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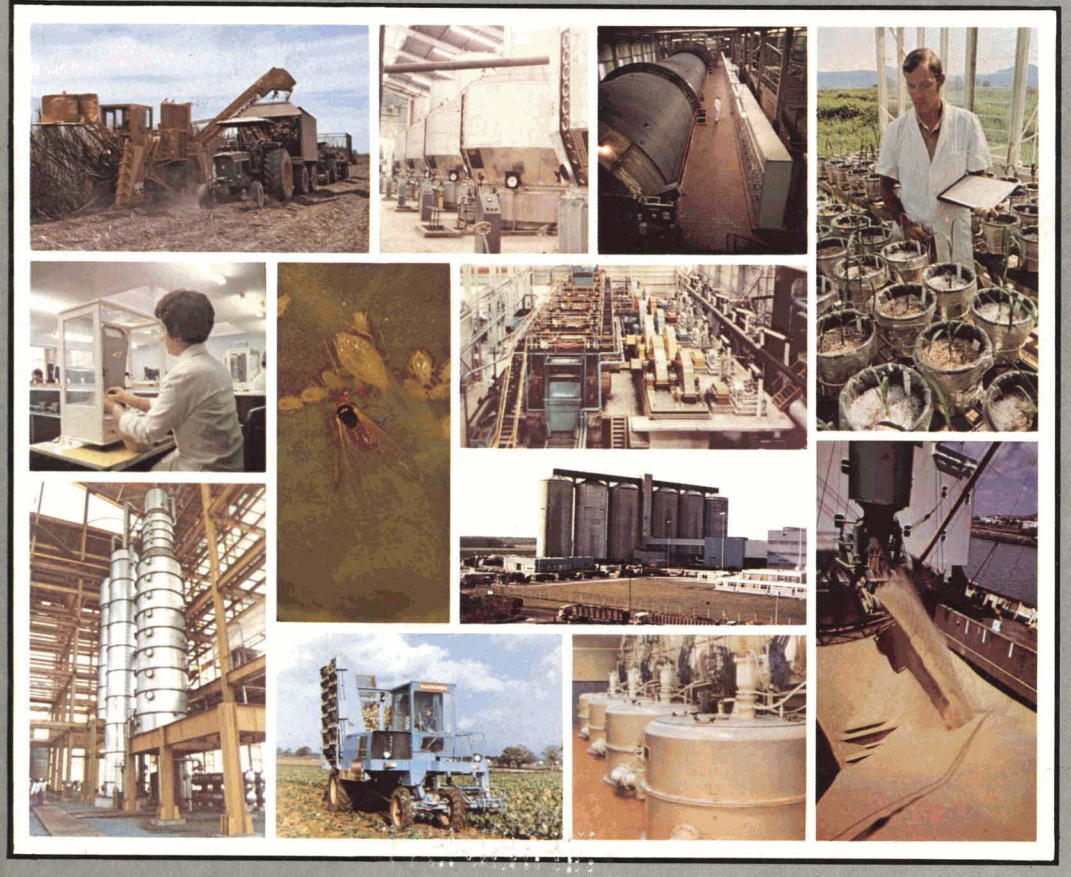

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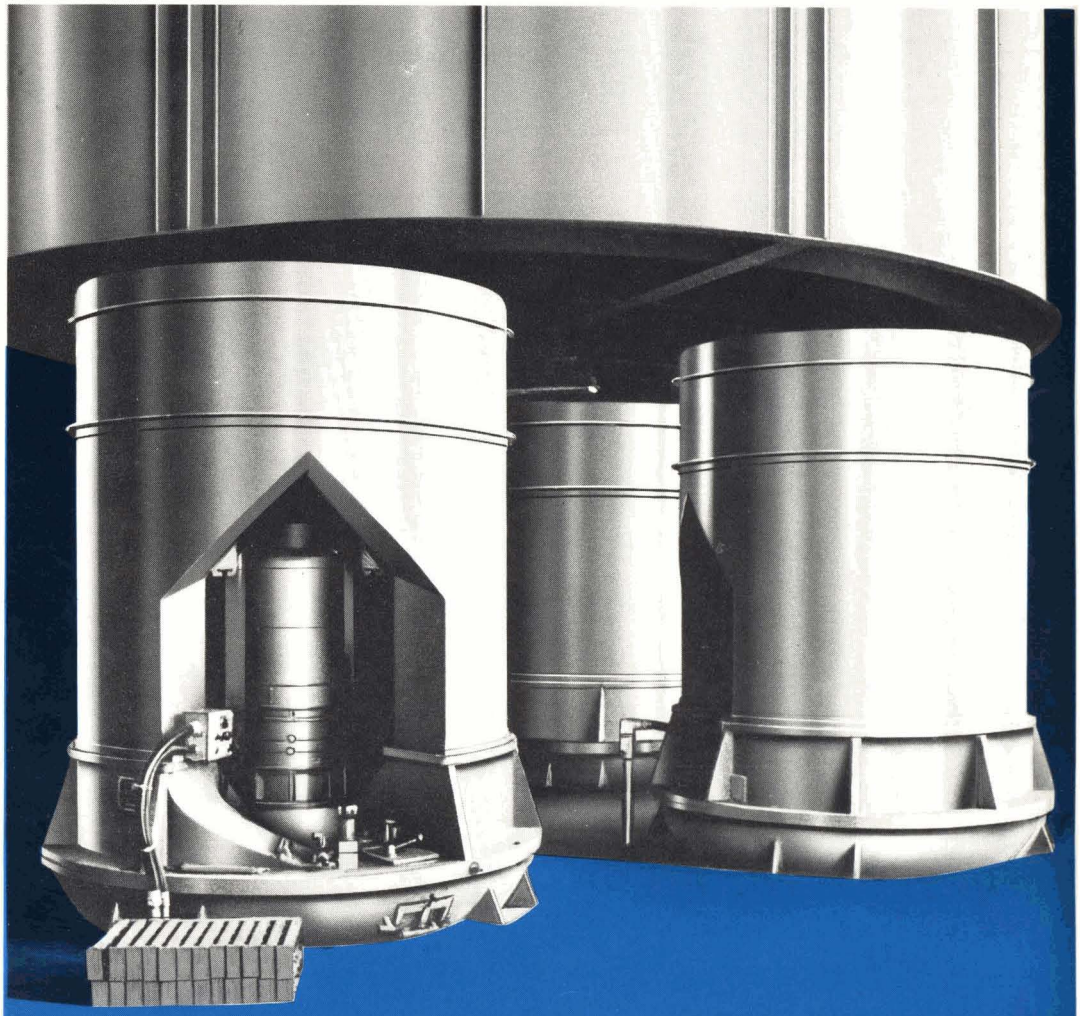

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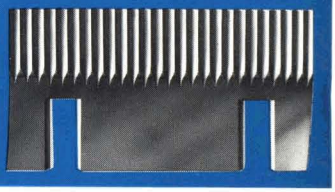

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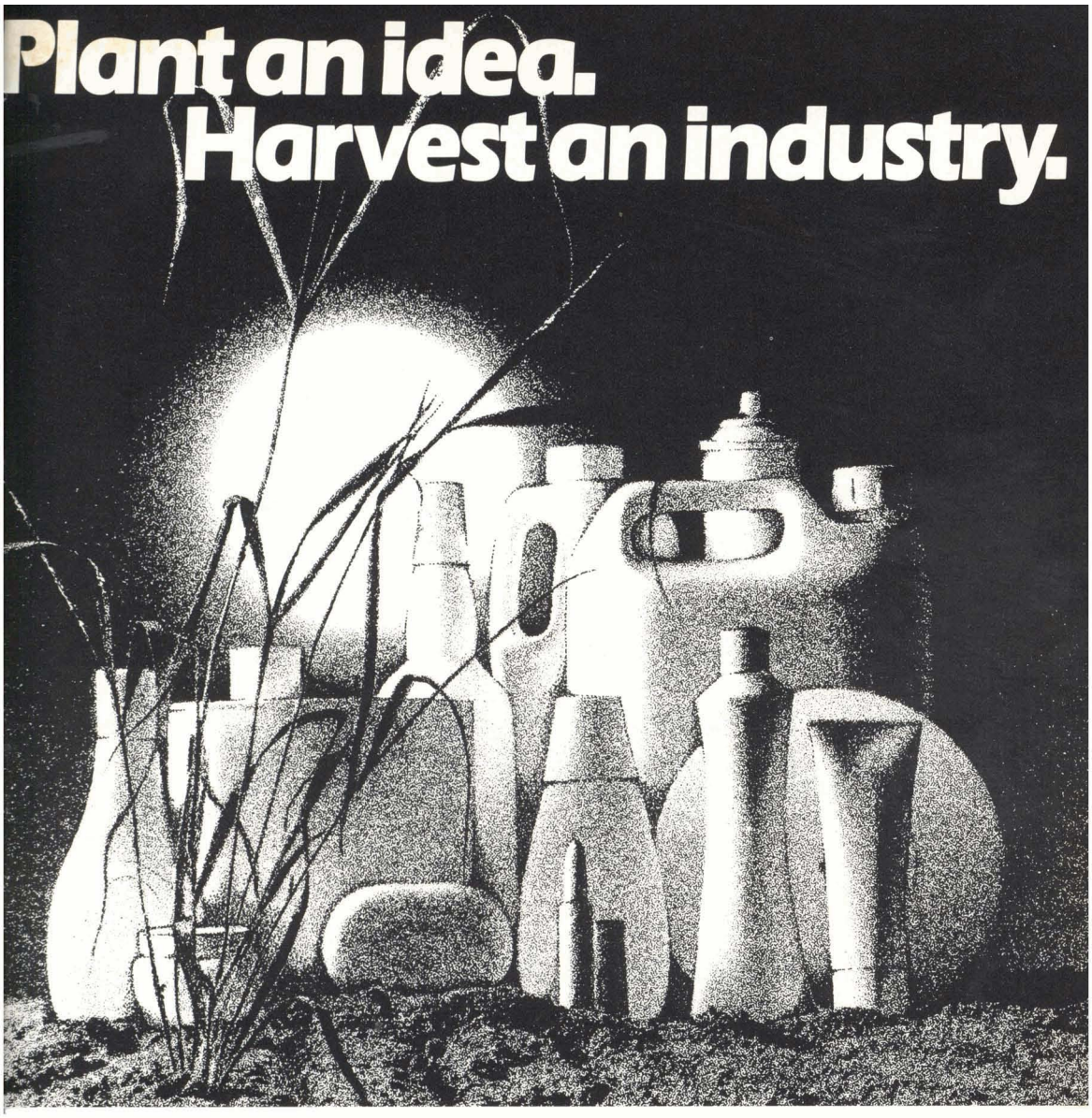

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NOTES AND COMMENTS

World sugar prices

The upward trend in sugar prices at the end of May continued in early June and the LDP, which started the month at £215 per tonne, rose to £220, largely owing to Venezuelan and Indonesian interest in purchasing sugar. Thereafter the price fell by £10 and fluctuated appreciably in a quiet market, between £216 per tonne and a level of £196 reached on June 16. Rumours of Indian purchases strengthened the market but there were conflicting statements from government sources in that country as to the truth or otherwise of the rumours. The price rose to £208 by June 22; and eventually it was announced that contracts had been signed for the import of sugar by next September, in amounts which were unspecified but are believed to total around 200,000 tonnes.

Little occurred in the market during the remainder of the month and it was depressed with falls in prices in precious metals and other commodities to reach £199 on June 25, but with weakening of sterling against the US dollar and other currencies, the LDP started to fluctuate, with a rising trend, ending the month, however, in a trough at £198 per tonne.

During this time the LDP(W) had followed the general trends of the raw sugar price but with much smaller swings so that from a starting figure of £230 on June 1 it rose to a peak of £236 on June 8 and fell to £214 on June 16 but quickly rose again and ended the month at £223 per tonne.

International Sugar Organization

The Executive Committee of the ISO met on June 8 and again on June 23. At the first, since the prevailing price under the Agreement had exceeded 15.00 cents/lb for five consecutive market days, the global quota was increased by 5%, to 14,646,000 tonnes, raw value. Since this was more than covered by minimum export quotas at 85% of B.E.T., no changes in individual export quotas resulted, however. The Committee decided in advance not to allow any increase in quotas called for with prevailing prices exceeding 16 and 16.5 cents/lb. Should the prevailing price exceed 17 cents, quotas would be lifted automatically under the Agreement.

At its second meeting, the Committee decided not to re-allocate declared shortfalls, amounting to 1,145,000 tonnes. This move, together with special stocks, will have an eventual influence in withholding sugar from the market. Provided quotas remain in force, the accumulation of 40% of the total obligation, i.e. 1,000,000 tonnes, is due by June 30, 1982, and holders are entitled to loans equivalent to 1.50 cents/lb per year, free of interest, from the stock financing fund to support the amounts. This is built up from a fee of 50 cents/tonne on sugar imported or exported by member countries, imposed from July 1, 1981. No information is available as to the actual stocks which have been built up while, if the prevailing price exceeded 17 cents for five days so that quotas were lifted, the obligation to accumulate further stocks would disappear, although stocks already accumulated could not be sold until the price exceeded 21 cents/lb and then in stages.

European sugar beet areas, 1981

Estimates of the areas which have been sown to beet in Europe this year have been published by F. O. Licht GmbH[1] and are reproduced below, together with figures from the past two years.

	1981	1980	1979	Difference 1980-1981
	— *Thousand hectares* —			%
West Europe				
Belgium	135	125	124	+ 8.00
Denmark	76	75	75	+ 1.33
France	610	520	515	+ 17.31
Germany, West	453	414	405	+ 9.42
Greece	44	28	45	+ 57.14
Holland	132	124	127	+ 6.45
Ireland	36	33	35	+ 9.09
Italy	310	290	275	+ 6.90
UK	211	210	214	+ 0.48
Total EEC	2007	1819	1815	+ 10.34
Austria	59	51	45	+ 15.69
Finland	32	31	34	+ 3.23
Spain	221	168	166	+ 31.55
Sweden	52	51	52	+ 1.96
Switzerland	14	13	14	+ 7.69
Turkey	360	269	270	+ 33.83
Yugoslavia	146	123	137	+ 18.70
Total West Europe	2891	2525	2533	+ 14.50
East Europe				
Albania	12	12	12	0
Bulgaria	70	65	61	+ 7.69
Czechoslovakia	225	220	218	+ 2.27
Germany, East	265	252	265	+ 5.16
Hungary	121	102	111	+ 18.63
Poland	490	425	455	+ 15.29
Rumania	290	270	259	+ 1.62
USSR	3770	3710	3739	+ 7.41
Total East Europe	5193	5056	5120	+ 2.71
Total Europe	8084	7581	7653	+ 6.64

With the Community's higher 1981 minimum beet prices it is not surprising that the farmers of the EEC are planning to grow more beet and, assuming average yields comparable to 1975/80, would add a further 300,000 tonnes of sugar to the Community's surplus for subsidized disposal. Good weather with high yields would raise production by no less than 2,000,000 tonnes. The increase in the estimate for Greece is only to be expected now that this country's farmers will reap the benefits of the EEC price structures but, fortunately, even a 60% rise in the area is not large because of the small original area. It is clear from the increase of 17% that lower world sugar prices have not deterred farmers in France from growing more beet which will add to the quantity of C-quota (unsubsidized export) sugar produced in an area which already is the most important Community supplier in this category.

