered after a counter-attack by French interests, including Crédit Agricole, the semi-state banking concern. Crédit Agricole's support, which seems to have been influenced by the government's desire to keep Beghin-Say under French control, has been a vital element in the compromise agreement reached between French and Italian interests. Under this deal, at least 51% of Beghin-Say is to pass into the hands of a new holding company in which French shareholders will have the majority stake.

World sugar farmers' conference[9]. — A conference of world sugar farmers is to be held in Mexico in the week starting May 4, 1981. According to the head of Mexico's National Union of Sugar Cane Workers, it will discuss all aspects of the sugar industry, especially workers' benefits. The opening session will be held in Mexico City and working sessions in Guadalajara. The unfinished agenda will include workers' payment, mechanization and prices of cane and beet. The Conference has been convened by the International Federation of Agricultural Producers and the Iberoamerican and Philippine Confederation of Sugar Cane Producers.

Peru sugar imports[10]. — Although, after a three-year drought, rains have returned to the northern part of the country where the sugar cooperatives are located, Peru will need to import 130,000—150,000 tonnes of sugar in 1981. This compares with 45,000 tonnes imported in 1980; a further 49,000 tonnes which had been sold for export in 1980 had to be retained for domestic consumption but is to be exported by March 1981.

PERSONAL NOTES

Dr. E. V. Abbott died in September 1980 at the age of 81. As a plant pathologist he worked at the Louisiana State Agricultural Experiment Station, at Iowa State University and at La Molina Experiment Station in Peru before joining the US Sugarcane Field Station at Houma, Louisiana in 1930, where he was to stay until retirement in 1966, the last 16 years as Superintendent. He identified mosaic as a disease of sugar cane in Peru, and chlorotic streak and ratoon stunting disease in Louisiana. He developed techniques for screening cane varieties for red rot and seedlings for mosaic resistance, and was deeply involved in the development of new varieties. He was the author of numerous publications and served as editor and contributor to the authoritative "Sugar Cane Diseases of the World".

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1 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 710.
2 *Australian Canegrower*, 1980, **2** (9), 10.
3 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 710.
4 *Australian Canegrower*, 1980, **2**, (9), 17.
5 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 713.
6 *Maharashtra Sugar*, 1980, **5**, (12), 76.
7 *I.S.O. Stat. Bull.*, 1980, **39**, (11), 33.
8 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 727.
9 *Reuter Sugar Newsletter*, November 13, 1980.
10 F. O. Licht, *International Sugar Rpt.*, 1980, **112**, 734.

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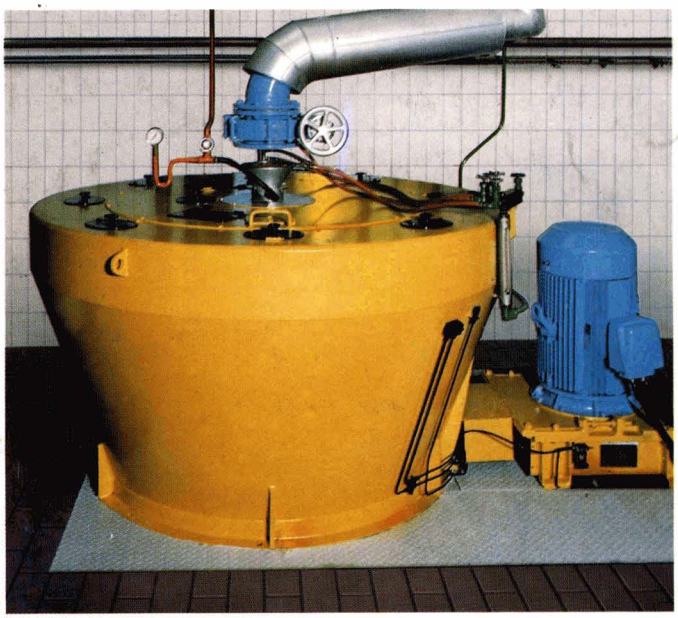

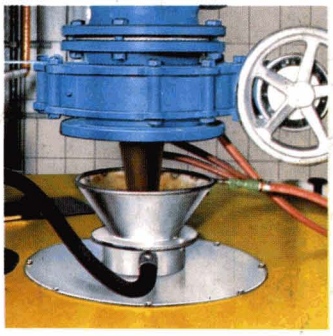

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