In Spain, the surplus stocks built up several years ago appear to have been reduced so that the 1981 beet area, although considerably greater than 1980, is no more than a return to the normal level of pre-1979. Turkey has experienced sugar shortages during the past two years and needed to import more than half a million tonnes. The increase expected in 1981 is therefore a reasonable measure to bring the country to self-sufficiency. Similarly, Yugoslavia is promoting beet growing by higher prices and is not expected to have sugar for export from the larger area estimated for 1981.

The disappointing results in the last campaign in East Europe, although largely the result of bad weather, are no doubt the reason for the expansion of beet area in

[1] *International Sugar Rpt.*, 1981, **113**, 411 – 414.

the countries concerned so that, even with bad weather this year, sugar production should be greater and better able to contribute to the area's needs. This is particularly so in view of Cuba's desire to protect her ISA quotas by giving priority to non-Comecon partners out of a sugar crop reduced by rust disease. It is surprising that the area set for the USSR should not have been greater in these circumstances, although problems with transport and infrastructure may be a limiting factor.

World sugar production 1981/82

F. O. Licht GmbH have recently published[1] their first, non-detailed estimate of sugar production for the crop years beginning between May 1981 and April 1982. These show a marked increase on the previous two seasons, as may be seen below:

	1981/82	1980/81	1979/80
	tonnes, raw value		
Beet sugar			
West Europe	17,000,000	16,644,000	16,896,000
East Europe	12,700,000	11,010,000	12,229,000
Other countries	5,000,000	4,738,000	4,761,000
Cane sugar			
Europe	3,000	3,000	4,000
North and Central America	16,400,000	15,049,000	15,327,000
South America	13,550,000	13,256,000	11,651,000
Africa	6,750,000	6,064,000	6,396,000
Asia	16,700,000	15,839,000	13,424,000
Oceania	3,950,000	3,857,000	3,451,000
	92,000,000	86,460,000	84,139,000

The dramatic expansion in output is attributed mainly to higher crops in the USSR, Cuba, Mexico, Brazil, Mauritius, South Africa, India, Thailand and Australia. An increase of 5.5 million tonnes appears exceptionally large but, as Licht points out, in this context it should not be forgotten that the depressed production levels of the past two years were mainly due to weather and the rust problem in Cuba; in both 1978/79 and 1977/78 world sugar production was in excess of 90 million tonnes.

If Licht's forecast is confirmed by events, production will balance current levels of consumption and will tend to lower sugar prices. The reduction of prices from their high levels of October/November 1980 was attributed, however, to a much greater demand-price elasticity than had previously been thought to exist, and a fall in prices could well restore some of the "lost" demand.

Possible Tate & Lyle return to Jamaica

Tate & Lyle Ltd. has offered to reorganize the Jamaican sugar industry and run the eight sugar factories for a 7-year term with the object of improving performance, output and restoring profitability. Negotiators were sent from the company to discuss the proposal with the Jamaican Minister for Agriculture although he had stated that Tate & Lyle's proposal to dismantle the cooperatives and exclude the unions from the National Sugar Company was "totally unacceptable to the government". The government recognized that the Jamaican sugar industry was in a precarious position, however, with production down to 268,000 tonnes in 1980 (from 387,000 tonnes in 1972 when Tate & Lyle's Jamaican factories were nationalized) and a financial loss of US$11,200,000, so that benefits could arise if a mutually acceptable plan were devised.

The Berisford bid for British Sugar

S. & W. Berisford, the commodity traders, failed by a small margin to gain control of the British Sugar Corporation Ltd. when their offer lapsed on July 1. They had bought just over 40% of the equity, 2.6% short of the level needed to trigger the sale of the UK government's holding. The result provides problems for all concerned; the Corporation management cannot be insensible of the large stake held by hostile hands while the government could be in difficulty in seeking to dispose of its 24% holding. Berisford, while holding two-fifths of the company, has no direct control over its operations yet would not wish to depress the value of its holding by precipitate disposal of the shares. Even the Corporation's merchant bankers, Schroder Wagg, who bought some £1.7 million of the shares in a successful bid to maintain the price above the 335p level, face a loss in their value since the shares fell to 331p immediately the bid had been defeated, while shareholders in the Corporation will have their profit reduced by the £1,000,000 spent on its defence, including submissions to the Monopolies Commission and £250,000 spent on newspaper advertisements.

US sugar program conflict

As reported previously[3], sub-committees of both houses of Congress have approved proposals for inclusion in the US Farm Bill of sugar loan provisions whereby a support program would be instituted based on a minimum price of 19.62 cents/lb for 1982. The Assistant Secretary of Agriculture (Economics) has stated that the department nevertheless sees no need for such a program, particularly while the International Sugar Agreement remains in operation, and the Administration has been lobbying to have the provisions removed from the Bill, even suggesting that it might be vetoed by the President if approved by Congress.

Recent reports have indicated, however, that President Reagan is not so opposed to the loan program provisions as had been indicated, although conflicting reports continue to emerge from the USDA. Congressional action on the Farm Bill was expected to be completed before the August 1 recess and the true response of the Administration should then become clear.

Australia sugar exports, 1980[3]

	1980	1979	1978
	tonnes, raw value		
Canada	340,331	399,325	326,561
China	300,590	119,274	134,195
Japan	762,479	769,743	696,105
Korea, South	227,087	246,161	269,895
Malaysia	276,399	249,423	228,219
New Zealand	109,028	20,013	97,273
Oceania	9,020	8,695	8,412
Papua New Guinea	19,069	22,576	23,323
Singapore	51,951	55,098	50,786
USA	314,103	112,519	167,340
Other countries	500	26	0
	2,410,557	2,002,853	2,002,109

[1] *International Sugar Rpt.*, 1981, **113**, 309-310.
[2] *I.S.J.*, 1981, **83**, 194.
[3] *I.S.O. Stat. Bull.*, 1981, **40**, (3), 17.

Production of fructose-containing syrup with enzymes

By BJARNE HELWIIG-NIELSEN
(Novo Industri A/S, Novo Allé, Bagsvaerd, Denmark)

The oldest sweetener known to man is honey, a syrup in which the main components are dextrose and levulose. In very early history honey was supplemented by cane sugar, and for centuries sucrose, a compound of dextrose and levulose, has been the preferred sweetener.

This position was not really threatened when, in an attempt to find a sugar substitute, Kirchhoff in 1811 discovered that starch turned into something sweet when treated with acid. Nor was this the case as the starch syrup technology improved considerably during the next 150 years.

The increased knowledge of the process and of the application of enzymes led to the production of useful syrups, but not even the sweetest of the starch hydrolysis products, maltose, or dextrose, had the high sweetness of sucrose, and this was therefore still the dominating sweetener.

Not until the development of fructose-containing syrup in the late sixties, a development which made it possible to make a syrup similar in composition to honey, was this gap in sweetness properties closed, and today sucrose may be replaced by a starch-based sweetener for practically all applications except where crystallinity of the sucrose is needed.

The production of fructose from dextrose and thus from starch became possible following discovery of the enzyme glucose isomerase, and the development of this enzyme into an immobilized preparation made the process economical.

The process is now well established, and in the following the enzymatic procedures used today for production of most of the fructose-containing syrups will be described with main emphasis on the last step – the isomerization.

The enzymatic processes lead to syrups with up to 50% fructose, typically 42% as in High Fructose Corn Syrup (HFCS). This syrup serves as starting material for the production of syrups with higher fructose content, e.g. 55% or 90%, but the enrichment includes a non-enzymatic separation step which will not be dealt with here.

The conversion of starch to glucose/fructose syrup involves three enzymatic steps: first, liquefaction where the starch is gelatinized and broken down to dextrins by means of an alpha-amylase; second, saccharification, in which the dextrins are further hydrolysed to dextrose by means of an amyloglucosidase, and third, isomerization, in which part of the dextrose is converted to levulose by means of a glucose isomerase. The processes and the usual process conditions for Novo's commercial preparations are summarized in Table I.

Bjarne Helwiig-Nielsen

Table I

Enzyme	Process steps	Process conditions		
		Temp., °C	pH	Time
Termamyl (Bacterial α-amylase)	Gelatinization	105	6.5	5 min
	Dextrinization	95	6.5	120 min
AMG NOVO (Amyloglucosidase)	Saccharification	60	4.3	72 hr
Sweetzyme (Glucose isomerase)	Isomerization	60	8.2	1–3 hr

LIQUEFACTION

The initial breakdown of starch for solubilizing and making it susceptible to the subsequent reaction with amyloglucosidase is performed with bacterial alpha-amylase. Liquefaction may for some purposes be carried out by acid treatment, but enzymatic liquefaction is preferred in most cases, especially when a high degree of purity and a high dextrose content are desired as is the case for the feed for the isomerization step.

Two types of amylases are available for the liquefaction: the conventional ones from *Bacillus subtilis* marketed by Novo as BAN, and an extremely heat-stable one from *B. licheniformis* marketed by Novo under the trade name Termamyl. The former is used at a temperature of about 85°C, and the preferred procedure includes dual enzyme additions with a high temperature treatment in between (around 140°C), a treatment which destroys the enzyme added first. The latter works at a temperature of 95°C and withstands temperatures up to 110°C for a short period of time, thus allowing a single dose procedure with an initial short time at 105°C followed by a dextrinization period at 95°C.

Another advantage of Termamyl is that it is considerably less dependent on calcium than BAN. In the conventional process 150–200 ppm of calcium is necessary to stabilize the enzyme, where 30–50 ppm suffices in the Termamyl process, and this amount will often be present in the process water and the starch.

The Termamyl process is more advantageous with regard to temperature and calcium content, the importance of which will be explained later, and these factors make Termamyl the most suitable enzyme for liquefaction of starch in the production of fructose-containing syrups.

The process conditions for starch liquefaction with Termamyl are as given in Table II.

This treatment will give a soluble dextrin with a DE (dextrose equivalent) of 10–15, well suited for the following saccharification step.

Table II

Starch slurry	30–35% w/w (on d.s.)
pH	6.5
Calcium	30–50 ppm
Termamyl 120 L	0.5–1 kg per tonne of starch d.s.
Heating by a jet-cooker to	105°C
Holding time	5 min
Pressure release to	95°C
Second holding time	1–2 hours

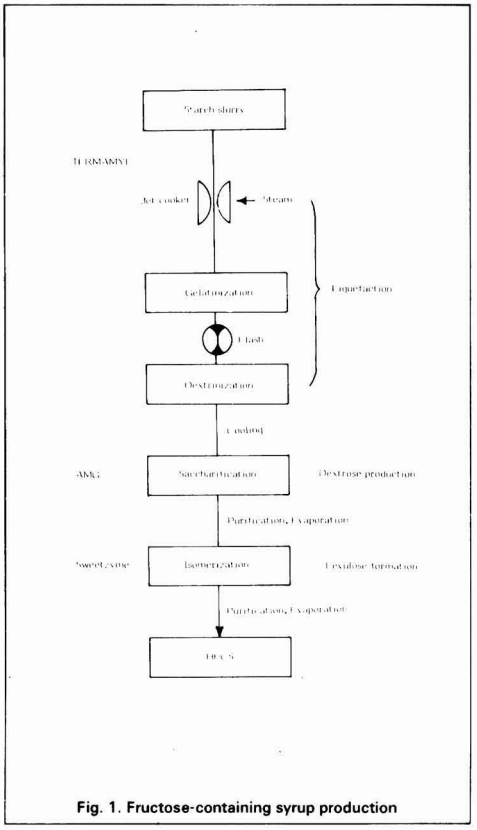

Fig. 1. Fructose-containing syrup production

SACCHARIFICATION

The conversion of the dextrins to dextrose is catalysed by amylogucosidase, and enzyme produced by *Aspergillus niger*. Typical conditions are given in Table III.

Table III

Dry substance	30%
pH	4.3
Temperature	60°C
AMG 200 L	1.1 litre/tonne starch d.s.
Reaction time	72 hours

The resulting product is a syrup with a dextrose content between 94 and 96%. The dextrose is the starting material for the subsequent isomerization.

ISOMERIZATION

The reactions catalysed by the amylases previously mentioned are hydrolyses, and the result of the combined effect is an almost 100% conversion of starch to dextrose. The third enzymatic reaction is of another type, i.e. an isomerization. The equilibrium of this process, under the process conditions specified below, is around 50% fructose/50% dextrose.

As the rate of formation decreases substantially when this concentration is approached, the fructose concentration aimed at in practice is around 42%.

Enzymes which catalyse this isomerization are found in several microorganisms of which Novo have chosen the thermophilic *Bacillus coagulans* for their production.

The enzyme is immobilized in a form which makes it well suited for a continuous process with the enzyme in a packed bed column. It is marketed under the trade name Sweetzyme.

Feed syrup purification

The amylases used in the processes hitherto described are inexpensive, and in liquid form. They are added at the beginning of the process and then discarded once their work is finished. Therefore, they do not make special demands on the purity of their substrate apart from the absence of enzyme inhibitors.

In contrast to this, glucose isomerase is a more expensive enzyme and it has been necessary to develop an immobilization technique for the enzyme preparation which makes it possible to use it continuously over a long period of time – the present practice is several months. During this time syrup is passed constantly through the enzyme preparation and even a small adverse effect of a possible impurity will accumulate and eventually lead to decreased productivity of the enzyme.

Besides the dextrose and a few percent of oligosaccharides, the syrup produced as mentioned above contains the impurities originally present in the starch (ash, protein) and the process water plus the chemicals added during the process, particularly the calcium salt. As calcium is a known inhibitor of glucose isomerase and the other impurities are possible inhibitors, the syrup has to be purified before the isomerization.

The purification consists of a filtration step, a treatment with activated carbon, and a cation/anion exchange. It results in a clear, water-white, almost pure dextrose solution which after evaporation to the desired dry substance is ready for isomerization.

Process conditions

The considerations mentioned with regard to purification also imply that the process conditions have to be chosen carefully:

Temperature. – The temperature influences both the activity and the stability of the enzyme. The activity increases with increasing temperature (up to above 80°C) but the stability decreases, so the working temperature has to be a compromise. Practical, industrial experience has shown that a temperature of about 60°C results in optimal use of the enzyme.

pH. – The maximum activity of the enzyme is found around pH 8; the stability, however, is best at pH 7.0–7.5, so the ideal pH would be around pH 7.7. But a

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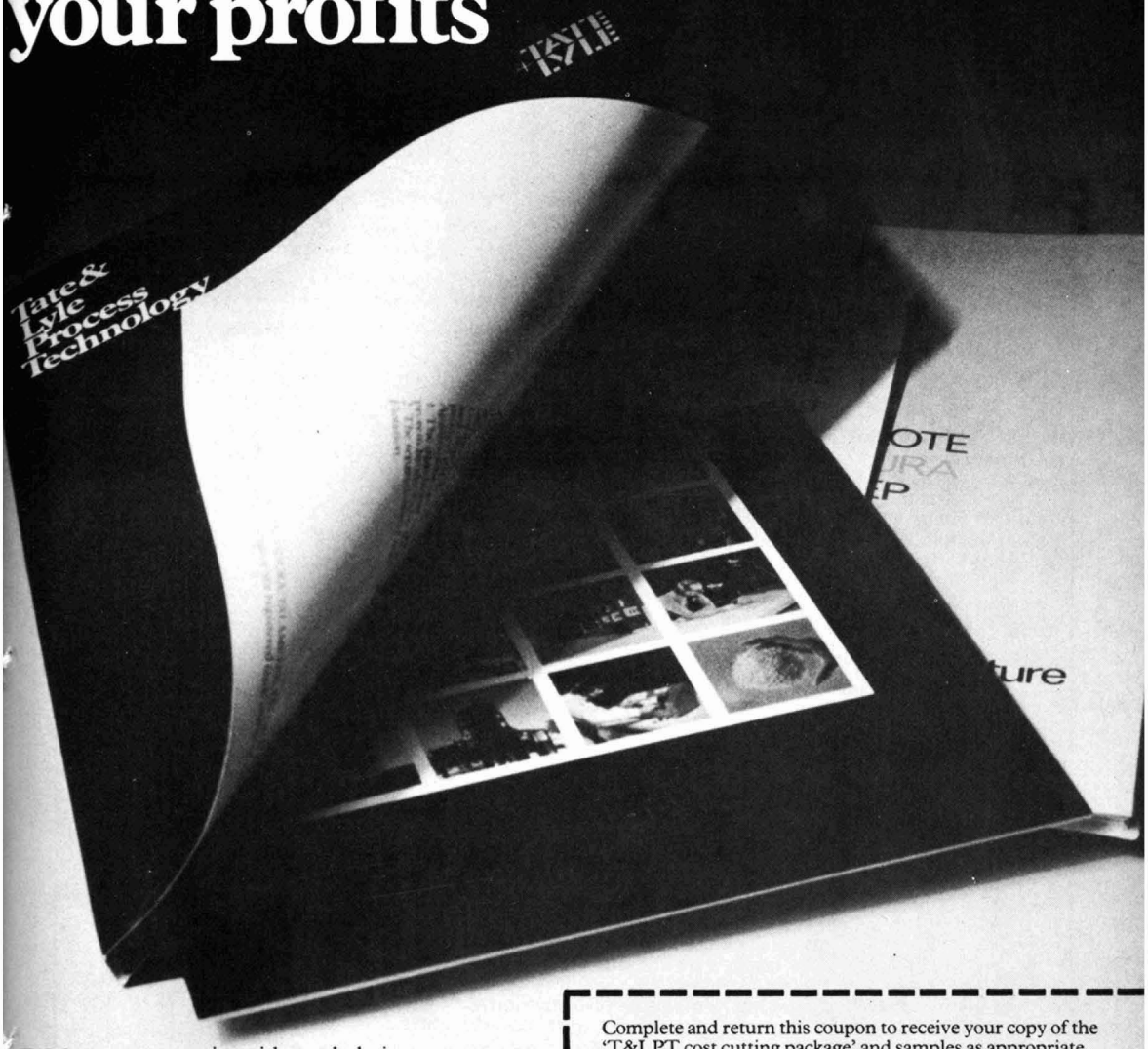

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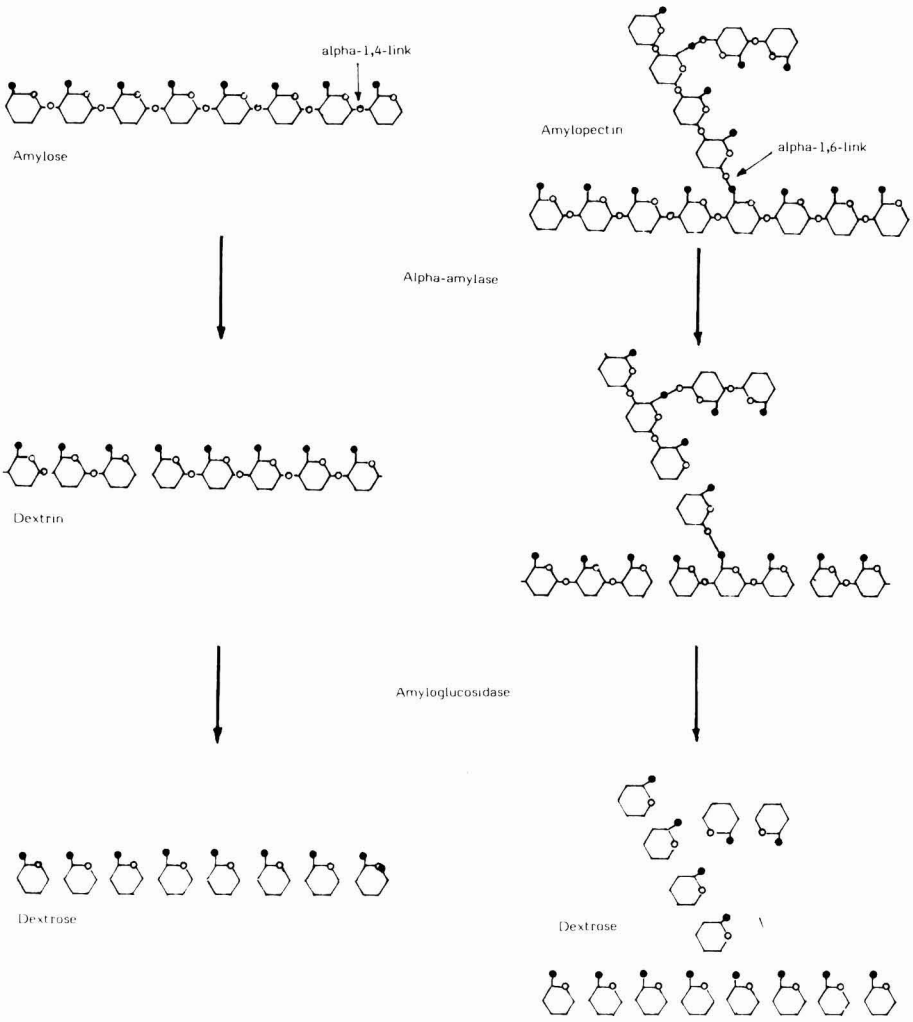


Fig. 2. Enzymatic breakdown of starch

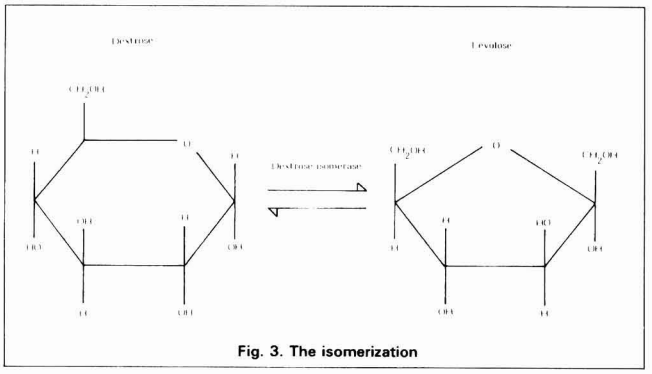


Fig. 3. The isomerization

dextrose or a dextrose/levulose syrup heated to 60°C is not stable with regard to pH. A slight decomposition takes place resulting in formation of some acid. Therefore, when the syrup passes the enzyme, a pH drop occurs and this means that the inlet pH has to be higher than the ideal, i.e. 8.2, in order to give the best average pH for the enzyme bed.

Dry substance. – The activity and the stability of the enzyme increase with increasing dry substance, but with too high a content, the apparent activity decreases owing to diffusion resistance in the enzyme particles. A dry substance content of 40–45% w/w has turned out to be the optimum.

Activator. – While most other possible components of the dextrose syrup except the carbohydrates are inhibitory or, at best, neutral, magnesium activates and stabilizes the enzyme.

Moreover, magnesium can counteract the adverse influence of a possible small calcium content so, before the isomerization, a small amount of a magnesium salt is added to the purified feed syrup.

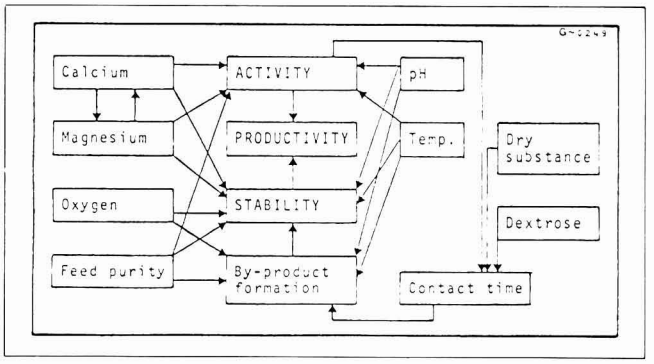


Fig. 4. The influence of the individual process parameters on the activity, stability and hence productivity of Sweetzyme

The above considerations were originally based on the laboratory development of Sweetzyme, but the ideas were tested on full industrial scale, and from this experience a set of reaction conditions has appeared (see Table IV).

Reactor considerations

When dealing with an immobilized enzyme, it is not sufficient to find out the optimum reaction parameters; the physical form and strength of the preparation determine the way in which it can be used. Of the several methods for application of immobilized enzyme which have been proposed, the simplest and most efficient, *viz.* a fixed-bed down-flow reactor, has been preferred for Sweetzyme.

After adjustment of the reaction parameters, the feed syrup is pumped down through the bed of the immobilized enzyme at such a rate that the desired levulose content is reached at the outlet.

Table IV. Reaction parameters for column isomerization with Sweetzyme, type Q

Temperature	60°C
pH (inlet)	8.2
Dry substance	40–45% w/w
Calcium	< 1 ppm
Magnesium	⩾ 10 ppm

On a large-scale application the pressure drop characteristics of the particles become of major importance. They must be sufficiently rigid that no clogging occurs when, for example, a bed 5 m high is exposed to a linear flow of 8 $m.hr^{-1}$, and this strength must be maintained for run times of more than 3000 hours.

These severe demands are met by Sweetzyme, and during its lifetime, a kilogram of Sweetzyme will produce 2500–3000 kg HFCS (d.s.) of standard composition (i.e. 42% levulose).

Another question arises when full-scale production is considered: If all the enzyme necessary for the desired production capacity is placed in one reactor – and this is technically possible for small to medium sized productions – the flow reduction from the loading of the enzyme to the discarding of the used enzyme will be huge. This reduction is caused by the decay of the enzyme activity.

From the time of loading – supposing the process is run properly – the activity will decrease according to an exponential decay curve with a half-life of at least 1000 hours, and the enzyme is often used for approx. 3 half-lives corresponding to a residual activity of approx. 10% when discarded. As the syrup flow is proportional to the activity, this means that the initial flow is 230% of the average while the final flow would be only around 30%.

This flow variation is not acceptable for a normal production plant, and the way to avoid this is to have several columns and load them at staggered intervals.

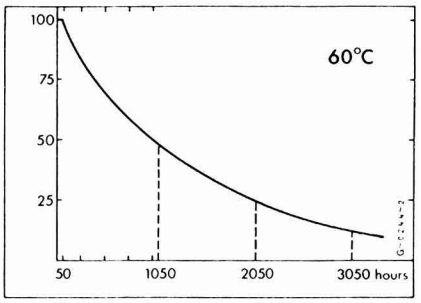


Fig. 5. Sweetzyme type Q activity *vs* time

CONCLUSION

The development of the above system started in the early seventies, and it was improved by a fruitful collaboration between industry and laboratory, so that today more than 20 factories in Europe, America and the Far East are using the system for production of fructose-containing syrups either to be used as such or as a starting material for enriched fructose syrup.

The production of HFCS has thus developed into a considerable industry and the development continues, especially in the more industrialized parts of the world. Worldwide, HFCS production, however, accounts for only 2½% of the total sweetener production, so sugar is and will for the next many years still be the major sweetener.

Summary

Enzymatic processes used for production of fructose-containing syrups are described, with particular emphasis on the isomerization stage.

La production, à l'aide d'enzymes, de sirops contenant du fructose.

Des procédés enzymatiques de production de sirops contenant du fructose sont décrits, l'accent étant mis en particulier sur le stade d'isomérisation.

Produktion von Fructose enthaltenden Sirupen mit Enzymen

Enzymatische Verfahren zur Produktion von Fructose enthaltenden Sirupen werden beschrieben, insbesondere die Isomerisationsverfahren.

Producción con enzimas de siropes conteniendo de fructosa

Se describen procesos enzimáticos para producción de siropes conteniendo de fructosa, con énfasis sobre la etapa de isomerización.

A new diffuser for beet sugar extraction

By G. V. GENIE, Dr.Sc. (Consultant, Chaumont-Gistouz, Belgium)

Introduction

Rotary diffusers have the advantage that cossettes and juice are divided into batches, which the revolving of the drum causes to move in opposite directions without mixing of successive portions. As a result, all cossettes have the same residence time in the drum and this is in principle also true for the juice provided the diffuser is correctly operated. The situation is quite different in towers or trough diffusers, where the longitudinal mixing of cossettes and juice is an unavoidable evil. Careful measurements made in Germany by Cronewitz and co-workers[1] on a tower of 18 feet diameter have shown that the residence time exceeds 1 hour 45 minutes for 90% of the cossettes, 2 hours 30 minutes for 50% of the cossettes and 3 hours 20 minutes for 10% of the cossettes. The normal time required for the exhaustion of the cossettes is about 70–80 minutes and cossettes with a residence time of longer than 90 minutes in the tower – i.e. over 90% of them – just reduce the throughput because they help to fill the available space without being able to release more sugar. For the juice the situation is even worse: a tracer injected at mid-height of the tower reached a maximum in the diffusion juice after *four hours*. Such long retention time of course involves a danger of fermentation losses and requires a liberal use of formaldehyde. But rotary diffusers have further advantages over towers or trough diffusers:

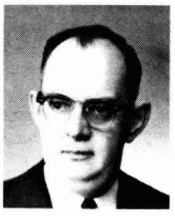
(1) In spite of their shorter retention time, they are known to operate at a *lower juice draft*, with a lower loss in the pulp, than towers or trough diffusers and this results in an economy of fuel.

(2) The effect of juice channelling is reduced because the bed of cossettes is reconstituted thirty times along the drum. A dead spot has no chance to survive more than a few minutes and flow irregularities are statistically balanced.

(3) Rotary diffusers are much less sensitive to the quality of the cossettes than trough or moving-bed diffusers.

(4) When properly designed, rotary diffusers are able to operate with the same good results from almost nil up to their rated capacity. This flexibility also makes the start-up easy.

(5) Unlike towers and trough diffusers, rotary diffusers have no moving parts in contact with the juice inside the drum.



G.V. Genie

[1] *Zuckerind.*, 1979, **104**, 1107–1111.

The competitivity of rotary diffusers is however restricted by some inconveniences, which will be discussed below after a short description.

Inconveniences of conventional rotary diffusers

A rotary diffuser is a horizontal drum about 100 feet long, equipped with an internal Archimedean screw with a double inlet, which carries the juice from one end to the other, and a diametral partition composed of a solid axial section and screens on both ends, where the partition joins the drum (Fig. 1). When the drum revolves, the immersed cossettes are swept by the screens and lifted out of the juice, which flows undisturbed through the screens and follows the screw. When the slope of the diametral partition reverses, the drained cossettes slide down and are directed by chutes (not shown in the figure) so as to fall into another turn of the screw, where the next portion of juice is waiting for them. Such drums have about thirty compartments and are constructed up to 23 feet in diameter corresponding to a throughput of 10,000 tons/day. Ten years ago a slightly different design was introduced in which the Archimedean screw is distorted in order to make the sliding of the cossettes easier and to prevent an obstruction of the chutes. This allows a slight increase of the load at the cost of a somewhat higher diffusion loss, as experienced at those places in France where both types are operated in parallel.

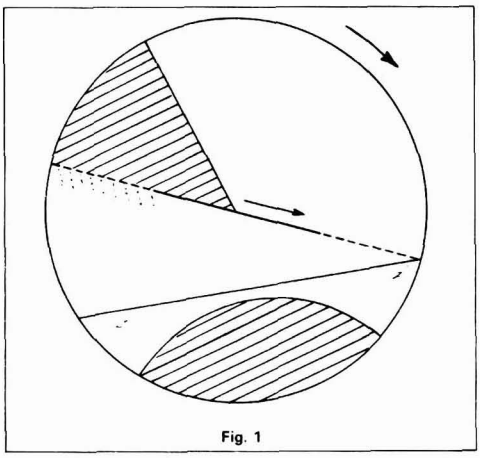


Fig. 1

Conventional rotary diffusers however suffer from several major inconveniences, all linked with the diametral partition, which appears to be a nonsense.

(1) The diametral partition, which the cossettes cannot cross, divides the drum in two halves which are to be fed in parallel. There are consequently twice as many batches of cossettes as turns of the screw and portions of juice. Two batches of cossettes must therefore be successively immersed in one single portion of juice and the volume of juice is not sufficient to submerge both loads of cossettes when the diametral partition is vertical, with the result that the time of actual complete immersion of the cossettes is quite small.

(2) To prevent an overflow between adjacent compartments, the level of the mixture of immersed cossettes and juice must be kept below two-thirds of the radius, as shown in Figure 1. This means that the useful volume is only 29% of that of the drum compared with 70% for a tower diffuser.

(3) Much damage occurs to both the cossettes and the screens through the repeated sliding on the diametral partition. Cossettes are squeezed and broken into small pieces and mush, which substantially decreases their permeability and increases the amount of loose pulp in the juice. On the other hand, the screens are quickly worn out by the hard particles of soil or sand carried by the cossettes. From the fifth campaign on, a few screens have to be replaced every year unless the beets are perfectly clean.

(4) The maximum possible length of the radial screens is only 0.7 radius because two of them must be fitted in the diametral partition.

(5) The revolving speed is limited because, as soon as the diametral partition passes beyond the horizontal (see Fig. 1), most of the juice still draining from the wet cossettes is drawn by the slope and flows through the chutes ahead of the cossettes, causing backmixing. To prevent this a new design is now being experimented on in order to catch part of that juice[2].

The diametral partition is a mistake of the original design, which dates back to 1930, and it is hard to believe that it has remained unquestioned for half a century.

Improved design

A much simpler design[3] is shown in figure 2. It consists of a screen shaped as a sickle or G, the straight radial portion of which is solid and forms a dike or barrier for the juice. When the drum revolves, the cossettes are progressively raised out of the juice and the percolating juice is collected in a chamber of increasing volume which develops between the screen and the shell of the drum. The drained cossettes are then gradually dropped over the dike, in the same order as they were lifted out of the juice and without any sliding on the screen, as soon as their angle exceeds that of their natural angle of repose. Meanwhile the dike forces back the collected juice in another turn of the screw through a notch or a short channel in the helicoidal partition and juice less concentrated in sucrose is brought into contact with the

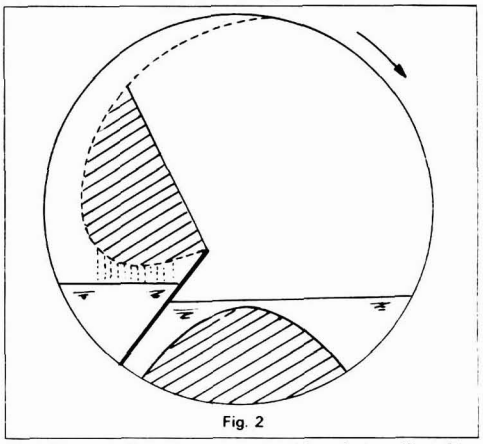


Fig. 2

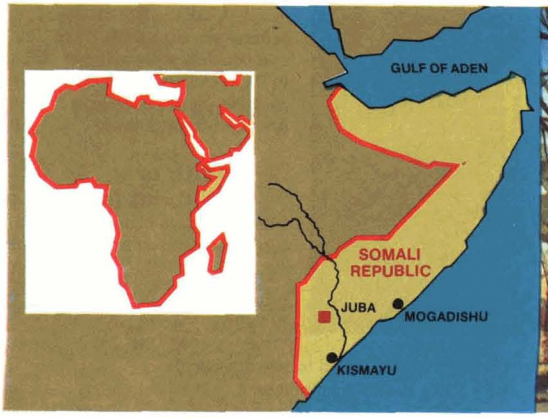
cossettes on the downstream side of the dike. The advantages of such a design are numerous:

(1) There is an equal number of portions of cossettes

[2] Belgian Patent 879,198.

[3] Belgian Patents 863,184 and 868,984; US Patent 4,248,835.

FS IN SOMALIA

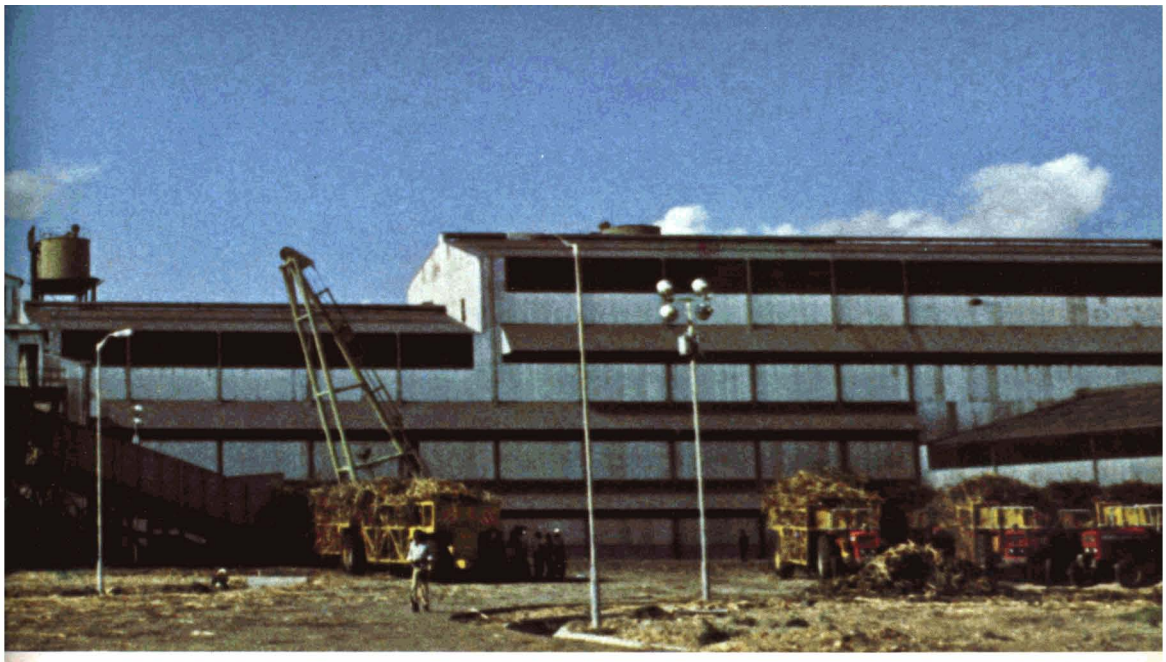


Covering an area of some 170,000 sq.km with an estimated population of 800,000, the Juba Valley in Southern Somalia is a Government designated area for the exploitation of raw materials aimed at reducing imports, increasing exports, improving the balance of payments and creating job opportunities.

Particular emphasis has been placed on increasing sugar production, and to this end the Juba Sugar Project (JSP) was formed as an autonomous agency in 1977 following two years of feasibility, planning and design studies, and field trials by Booker Agriculture International, a sister company of FS within the Booker McConnell Group.

A site was chosen on the west bank of the Juba river, 105 km north west of the port of Kismayo and comprised the development of 8,000 hectares of irrigated cane, the erection of a 3,360 MTCD factory and the construction of estate buildings, housing, roads and associated infrastructure.

The factory, designed and supplied by FS, is capable of processing 3,360 MTCD producing raw sugar by the lime defacation process with inbuilt provision for future expansion to 5,280 MCTD with optional conversion to produce 50% raw and 50% refined sugar output if required.



In addition the design embodies the facility to add a distillery at some future date to process all the final molasses produced.

In the face of every obstacle, including a catastrophic flood which necessitated the almost total evacuation of the project and lost six months on-site work, the first sugar was produced during July 1980 – on schedule!

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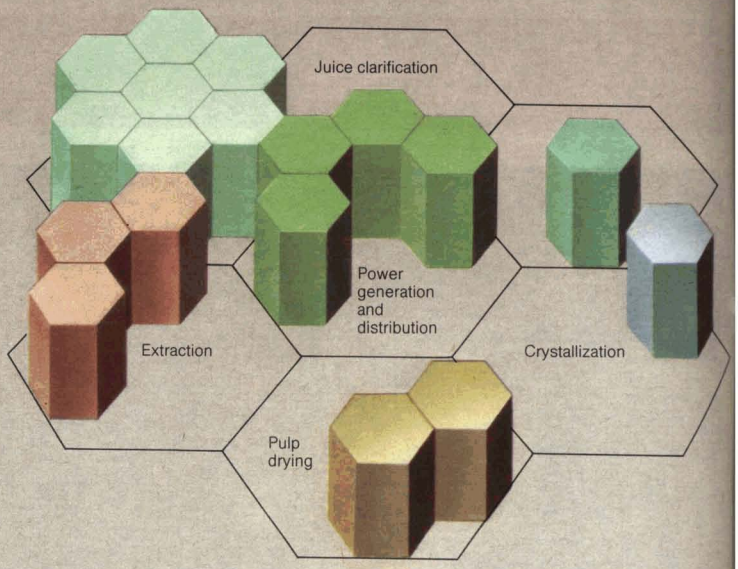

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and juice in the drum.
(2) The overflow level is raised to nine-tenths of the radius, which brings the useful volume to 44% of that of the drum instead of 29%.
(3) The cossettes do not slide on the screen, they are much less damaged and cause no abrasion whatever.
(4) The length of the screen is multiplied by 3–4 times.
(5) The time allowed for the separation of the juice is increased and the lower layers of cossettes continue to drain while the drained upper layers are dropped into the next portion of juice.
(6) The separated juice never flows along the same path as the drained cossettes and the separation is useful to the last drop.
(7) The height at which the cossettes are lifted is lower and less power is required to rotate the drum.

Additionally, the elimination of the diametral partition relieves the constraint on the angle between successive screens in the screw – which will be hereafter called "angle alpha" – and this leads to useful properties. The time required for the cossettes to move from one screen to the next one obviously corresponds to a rotation of the drum through an angle alpha, but the time for the juice to move over in the opposite direction is shorter because the juice takes the short way through the helical partition. The ratio of these times depends on the angle alpha and it is thus possible to choose the optimum retention time of the juice in the drum. This time should be kept short so as to avoid fermentation losses, but not so short as to have a level of juice in the drum too low to cover the cossettes. Other considerations also influence the choice of the angle alpha, whose optimum value is about 395°. Another advantage of this angle is that the successive dikes are shifted by 35°. Besides a balanced drum, this allows a low height of the dike because, on account of the overlap of the compartments, the space available for juice is increased when the cossettes are about to be lifted and the juice level lowered. As a consequence, the level along the drum is 0.9 radius except in those compartments where the cossettes are being lifted, where it is 0.7 radius or less.

Internal structure of the new diffuser

In order to reduce the cost of the diffuser, a very simple design has been developed. The screw is composed of a succession of circular segments perpendicular to the axis of the drum (Fig. 3*a*) joined by two sloping sectors *b, c* which direct the immersed cossettes toward the next separation screen *d*. Between the two sloping sectors, three surfaces (*e, f* and *g*, also shown in the middle compartment) form a deflector whose edge *h* passes close to the surface of the juice during the rotation and sweeps any emerged cossettes. Cossettes which cannot be immersed in the juice are lifted by the deflector and returned to the preceding compartment, thus removing any local excess of cossettes and preventing unextracted cossettes from moving toward the water end of the drum. The sloping sectors and the deflector are arranged in such a way that the channel in which the immersed cossettes flow to the next screen has a section of changing shape in order to keep the juice moving with respect to the cossettes. The screen *d* and the dike *i* (another dike *i'* is better shown in the right-hand compartment) are rectangular and are located between two successive segments *a*, which are parallel. The upper edge of the dike is closer to the axis than the upper edge of the screen and an aperture *j* is provided between them in order to catch any fortuitous overflow of juice at high rotational speed and to avoid juice backmixing. The juice channel *k*, (the cylindrical shell is not shown) has a triangular section to prevent it from carrying away cossettes and is slightly oblique with respect to the axis in order that its slope allows complete drainage of juice. Owing to the value of the angle alpha (395°) there is an offset of about 70° between the dike *i* and the channel *k*, which delays the arrival of the juice until the cossettes lifted by the screen *d* are ready to drop over the dike *i*. As mentioned above, another useful consequence of this offset is that the juice suddenly fills the empty space between the channel *k* and the dike *i*, which exists on account of the overlap of the compartments, and that the juice level in the compartment where it comes from (behind the dike *i'*) is lowered so that the height of the dike *i'* may be substantially lower than 0.9 radius. This results in a larger capacity of the screens for cossettes, in a larger clearance above the dike for dropping over the cossettes and in a lower height at which the cossettes are to be raised.

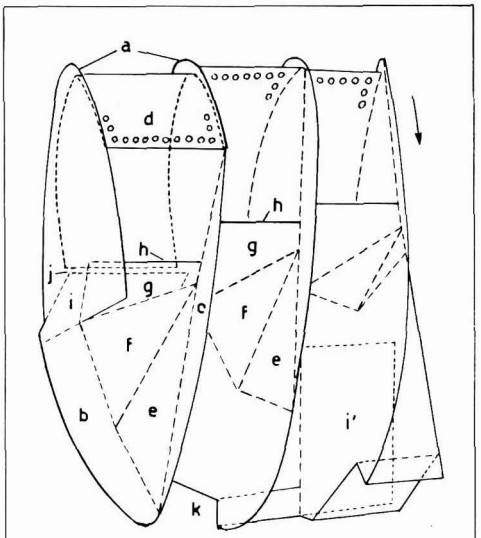


Fig. 3

In order to save energy, many factories now draw off cold juice, which is subsequently reheated by means of low-temperature calories. Trials in France to use the first compartments of conventional rotary diffusers as a heat exchanger failed on account of inadequate contact between juice and cossettes, and the trend is now to use a countercurrent cossette mixer similar to those used with towers. An interesting feature of the new diffuser, in which this contact is much improved, is that, besides a conventional feed of cossettes scalded by recirculated juice or a cossette mixer, it can also be fed with dry cold cossettes, thus saving the cost of a separate exhanger. Therefore a special first compartment with recirculation of juice has been designed. The G-diffuser has no fixed headpiece as with conventional drum diffusers because the juice is merely collected in a semi-circular trough through a hole in the shell of the drum.

Capacity and cost of the diffuser

The G-diffuser carries only one load of cossettes per revolution instead of two in conventional rotary diffusers and either the load or the revolution speed or both must obviously be increased if the daily slice is to be the same. However, as explained above, the useful volume of the drum available for the immersion of the cossettes is raised from 29 to 44% and there is no mechanical problem in increasing the load because the lifting and the dropping of the cossettes is made gradual over a wide angle. There is consequently no sudden sliding of the load of cossettes as in conventional rotary diffusers and the height to which the cossettes are raised is lower. Moreover, the improvement of separation, the greater length of the screens, the longer immersion and the extended time available for the draining of the cossettes allow a faster rotation and a reduction of the number of steps from 36 to 31. A conservative evaluation shows that no difficulty should be encountered to reach the same capacity as conventional diffusers and that the load per square foot of horizontal screen would be similar. The savings are in the lower investment and the reduced maintenance cost. Owing to the simpler design and the absence of abrasion of the screens (the number of which is moreover reduced from 72 to 31) combined with their favourable "drop" shape, which allows the use of thin stainless plate, the cost of the internal structure of a G-diffuser has been calculated by a Belgian engineering bureau to be only half of that of a conventional drum. More savings result from the lower torque, which requires a smaller driving unit and speed reducer, and from the absence of a headpiece. The estimated cost reduction on the complete diffuser is about 25%.

Summary

The advantages of rotary beet diffusers over towers and trough diffusers are explained, but conventional rotary diffusers have also some inconveniences, which are shown to be linked with the presence of a diametral partition in the drum. A new design is proposed in which G-shaped screens secure a longer time for draining the cossettes and their gradual dropping over a dike, which forces back the separated juice in another turn of the screw. In addition to better separation of the juice from the cossettes and the absence of abrasion of the screens, the useful volume of the drum is increased from 29 to 44% and the cost of the diffuser is reduced by 25%.

Un nouveau diffuseur pour l'extraction de sucre des betteraves

Les diffuseurs de betterave rotatifs ont des avantages par rapport aux tours et auges de diffusion, mais ils ont aussi quelques défauts, lesquels sont liés à la présence d'une séparation diamétrale dans la tambour. Un nouveau type est proposé dans lequel des surfaces perforées en forme de G assurent une durée d'égouttage plus longue pour les cossettes et leur chute progressive par-dessus une digue, laquelle refoule le jus dans une autre spire de la vis. En plus d'une meilleure séparation du jus et des cossettes et de l'absence d'abrasion des surfaces perforées, le volume utile du tambour est augmenté de 29 à 44% et le prix du diffuseur est réduit de 25%.

Ein neuer Extraktionsapparat für Zuckerrüben

Die Vorteile von rotierenden Extraktionsapparaten gegenüber Türmen und Trögen werden erklärt, aber gewöhnliche rotierende Apparate haben auch einige Nachteile, die von der diametralen Teilung der Trommel verursacht werden. Eine neue Konstruktion mit G-förmigen Sieben wird vorgestellt, die eine längere Drainagezeit der Schnitzel gewährleistet und deren progressives Hinüberfallen über eine Barriere bewirkt, sowie dabei die separierte Flüssigkeit in ein anderes Abteil zurückdrängt. Zusätzlich zu der besseren Trennung der Flüssigkeit von den Schnitzeln und der Erosionsfreiheit der Siebe werden das Nutzvolumen von 29 auf 44% vergrößert und die Kosten des Extrakteurs um 25% reduziert.

Un nuevo difusor para extracción de azúcar de remolachas

Difusores de remolacha rotativos tienen algunos ventajes sobre torres o artesas de difusión, pero tienen también algunos defectos asociados con la presencia de un tabique diametral en el tambor. Un nuevo tipo se propone en que superficies perforadas en forma de G aseguran una duración de drenaje más larga para cosetas y su caída gradual por encima de un dique que direge el jugo separado en un otro giro del tornillo. Además de una mejor separación de jugo de las cosetas, y la ausencia de desgaste de los tamices, el volumen útil del tambor es aumentado de 29 a 44% y el costo del difusor es reducido de 25%.

Colombia sugar exports, 1980[1]

	1980	1979
	tonnes *	
Dominica	780	0
Haiti	4,536	0
Portugal	11,695	0
Senegal	28,298	6,500
USA	471,701	792,055
USSR	9,450	0
Venezuela	151,609	184,243
West Indies	1,200	5,838
	679,269	925,636

* Raw value 1980; tel quel 1979.

Thailand sugar exports, 1980[2]

	1980	1979	1978
		tonnes, raw value	
Canada	0	11,770	0
China	56,153	73,565	253,349
Indonesia	0	0	5,374
Iran	0	0	87,809
Iraq	0	9,980	0
Japan	112,919	678,602	400,299
Korea, South	15,417	90,744	73,524
Malaysia	18,261	116,969	104,823
Morocco	49,596	88,330	0
New Zealand	0	18,571	0
Singapore	28,274	45,708	24,693
Sweden	0	21,356	12,827
USA	81,637	11,527	65,977
USSR	97,443	43,182	0
	459,700	1,210,304	1,028,675

[1] C. Czarnikow Ltd., *Sugar Review*, 1981, (1536), 47.
[2] *I.S.O. Stat. Bull.*, 1981, **40**, (2), 88.

Synthesis of lipids by cane leaf chloroplasts

By A. P. S. MANN*, P. K. MONGA† and H. K. SHARMA*

Introduction

The authors aimed at measuring the rate of lipid synthesis in chloroplasts under low temperature conditions to determine whether any relationship could be found with tolerance to low temperatures. The six varieties CoJ 58, CoJ 64, Co 975, Co 1158, CoJ 46 and Co 1148 were used in the study. The third and fourth leaves from five individual plants were used for chloroplast isolation.

Methods

Chloroplasts were isolated using the media recommended by Giaquinta *et al.*[1], *viz.* 0.4 M sorbitol, 20 mM tricin (N-tris-hydroxymethyl methyl glycine), 3 mM ascorbate, 10 mM potassium chloride, 3 mM magnesium chloride and bovine serum albumin (2 $mg.cm^{-3}$ of final volume). The tricin was prepared by the authors using accepted methods; a final yield of white crystals (about 42% on chloro-acetic acid) was obtained.

Incubation media

The following was used to determine lipid synthesis by chloroplasts: 20 mM tricin, 400 mM sorbitol, 9.1 mM NADH, 0.01 mM COA, 0.1 mM ATP, sodium 1-^{14}C-acetate (819148 c.p.m.) or ^{14}C-U-sucrose (826333 c.p.m.), 1 ppm biotin and 0.1 cm^3 of 0.08% Triton 100.

Incubation studies

Chloroplasts containing 1 mg of chlorophyll[2] from each of the six varieties were added to aliquots of the reaction mixture and the final volume adjusted to 1 cm^3. The reaction was allowed to proceed for 1½ hr at 25°C in one set of experiments.

The effect of low temperature on lipid synthesis by chloroplasts from the six varieties was also studied at 10°C with prior exposure of the chloroplast solutions to −1°C for 5 minutes in a second set of experiments. The reaction was terminated by adding 2.5 cm^3 of a 1:1 chloroform:methanol mixture, washing twice with 2.5 cm^3 of the chloroform:methanol mixture and with 4 cm^3 of saturated NaCl solution; the non-aqueous extracts were removed for lipid studies and concentrated under nitrogen at 60°C. Radioactivity was measured using a Packard liquid scintillation spectrometer Model 3330 with 10 cm^3 scintillation solution as described by Bray[3].

Results and discussion

The results of incubation studies with intact chloroplasts using radio-active acetate and sucrose are presented in Table I.

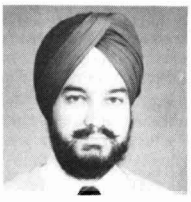
Table I. ^{14}C incorporation in the lipid fraction by isolated cane leaf chloroplasts at 25°C

Variety	Acetate-1-^{14}C		Sucrose-U-^{14}C	
	Specific activity	% Incorporation	Specific activity	% Incorporation
CoJ 64	97063	11.85	16047	1.94
CoJ 58	48028	5.86	3048	0.37
Co 975	97358	11.88	15542	1.88
Co 1158	137124	15.52	11640	1.40
CoJ 46	113200	13.82	25367	3.07
Co 1148	94710	11.56	18183	2.20

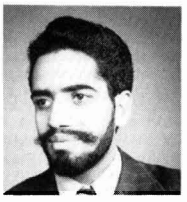
Acetate is a precursor of fatty acid synthesis but it is apparent that the rate of lipid synthesis differs between varieties, being fastest in Co 1158 of those examined. The early-maturing varieties CoJ 64 and CoJ 58 differed from each other, the rate of incorporation in the lipid fraction being much higher in the former. Since it is known that chilling resistance may be introduced to some extent, it was considered interesting to compare lipid synthesis from its normal precursor acetate and from the normal sucrose reserve of the plant.

It has been noted here that the rate of lipid synthesis from acetate is maximum in Co 1158 and minimum in CoJ 58. However, when radio-active sucrose was used as the precursor, the order of rate of synthesis between varieties was different, the maximum rate being in CoJ 46 and the minimum again in CoJ 58, while Co 1158 had dropped to fifth in rank.

When the chloroplasts were subjected to a temperature of −1°C for 5 minutes, and then allowed to recover for further studies of lipid synthesis at 10°C, they behaved differently, as shown in Table II. The rate of incorporation of lipids from both radio-active acetate and sucrose was maximum in Co 1148 and in decreasing order for CoJ 46, CoJ 64, Co 975, CoJ 58 and Co 1158, respectively. The comparative rates of acetate and sucrose incorporation into lipids at 10°C were different from those at 25°C.



A. P. S. Mann



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1 *J. Biol. Chem.*, 1974, **249**, 2873.
2 Arnon: *Plant Physiol.*, 1949, **24**, 1.
3 *Anal. Biochem.*, 1960, **1**, 279.

Table II. ^{14}C incorporation in the lipid fraction by isolated cane leaf chloroplasts at 10°C

Variety	Acetate-l-^{14}C		Sucrose-U-^{14}C	
	Specific activity	% Incorporation	Specific activity	% Incorporation
CoJ 64	22526	2.75	6197	0.75
CoJ 58	15154	1.85	5784	0.70
Co 975	15973	1.95	5371	0.65
Co 1158	4505	0.55	1239	0.15
CoJ 46	22688	2.76	6610	0.80
Co 1148	24410	2.98	7850	0.95

The rate of synthesis was faster in those varieties known to be frost tolerant than in the varieties known to be frost susceptible. Although lipid synthesis was generally faster from acetate precursor, frost tolerant varieties can synthesize at a relatively rapid rate from sucrose.

The varieties used in these studies had been examined for frost tolerance and tissue injury by Singh & Kanwar[4] who found that the tissue injury index was high (0.87) in Co 1158 while that of CoJ 46 and 0.65 and that of CoJ 58 was 0.63. It was also noted by these authors that Co 1148 was frost resistant and CoJ 64, CoJ 46, Co 975 and CoJ 58 were moderately resistant while Co 1158 was susceptible to frost.

The resistance or tolerance and susceptibility to frost injury thus appears to be correlated with rate of lipid synthesis, frost resistant varieties having a very high rate of lipid synthesis from acetate and a relatively high rate from sucrose. The difference between the two early-maturing varieties CoJ 64 and CoJ 58 is of interest in that the former has a rapid rate of lipid synthesis at high and low temperatures whereas the latter has a low rate at high temperature (25°C) but approaches the former at the lower temperature (10°).

It is suggested that the relative rates of lipid synthesis from sucrose and acetate as precursors may be valuable in predicting frost tolerance.

Summary

Chloroplasts were isolated from six cane varieties and their rates of lipid synthesis measured using radio-active acetate and sucrose as precursors. Incubation experiments were at 25°C and at 10°C, the latter after subjecting the chloroplasts to a temperature of −1°C for 5 minutes. The rates of lipid syhthesis were found to be different for the six varieties. In general, acetate was incorporated 4-5 times as fast as sucrose into the lipid fraction. The rate of lipid synthesis at 25°C has no relevance to frost tolerance or susceptibility, but studies at 10°C indicate a relationship between the rate of lipid synthesis and the ability of the cane to withstand low temperatures.

Synthèse de lipides par les chloroplastes des feuilles de la canne

Les chloroplastes furent isolés de six variété de canne et leur vitesse de synthèse de lipides mesurée en utilisant de l'acétate et du saccharose radioactifs comme précurseurs. Des essais d'incubation furent effectués à 25°C et à 10°C, ces derniers après avoir soumis les chloroplastes à une température de −1°C pendant 5 minutes. En général l'acétate était incorporé 4 – 5 fois plus vite que le saccharose dans la fraction lipide. La vitesse de la synthèse des lipides à 25°C n'a pas de rapport avec la tolérance ni la susceptibilité à la gelée, mais des études à 10°C indiquent qu'il y a une relation entre la vitesse de synthèse des lipides et la faculté de la canne de résister aux basses températures.

Lipidsynthese von Rohrblattchloroplasten

An sechs Rohrsorten wurden Chloroplaste isoliert und deren Lipid-Synthese-Geschwindigkeit mit Hilfe von radioaktivem Acetat und Saccharose als Vorläufer bestimmt. Inkubationsversuche wurden bei 25 und 10°C durchgeführt, letztere nachdem das Chloroplast 5 Minuten lang einer Temperatur von −1°C unterworfen war. Die sechs Rohrsorten hatten unterschiedliche Lipidsynthese-Geschwindigkeiten. Im allgemeinen wurde Acetat 4-5mal schneller als Saccharose in die Lipidfraktionen eingebaut. Die Lipidsynthese-Geschwindigkeit bei 25°C hat keinen Zusammenhang mit der Frostverträglichkeit oder -anfälligkeit, aber Untersuchungen bei 10°C zeigen einen Zusammenhang zwischen der Lipidsynthese-Geschwindigkeit und der Fähigkeit des Rohrs niedrigen Temperaturen zu widerstehen.

Síntesis de lípidos por cloroplastes de la hoja de caña

Se han aislado cloroplastes de seis variedades de caña y sus pasos de síntesis de lípidos se han medido empleando acetato y sacarosa radioactivas como precursores. Experimentos de incubación se han conducido a 25°C y 10°C, en el segundo caso después de los cloroplastes se han sometido a una temperatura de -1°C durante 5 minutos. Los pasos de síntesis de lípidos se resultan diferente para las seis variedades. Eu general, el acetato se incorpora en la fracción lípida a 4-5 veces de la rapidez de la sacarosa. El paso de síntesis de lípido a 25°C no había pertinencia a resistencia o toleración a helado, pero estudios a 10°C indican una relación entre el paso de síntesis y la capacidad de la caña de aguantar temperaturas bajas.

Turkey sugar industry expansion[5]. – Work on construction of new sugar factories and expansion of processing capacities of the present factories continues in Turkey, according to the US Department of Agriculture. Two of the new plants (at Mus and Agri) will be completed for the next campaign. Capacity expansion of seven older plants has been completed, yielding an additional sugar production capacity of 225,000 tonnes. Five others are being enlarged for an additional sugar production capacity of about 160,000 tonnes. It is hoped that with the expected increase in total beet production and processing capacity Turkey will not have to import sugar next year. In the past sugar has been very heavily subsidized by the government and, as a result, sugar became relatively cheaper than many other food items. This caused a very rapid increase in total sugar consumption and a heavy burden on the treasury. In line with the new economic policy announced in January 1980, the subsidy was reduced by increasing the ex-factory price of sugar four times during 1980. These increases reduced total consumption and consequently import requirements.

[4] *I.S.J.*, 1978, **80**, 139-141.
[5] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 316.

SUGAR CANE AGRONOMY

Permanent furrows as an option of minimum tillage for sugar cane. J. Fernandes. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — The use of a system of planting cane in wide-based furrows spaced 170 cm apart is discussed. It permits movement within the fields by machinery which stays in the same lines in the inter-row so that any compaction stays in those lines and does not affect the furrows which are used repeatedly, with setts being planted in the same lines after destruction of ratoon stools and preparation of new furrows. Benefit is also obtained of residues of organic matter and fertilizer applied to the previous crop. The system is more economical and involves rotary tillage of only the furrows before planting so that cultivation takes on the nature of a plantation with permanent furrows.

Wide-based furrows for sugar cane planting. J. Fernandes, V. L. F. Neto, D. Camposilvan and R. Stolf. *Paper presented to the 17th Congr. ISSCT,* 1980, 11 pp. — Growing of cane in wide-base furrows having bottom widths of 30 cm and spacing of 180, 200 and 220 cm between furrow centres (see previous abstract) increased yield for five consecutive years, as compared with use of conventional V-furrows spaced at 150 cm apart.

Simulation modelling of potential evapotranspiration for irrigated sugar cane. A. C. Early and S. Khan. *Paper presented to the 17th Congr. ISSCT,* 1980, 20 pp. Using historical hydrometeorological data collected over a period of 56 years, a computer simulation model was developed for daily mean potential evapotranspiration (PET) on a weekly basis. This assumed that there was little variation in PET during a week but, during development of the model, it was found that occurrence of a single rainy day or a series of rainy days during a week was important although having no significant effect on PET. Aspects of the model are discussed; for studying a complete crop production system it can be used as a component of an overall crop environmental model describing the inputs of rainfall, evapotranspiration and soil moisture variations with depth as a basis for irrigation water allocation to intensify cane production.

Johnson grass competition and control in succession-planted sugar cane. R. W. Millhollon. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — Cane fields are usually left fallow for a year between ploughing-out and planting in Louisiana. In one trial, this fallow year was omitted when the ratoon crop had been heavily infested with *Sorghum halepense;* the new crop was very highly infested but seedlings were controlled by pre-emergence treatment the following autumn with Terbacil, Fenac, Picloram or a Fenac-TCA combination. Only Picloram effectively suppressed development of rhizome plants. Rhizome plants were controlled more effectively by post-emergence treatment with MSMA or Dalapon, the former giving better results. Compared with the hand-weeded control, yields of sugar per hectare for the crops were 49% for pre-emergence treatment alone, 76% for pre-emergence treatment plus Dalapon at post-emergence, and 92% for pre-emergence treatment plus MSMA.

Rainfall and frost modelling for sugar cane system synchronization. M. K. Ayub and A. C. Early. *Paper presented to the 17th Congr. ISSCT,* 1980, 15 pp. — The low rainfall and frosts in the early part of the year are factors limiting cane production, and meteorological models for these two were studied in order to synchronize milling and harvesting. Climatic data covering the period 1914-1975 was used as a basis for developing the models and, based on the work done elsewhere, it was decided to establish lag-one Markov chain models. Development and characteristics of the models are described; both have proved effective in generating rainfall and frost probabilities.

Draining cane fields. D. R. Ridge. *Cane Growers' Quarterly Bull.,* 1980, **43,** 56-78. — After discussing the causes, indicators and effects on cane growth of poor drainage, the author lists benefits of improved drainage, and indicates typical yield losses resulting from inadequate drainage in north Queensland. Surface drainage systems are described, together with their means of construction, and advice is given on their maintenance. Sub-surface drainage is discussed, with descriptions given of types of system and of the drains; details are given of design and construction as well as maintenance. Brief mention is made of drainage in flood-prone and tidal areas, and of community drainage, where a drainage board is set up to control and coordinate the actions taken by individual growers regarding drainage water outlets.

Current trends in temperature in Tucumán and their impact on sugar cane production. J. L. Minetti and R. A. Neder. *Rev. Ind. Agríc. Tucumán,* 1979, **56,** (1), 17-31 (*Spanish*). — Since 1950 there has been a reduction in the available atmospheric energy for potential evapotranspiration, and increases in the numbers of days with minimum temperatures below 16°C and of frosts. All these factors have had a negative influence on sugar cane production.

Control of *Sorghum halepense* (L.) Pers., with Glyphosate (N-phosphomethyl glycine). R. Barcudi, J. M. Hinojo and A. R. Lazarte. *Rev. Ind. Agríc. Tucumán,* 1979, **56,** (1), 33-42 (*Spanish*). — The title plant, Johnson grass, is one of the most noxious weeds in Argentina, and tests were made on its control with Glyphosate, using 960, 1920 and 2880 g a.i. per ha on ploughed and unploughed fields, the latter cut a level 10 cm above the soil. The herbicide was applied while the grass was still growing, before flowering and during flowering. Evaluation was in terms of dead stools at 60, 90 and 110 days. Asulam and MSMA at 3600 and 2515 g a.i. per ha were used as controls. Subsequently, the rhizomes in the 0-10 cm and 10-20 cm layers were collected and planted out in a greenhouse to determine, from the germination obtained, the underground effectiveness of the Glyphosate. All treatments gave excellent control in all three stages, but the smallest dosage of Glyphosate was less effective in unploughed soils and when the grass was still growing. No difference was observed between treatment with 1920 and 2880 $g.ha^{-1}$.

Methods of estimation of the yield of sugar cane in experimental plots. J. C. Díaz D., F. Reyes L. and F. Méndez R. *Cienc. Agric.* (Cuba), 1978, (3), 13-27 (*Spanish*). — A comparison was made between actual trial

plot weighing of cane and yield estimation methods. The most accurate estimations were those based on population, and the most promising that in which the millable stalk number of two rows — one inner and one outer from a total of four — was multiplied by the average weight of 20 cane stalks collected at random from the whole plot. This is recommended for plots of 76.8 m^2 or less and with erect to slightly lodged cane.

Effects of interior borders in comparative experiments with sugar cane varieties. N. Milanés and J. L. Pérez C. *Cienc. Agric.* (Cuba), 1978, (3), 29-34 (*Spanish*). — Statistical examination of the results of different rows in experimental plots showed no differences between the borders and other rows of the plots in regard to variety and fertilizer experiments.

Control of weeds in sugar cane with new residual herbicides on red ferralitic soil. F. Naranjo M. de O. and J. C. Díaz D. *Cienc. Agric.* (Cuba), 1978, (3), 149-158 (*Spanish*). — Trials in the chemical control of *Rottboellia exaltata* in sugar cane on a red ferralitic soil, both plant and first ratoon crops, using pre-emergence herbicides, showed that best results were obtained with 17623 RP at 2 kg.ha $^{-1}$ a.i. (VT 2569 at 5 l.ha $^{-1}$), followed by Metribuzin or B 94337 at 2.1 kg.ha $^{-1}$ a.i. (Sencor at 3 kg.ha $^{-1}$), and GS 14259 at 4 and 3 kg.ha $^{-1}$ (Caragard at 8 and 6 kg.ha $^{-1}$). Poorer control was obtained with GS 14254 at 4 kg.ha $^{-1}$ a.i. (Ethazine at 8 kg.ha $^{-1}$) and DCMU at 4.8 kg.ha $^{-1}$ a.i. (Diuron at 6 kg.ha $^{-1}$), while Atrazine at 4.8 kg.ha $^{-1}$ (Gesaprim at 6 kg.ha $^{-1}$) gave almost no control. The herbicide 17623 RP, which gave the best general control, did not control dicotyledonous weeds, however, and was the only one to produce symptoms of damage in the B 4362 cane, although these were slight, ephemeral and without effect on the growth, tillering and harvesting of the cane.

Use of the herbicide Doruplant in sugar cane plantations. R. Villasana B., H. Wozniak, P. Díaz and J. Fernández. *Cienc. Agric.* (Cuba), 1978, (3), 159-167 (*Spanish*). — Trials were carried out in different locations in Cuba, using plant and ratoon cane, to evaluate several new formulations containing Ametryne as active ingredient by comparison with Gesapax 80, an 80% Ametryne formulation, in pre- and post-emergence. In terms of observed phytotoxicity, weed control and yields obtained, Doruplant, a 40% Ametryne formulation, showed good possibilities for commercial usage in post-emergence at a rate of 8 l.ha $^{-1}$ when the weeds are at the 3-4 leaves stage.

Use of filter cake in the planting furrow of sugar cane (*Saccharum* spp.). L. J. P. de Castro and O. P. Godoy. *Brasil Açuc.*, 1979, **94**, 362-372 *(Portuguese)*. — Field trials on cane with N-P-K alone as control and supplemented with castor bean cake and with filter cake showed that both supplements raised cane and sugar yield, the filter cake having a greater response.

Effect of micronutrients in the presence or absence of calcitic lime on the agricultural yield and juice quality of sugar cane (plant cane). J. O. de Siquiera, J. F. da Silveira and G. A. A. Guedes. *Brasil Açuc.*, 1979, **94**, 373-376 *(Portuguese)*. — The effect of B, Zn, Fe, Mg, Cu and Mo was studied in the presence and absence of lime, using the "missing element" method, on CB 41-76 cane grown on a dark red distrophic latosol clay soil. Liming increased yield, sometimes markedly, depending on the micro-nutrient omitted, and omission of B produced a considerable increase in cane yield and juice quality in the absence of liming, relative to the controls with no micro-nutrients and with them all. The presence of all micro-nutrients combined with liming produced a reduction in yield and juice quality and only with Cu omitted was the yield improved, but the sucrose content was much reduced. Sucrose was increased in the absence of B but the yield was lower.

Effect of split-dosing of nitrogen and potassium in sugar cane (plant cane) in the Tres Pontas region of Minas Gerais state. G. A. A. Guedes, J. O. de Siqueira and J. F. da Silveira. *Brasil Açuc.*, 1979, **94**, 425-528 *(Portuguese)*. — Experiments were carried out in which 100 kg per hectare of N and of K_2O were applied to cane either in one dose at planting, in April or in October, or in split doses at either two or three of the dates. The yields recorded show that in the case of N, the best results were obtained by applying half in April and half in October. Application of K gave improved yields over the control, but different times of application showed no differences.

A sketch of TSC's corporate cane plantation and sugar cane extension program. Anon. *Taiwan Sugar*, 1979, **26**, 199-201. — A brief outline is presented of cane agricultural practices on plantations owned by the Taiwan Sugar Corporation and on those supplying cane (two thirds of the total) to TSC under contract. The survey includes information on varieties and control of pests and diseases.

Cane field inventory with the aid of aerial photography. The Greater Piracicaba region in the harvest year 1978/79. N. F. Koffler, A. C. Cavalli, J. V. Chiarini and F. P. Nogueira. *Bol. Téc. Planalsucar*, 1979, **1**, (2), 3-38. — This report presents the cane crop inventory of one of the largest areas (10,813 km^2) of planting concentration in the State of São Paulo. Aerial photographs are interpreted by using a dot-grid built according to a systematic sampling procedure. The survey reveals that 328,170 ha are covered with cane plantations, some 27% of land use in the region, of which 261,020 ha (79.3%) is ripe cane to be harvested in 1978/79 and 68,150 ha (20.7%) is growing cane to be cut for the 1979/80 crop. Questionnaires filled out by sugar factories (census) and cane growers (stratified sampling) allow an assessment of the composition of the area planted to cane in terms of stage of cutting, main varieties and yield. The geographic distribution of the cane crop and other types of land use is summarized in a map of the region.

On some aspects of trace elements nutrition in sugar cane. S. C. Sharma, G. S. C. Rao and P. C. Johary. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India*, 1979, Ag.1-Ag.10. Of trace elements applied as foliar spray to cane during the tillering phase, Zn gave the maximum sugar yield per ha, while Cu, B and Mn also increased the yield by comparison with the control, whereas Fe and Mo gave lower yields, However, when application was made during the elongation phase, Cu gave the maximum sugar yield, followed by Mo, Zn, Mn and Fe; Bo gave less sugar per ha than did the control. The effects of the trace elements on juice composition and clarification were also studied.

The effect of nitrogen, phosphorus and potash on yield and sucrose content of sugar cane in acid soils of Kerala. P. K. C. Nair. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India*, 1979, Ag.15-Ag.24. — N-P-K fertilization trials involving Co 997 cane are reported and the results tabulated.

SUGAR CANE MECHANIZATION

Recent developments with the BSPA/McConnel harvesting system. D. A. Scott and J. C. Hudson. *Paper presented to the 17th Congr. ISSCT,* 1980, 9 pp. Developments in the BSPA harvesting system since 1977 are described; sharp-tipped base cutter blades are now fitted to the Stage I unit and the topper is now only used where green cane is cut and burnt in the windrow, since it is cheaper to pay for manual topping. The unit is now mounted on a tractor with reversed controls. The Stage II cleaner-piler unit has been modified so that trash and tops are removed from the bottom fan only and by replacement of the stationary ramp with a powered feed roller, which permits operation in very wet field conditions. The Loadster loading unit has been developed for smaller farms and is mounted on a tractor; it has been simplified by eliminating the telescopic extension. Output of the system and fuel usages in a number of countries where it has been undergoing tests are tabulated.

Mechanization of high-population sugar cane in Louisiana. B. J. Cochran and R. Ricaud. *Paper presented to the 17th Congr. ISSCT,* 1980, 9 pp. – New methods of planting cane have been used in Louisiana in an attempt to raise yields and sunlight utilization efficiency; these have employed variations in drilling, row spacing, etc., and some have given positive results. They have been associated with higher population densities, however, and the field mechanization employed needs to be adapted to these. Modifications to cultivation implements are described and illustrated; these include a parabolic subsoiler fitted with "wings" to increase the area of soil fracture, a furrow opener which provides a wide furrow with a convex base, a powered seed-cane covering disc, and a modified soldier cane harvester with a double-bladed base cutter to operate on a wider swathe of cane.

Effects of harvest traffic and soil water content on soil compaction and regrowth of sugar cane. J. E. W. Georges. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. The effect on compaction of a fine sandy loam soil of harvesting traffic was examined with a comparison between three types of mechanical harvester and manual cutting followed by transport in a self-loading trailer hauled by a tractor. The last increased the soil density from 1.56 to 1.62 $g.cm^{-3}$ while mechanical harvesting raised it to 1.66 $g.cm^{-3}$ Soil porosity and depth to maximum compaction were reduced and soil penetration resistance was increased by the traffic, mechanical harvesting producing greater adverse effects. Root development and ratoon growth were poorer in the mechanically-harvested soil, furthermore. Significant bulk density increases occurred through mechanical havester traffic on three clay soils, the effects being greater at higher water contents. No definite relationship was observed between soil moisture and the other physical properties, but the harmful effects on cane regrowth and root development were greater at higher soil moisture content.

Chamber for sugar cane extraneous matter removal under varying vegetal mass feeding rates. U. A. Peralta A. and L. E. Abreu. *Paper presented to the 17th Congr. ISSCT,* 1980, 19 pp. – A Claas Libertadora 1200 harvester was used as a test bed and its normal feed mechanism replaced by an apron conveyor on which was delivered a supply of cane which was passed through the machine and subjected to a pneumatic separation of extraneous matter. The feed rate was varied from 3.2 to 33.2 $kg.sec^{-1}$ of a supply of cane having 28% extraneous matter and measurements made of the power consumption (which ranged from 45 to 60 h.p.) and residual impurities (14.8 to 16.8%) and the separation efficiency and cane losses calculated (56.9 – 50.6% and 1.5 – 0.6%, respectively). In a second series of trials with a cane supply containing 21% extraneous matter at feed rates of 7.5 to 37.9 $kg.sec^{-1}$, power consumption ranged from 46 to 57 h.p. and residual impurities from 10.0 to 11.2%, cleaning efficiency varying from 58.6 to 55.2% and cane losses from 0 to 0.9%. Experiments were made with variation of the width of the trash deflector and of the speed of rotation of the axial fan; with a wide deflector power consumption was lower but residual impurities greater, with poorer efficiency, while for a higher fan speed (1287 *vs.* 1188 rpm) power consumption rose from 54 to 66 h.p. while residual impurities fell from 10.8 to 10.2%. Implications for harvester design are discussed.

Analysis of the cutting process in the chopper of KTP-1 sugar cane harvester. J. Silveira R. *Paper presented to the 17th Congr. ISSCT,* 1980, 10 pp. – In the KTP-1 machine the cane is cut into billets by blades mounted on two drums. The power consumption of the drive for each drum was measured and the action of the mechanism recorded by ultra high speed filming (1000 – 3000 frames per second). The results are described and their application to harvester operation and design discussed.

Means of sugar cane transport in Tucumán. M. O. Haro. *La Ind. Azuc.,* 1979, **86**, 226-231 (*Spanish*). – The first steps towards mechanization of cane harvesting and transport in Argentina were taken in 1964 but there has been real progress only since 1972. A survey is presented of developments in terms of annual proportions of chain-bundles of cane and bulk cane over the period to 1978, the latter rising from 11.4 to 38.0%, of the growth in semi- and totally-mechanized harvest (11.4% and 0% in 1972 to 20.0% and 18.0% in 1978), etc.

Mechanical sugar cane harvester performance efficiency and product quality with selected sugar cane varieties. J. E. Clayton, B. R. Eiland, J. D. Miller, P. M. Lyrene and H. H. Samol. *Proc. Amer. Soc. Sugar Cane Tech.,* 1977, 29-34. The performances of nine varieties with regard to mechanical harvesting were determined during a 3-year crop cycle in Florida. All the varieties were harvested efficiently without uprooting in the plant crop, whereas efficiency was lower for all varieties in the 1st ratoon crop, some stalks of recumbent varieties being uprooted. Harvester efficiency was higher in the 2nd ratoon crop because of the erectness of most varieties. CP 65-357 cane had the highest plant population and its harvesting efficiency was greatest (an average of 96.7% over the 3-year period), yielding an average of 48.5 $tons.acre^{-1}$. The average trash content ranged from 7.4 to 16.6% over the three harvests.

CANE PESTS AND DISEASES

Integrated control of sugar cane pests. A. S. Patil, B. P. Gajare, D. G. Hapase, P. R. Moholkar and B. S. Lhewale. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India,* 1979, Ag.51-Ag.55. — In trials to control the early shoot borer, *Chilotraea infuscatellus,* and white grub, *Holotrichia serrata,* a number of hygiene measures were adopted as well as scrubbing of setts with 0.1% Malathion, application of gamma-BHC at 1 kg a.i. per ha in the furrow at planting, and application of 10% BHC dust at 100 kg.ha^{-1} in June and July. Results showed that germination and yield were increased by comparison with untreated cane and that a 180% return on investment was obtained.

Doses and formulations of nematicides and their effect on the agricultural and industrial yields of sugar cane. W. R. T. Novaretti. *Brasil Açuc.,* 1979, **94,** 407-411 *(Portuguese).* — Trials were carried out on the control of four nematode species by application of chemicals applied at planting in the cane furrows. All treatments except Vydate 10G at 10 kg.ha^{-1} gave significant increases in yield over untreated control plots, the treatments and increases being as follows: Temik 10G at 10 kg.ha^{-1} gave a 21% increase, Temik 10G at 30 kg.ha^{-1} 20%, Hydate 10G at 30 kg.ha^{-1} 22%, Furadan 350 FW at 7.14 l.ha^{-1} 33%, Furadan 350 FW at 11.43 l.ha^{-1} 37%, Furadan 75 PM at 4 kg.ha^{-1} 28% and Furadan 5G at 60 kg.ha^{-1} 38%.

Eldana borer. Is it a serious threat to the sugar industry? T. G. Cleasby. *The Condenser,* 1980, 19-21. — The situation regarding *Eldana saccharina* in South African cane fields is examined. Since its reappearance in Zululand in 1970, the pest has spread south (possibly under the effect of a considerable increase in population of the borer, giving rise to a population pressure) and has become a major problem. Reference is made to means of control (basically field hygiene and control of cane movement, since there are no known parasites in South Africa, and ant predators are vulnerable to herbicides and insecticides, increased use of which are therefore regarded as contributory factors in the spread of the borer) and to the economic importance of the pest. Actions being taken within the industry to counter the threat posed by the pest are indicated.

Effect of cane lodging and rat damage on cane quality and deterioration after harvest. G. El-K. Sayed, S. El-N. A. Hemaida and A. A. El-Badawi. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — Samples of 25 stalks of cane were taken from plots of erect, lodged and unlodged, rat-damaged cane and analyses made of Brix, pol, purity, and dextrose ratio. The theoretical sugar yield was calculated for each sample. The experiment was repeated at intervals from the end of December to the middle of March and it was found that, while lodging reduced the theoretical sugar yield by an average of 17.2%, rat damage in addition to lodging reduced the yield by an average of 56.4%.

A review of the world distribution of *Puccinia* spp. attacking sugar cane. B. T. Egan. *Paper presented to the 17th Congr. ISSCT,* 1980, 9 pp. — Reports of the occurrence of rust disease on sugar cane since 1940, attributed in several cases to *P. kuehnii* when the causal organism was in fact *P. melanocephala,* indicates the need to re-examine the pathogen in all countries except when the identification was made recently. Unless the few American reports can be confirmed, present information shows that *P. kuehnii* probably occurs only in the Asian-Australian-Pacific region; all previous African reports seem to be erroneous. *P. melanocephala* has a much wider distribution and is likely to be identified in many more countries over the next few years. A modified chronology for the spread of this pathogen is proposed and new world distribution lists are presented for both species.

Evaluation of sugar cane for resistance to rust in Puerto Rico and in the Dominican Republic. L. J. Liu. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — In Puerto Rico 41 local and commercial cane varieties were evaluated for resistance to infection by *Puccinia erianthi;* of these, 8 were highly susceptible and 15 highly resistant. Of the three methods used for artificial infection, wrapping the young shoot with rust-affected leaves seems to be the most effective. In similar trials with 34 varieties in the Dominican Republic, 8 varieties were found to be highly susceptible and 3 highly resistant. PR 61-632 variety was among those highly resistant in Puerto Rico but among those highly susceptible in the Dominican Republic.

Sugar cane red rot in the selection process. R. González H. *Paper presented to the 17th Congr. ISSCT,* 1980, 4 pp. Trials of commercial varieties and hybrids from a range of progenitors have been carried out in Cuba and some of the results are reported. Of 17 commercial varieties, 4 were classed as susceptible and two as very susceptible; of these six only B4362 is widely grown in Cuba. Of 3000 hybrids only 11 showed symptoms of natural infection so that the disease was not a limiting factor in the selection process.

Ecotaxonomical analysis of nematodes of the sugar cane *Saccharum* spp. hybrid in Cuba. J. P. O'Relly and A. A. Razjivin. *Paper presented to the 17th Congr. ISSCT,* 1980, 14 pp. — A total of 2580 samples of soil were collected from the whole of Cuba between 1967 and 1978 and the nematodes present isolated and identified. These include a total of 194 species belonging to 2 subclasses, 5 orders, 25 families and 76 genera. Most belong to the Tylenchida and Dorylaimida orders (70 and 71 species), followed by the Rhabditida (26), Enoplida (17) and Chromadorida (10) orders. According to ecological classification, all the recorded species are distributed as follows: Pararhizobiontics (83 species or 43%), Eusaprobiontics (4 species or 2%), Devisaprobiontics (35 species or 18%), and Phytohelminths (72 species or 37%).

Nematodes and nematicide trials in sugar cane in Java. H. Handojo, —. Siswojo and L. Legowo. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — A survey carried out during 1976/78 in eight sugar factory areas showed that *Helicotylenchus, Pratylenchus, Meloidogyne* and *Criconemoides* spp. were the most common in soil samples while *Pratylenchus* and *Meloidognye* spp. were the most common in cane root samples. Other nematode genera found included *Hirschmaniella, Aphelenchus, Rotylenchus, Tylenchus, Hemicriconemoides,*

Trichodorus, Paratylenchus, Xiphinema, Dorylaimus, Ditylenchus, Hoplolaimus, Longidorus, Aphelenchoides, Hemicycliophora and *Tylenchorynchus.* Nematode populations were higher in light sandy soils than in heavier soils. Nematicide trials during 1973/77 showed that increases in cane and sugar yields resulted from fumigation of light sandy soils with DD and Nemagon and the nematode population was reduced, although there was no difference in population between treated and untreated soil four months after fumigation.

Sugar cane varieties resistance to *Meloidogyne incognita* Chitwood, 1949. J. P. O'Relly L. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — None of ten cane varieties tested was immune to the root knot nematode, *M. incognita,* but one was resistant, seven tolerant, one susceptible and one highly susceptible. No significant differences in root weight or stalk length between affected varieties and the control were found.

***Sclerospora* species causing downy mildew of sugar cane (*Saccharum officinarum* L.) in the Philippines.** F. R. Husmillo and T. T. Reyes. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. — Three species of *Sclerospora* have been identified after isolation from mildewed cane, viz. *S. philippinensis* Weston, *S. sacchari* Miyake and *S. spontanea* Weston. They produce different symptoms on a standard cane variety: the first causes a white discoloration only on the base of the young leaves and up to the tip of succeeding leaves without leaf shredding, while the second produces well-defined continuous chlorotic streaks on the leaf blade with characteristic leaf shredding and stunting of the affected plant; the third produces similar symptoms to the second but also light yellow, irregular and discontinuous streaks and without the growth stunting. Conidia of *S. philippinensis* are ellipsoid or elongated oval in shape while those of *S. sacchari* are elliptical or oblong with rounded apices and a slightly apiculate base. Conidia of *S. spontanea* are more elongatedly ellipsoid or cylindrical with round to acute apices. Of the three species, *S. philippinensis* was the more virulent on six cane varieties tested, showing a mean infection rate of 28.36%, whereas the mean rates for the other two species were not significantly different at 14.04% and 12.07%, respectively.

Influence of diseases and herbicides on sugar cane growth in the greenhouse. H. Koike and R. W. Millhollon. *Paper presented to the 17th Congr. ISSCT.* 1980, 5 pp. Infection with strain H of the sugar cane mosaic virus (SCMV-H) or with ratoon stunting disease (RSD) reduced cane growth significantly, as did exposure to the herbicides Fenac and Terbacil. However, the combinations of SCMV-H and herbicides or RSD and herbicides did not cause greater yield losses than the individual effects of either disease or herbicides. The possibility that the herbicides were "curing" the disease did not seem likely because mosaic and RSD symptoms did not diminish in the herbicide-treated plants.

A method for bulk harvesting *Ustilago scitaminea* Syd. spores. H. Tokeshi, Y. Masuda and S. Matsuoka. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — In the method described, new smut whips are harvested in the field, taken to a processing room and the leaves and leaf sheaths removed, exposing the whips for drying. The basal part of the whips, where the spores are immature, is also eliminated. The whips are spread on shelves of wire screen inside a small drying chamber equipped with an electric air dehumidifier. After 12-16 hours the spores are dry enough to be collected with a vacuum cleaner provided with a disposable bag collector. The collected spores are then sifted through a 100-mesh sieve, dried to constant weight in the laboratory and stored at below 5°C in a desiccator containing silica gel. Viability of the spores collected by this method ranges from 86 to 93%.

Effect of the vacuum inoculation method on sugar cane caryopses colonization by *Ustilago scitaminea.* J. Bleicher and H. Tokeshi. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — Sugar cane caryopses were inoculated with chlamydospores of *U. scitaminea* by immersing in a suspension of the spores and subjecting to a vacuum of 250-550 mm Hg. Of seedlings produced on germination of the caryopses, 36% were colonized by the smut organism as against 21.1% colonization when the vacuum treatment was omitted. If the hull was removed before treatment with a spore suspension, the caryopses germinated to give 42% colonization without vacuum treatment. Vacuum treatment of the spore suspension alone did not affect their viability, whereas vacuum treatment of the caryopses in the absence of the spores resulted in a 14% reduction in germination.

Infection of the bud, establishment in the host and production of whips in sugar cane smut (*Ustilago scitaminea* Syd.). K. C. Alexander and K. Ramakrishnan. *Paper presented to the 17th Congr. ISSCT,* 1980, 3 pp. Entry into the meristem in the bud occurred between 6 and 36 hours after the teliospores were deposited on the bud. The infection hyphae did not penetrate and colonize the cells of the scale leaves but were found to grow along the outer and inner surfaces to reach the base of the innermost scale leaf where they effected entry into the meristem. Hyphae were noticed throughout the infected plant, mostly in the parenchyma cells towards the lower internodes. In the upper internodes the hyphae were progressively built up, culminating in the formation of sori with teliospores.

Reaction of sugar cane clones to Strain B of *Ustilago scitaminea* Syd. A. S. Latiza, D. C. Ampusta and J. R. Rivera. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — Susceptibility or resistance to smut of 144 clones of sugar cane was tested, including 61 from Hawaii. The results are tabulated; of the total, 13 clones were classified as very highly resistant, 12 highly resistant and 11 resistant.

Sugar cane smut (*Ustilago scitaminea* Syd.) in Belize and Mexico. S. Flores C. and S. Osaka K. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — Setts of 50 cane varieties were dipped in a suspension of spores (5×10^6 per ml) of *U. scitaminea* for 30 minutes and planted in a trial at Tower Hill, Belize, and their resistance to smut determined from the symptoms, whips appearing 60-90 days after planting. Of the varieties, 31 were resistant, 4 moderately resistant, 5 susceptible and 10 highly susceptible, including POJ 36, Co 213, Mex 57-337 and N:Co 310, all grown commercially in Mexico.

Studies on the epidemiology of sugar cane mosaic virus. S. H. Farrag and T. K. Kandasamy. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — In experiments to study the transmission of mosaic virus it was shown that aphids have a negligible role and also that using healthy planting material was an efficient method for control of the disease.

Strains of the sugar cane mosaic virus in the Philippines. R. D. Dosayla and D. A. Benigno. *Paper presented to the 17th Congr. ISSCT,* 1980, 10 pp. — Strains of the mosaic virus were isolated from the various cane-growing areas of the Philippines and identified by symptoms produced and by serology as strains A, D and H, the first two being the most common.

Induction of sugar cane mosaic virus variant through hot water treatment. S. H. Farrag and T. K. Kandasamy. *Paper presented to the 17th Congr. ISSCT,* 1980, 2 pp. — A mosaic virus variant, designated M_1, was isolated from a diseased sett treated with hot water at 52°C for 1 hour; it was characterized by showing mild symptoms, forming on Co 449 cane pale yellow short lines with a deep green background from the age of 3-4 months. The same symptoms appeared in the ratoon crop but necrosis did not occur even during winter when the temperature fell below 20°C; this contrasted with necrosis of the same cane variety infected with other strains of mosaic.

Evidence of resistance in *Saccharum spontaneum* and *Saccharum*-related genera to sugar cane mosaic virus strains H and I. H. Koike. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — A total of 24 *S. spontaneum* clones and 21 clones of related genera (*Ripidium, Miscanthus, Erianthus, Sclerostachya* and *Imperata* spp.) were inoculated with strains H and I of mosaic virus and 20 of the *S. spontaneum* clones and 9 of the others shown to be resistant by lack of symptom development in themselves and also in the highly-susceptible indicator plant, "Rio" sorghum, on inoculation with juice from the symptomless clone.

Sugar cane mosaic and yield of single plants of sugar cane. G. T. A. Benda. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — Variable results have been found in field tests on the effects of mosaic on sugar cane in Louisiana and varietal ratings can vary among experiments. Experiments were therefore made to determine the effects on single stools and to determine factors which influenced the results. Virus strains A, B, D, H and I produced falls in yield in plant cane, compared with the disease-free control, but the reductions were not significantly different. In the first ratoon crop mosaic incidence had reached 22% in the originally disease-free control and the yield was not significantly different from those of the cane infected with strains A and D but was higher than those from the cane infected with strains B, H and I. The incidence of ratoon stunting disease reduced the yields of both mosaic-free and mosaic-infected cane. Increasing the intra-row spacing between plants increased the sugar yield per plant but not proportionately, the increases occurring with RSD- and mosaic-infected plants as well as the disease-free controls.

Fungus pathology in sugar cane caryopses. A. Sanguino and H. Tokeshi. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — Seeds of sugar cane produced at the Copersucar Experiment Station at Camamu, Bahia, Brazil, were cleaned, the husks removed and the caryopses and husks separately treated to isolate the fungi present. A total of 292 of the caryopses (out of 400) contained fungi of different genera, the most common being *Cladosporium, Curvularia, Fusarium, Helminthosporium, Pestalotia* and *Phoma* spp. The pathogenicity of each fungus species was tested; those considered pathogenic were *Fusarium moniliforme, Pestalotia guepini,* a *Cladosporium* sp. (probably *C. herbarum*) and a *Phoma* sp.

Control of fungi from sugar cane caryopses. A. Sanguino and H. Tokeshi. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — Four chemicals were used to test their effectiveness against the fungi present in cane caryopses; Benomyl and Mancozeb were ineffective while Thiram at 2 g.litre^{-1} and a 1:20 dilution of 40% formaldehyde were most effective. Thiram is recommended where a residual effect is needed and formaldehyde where it is not.

Saprophytic behaviour of *Pleocyta sacchari,* the cause of rind disease of sugar cane. Anon. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — An account is given of studies on the title fungus. It grows well and sporulates on a number of agar media but variation in linear growth rate, density and sporulation indicate exacting nutritional requirements. It is a moderately competitive saprophyte and actively decomposes cellulose in filter paper and bagasse; this is significant in regard to the industrial quality of stored bagasse. It does not produce pectolytic culture filtrate and is susceptible to antibiotics produced by soil micro-organisms. A number of pycnidia are formed from sclerotia produced on agar media and cellulosic substrates. The fungus can survive in pure cultures grown on suitable sterile substrates for more than 16 months, and can also survive on plant tissue residues or in the form of sclerotia or chlamydospores.

Protection of sugar cane against red rot disease with *Fusarium moniliforme.* H. P. Liu, C. A. Wismer, S. L. Wang and M. C. C. Leite. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — Previous inoculation of cane stalks with *F. moniliforme* (the causal agent of Fusarium stem rot) reduced the rate of rotting caused by *Colletotrichum falcatum,* the threshold for inducing this protection being 4 hours from inoculation. Obstructions in the vascular bundles produced by *F. moniliforme* appear to be the main function in cross-protection by mechanically preventing migration of the red rot spores.

Investigations on host/carrier relationship in Fiji disease-resistant varieties. K. Reddy. *Paper presented to the 17th Congr. ISSCT,* 1980, 4 pp. — Some cane varieties classed in tests as resistant to Fiji disease have developed symptoms under high infection dose conditions and it was feared that some resistant varieties in Fiji were symptomless carriers of the disease and so would be a threat to the eradication program in Fiji. Trials were carried out with a number of varieties and proved that the resistant varieties Ragnar, H 64-2731, Homer, Kaba, Mali and Mana were truly resistant and were not symptomless carriers.

Factors that interfere in evaluation of ratoon stunting disease resistance by water flow in sugar cane stalks. P. J. Valarini and H. Tokeshi. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — A method developed by Teakle *et al.*[1], for measurement of water flow through the vascular tissues of a section of cane stalk under vacuum applied at one end, is used as a measure of the number of xylem vessels passing through the node, which is larger in the case of RSD-susceptible varieties. Examination of the method showed that the flow was affected by the vacuum applied, the position of the chosen node along the stalk from ground level, and the time delay from harvesting. The effects were such that it is always necessary to compare varieties under the same conditions to achieve meaningful evaluation of RSD resistance.

[1] *Phytopath.,* 1975, **65**, (2), 138-141.

CANE BREEDING AND VARIETIES

Need for breeding and selection of *Saccharum* clones for technological characters. K. C. Rao. *Maharashtra Sugar,* 1980, **5,** (3), 25, 27–29, 31, 33–34. – The author examines processing problems associated with specific cane characteristics, and suggests that selection for processing properties should also be included in a breeding program.

Selection trial data as a basis for breeding and selection strategies. B. T. Roach. *Paper presented to the 17th Congr. ISSCT.* 1980, 13 pp. – Data from routine selection trials in four of the five selection stages of the breeding program at Macknade Field Experiment Station, Queensland, are examined. Mean sugar content of the seedling populations, measured either as refractometric Brix or c.c.s., is only slightly less than that of the major local variety Triton, even in previously unselected populations. Mean fibre content of those seedlings reaching the final stages of selection is only slightly higher than that of Triton and screening for fibre content in earlier stages of selection is not considered necessary. Cane yield at all selection stages is markedly inferior to the yield of Triton, particularly in ratoon crops. The potential for selection gain for sugar content and cane yield is discussed and it is concluded that, while considerable gains may be obtained for cane yield, sugar content is probably close to the physiological limit. It is suggested that sugar content may receive undue emphasis in selection programs, as it generally shows a much higher degree of genetic determination than cane yield. Modifications to the Macknade breeding and selection program which give greater emphasis to cane yield are discussed.

Selection indices for high yield in sugar cane. V. G. Dosado, R. E. Tapay and H. M. Miayo. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. – Statistical examination of results from ten experiments over three crops indicated that high sugar yield was primarily due to high cane tonnage yield; stalk weight and millable stalks per stool are closely associated with cane yield and explain most of the variance in sugar yield among the cane yield components. The most stable and desirable index for selection for high cane and sugar yield was more millable stalks per stool.

Correlations among characters of sugar cane in two intermediate selection stages. P. Y. P. Tai, J. D. Miller, B. S. Gill and V. Chew. *Paper presented to the 17th Congr. ISSCT,* 1981, 10 pp. – Crop data were collected for 93 clones grown in the plant crop of Stage II and the plant and first ratoon crops of Stage III. Correlation coefficients between seven agronomic characters were examined; stalk number was negatively correlated with stalk weight but both were positively correlated with cane and sugar yield so that selection must involve a compromise between stalk number and weight to optimize yields. The multiple correlation of Brix and sugar content with sugar per ton of cane was as large as their simple correlations but their combined effect on sugar yield per hectare was not very large. Stalk number and weight, Brix, sugar content and sugar per ton of cane were highly repeatable between crops. Cane and sugar yields per hectare were not repeatable between selection stages and neither value from Stage II plant crop could be used effectively to predict performance in Stage III.

Experimental methodology for field research with varieties of sugar cane in Cuba. N. Milanes R. and J. L. Perez C. *Paper presented to the 17th Congr. ISSCT,* 1980, 11 pp. – A number of factors can affect the accuracy and reliability of field experiments with sugar cane and these have been studied, using factorial variance analysis. No significant differences were observed in plots having from 3 to 6 furrows, while no inner border effects were evident. None of the four plot shapes studied gave significant differences in the results. The number of replications needed varied with the size of the plot, from 19-20 in first ratoons grown in 30 m^2 plots to 5-6 for 150 m^2 plots; the best areas were 50 and 100 m^2 when 7-8 and 3-4 replications, respectively, were needed for a plant crop and 5-6 and 3-4 replications were needed for a first ratoon crop. In random sampling, four samples of five stalks should be taken in each plot and provides a more representative variability of the population than sampling of complete stools.

Further studies on sugar cane pollen. M. Krishnamurthi. *Paper presented to the 17th Congr. ISSCT,* 1980, 3 pp. The results of a study of pollen using scanning electron microscope photography showed that it is viable only for one hour, it is highly sensitive to humidity and light, and that it absorbs nutrients from stylar tissue to penetrate and grow through the style.

The genotype-environment interaction in experiments with sugar cane varieties (*Saccharum* spp.): comparison of three methods for investigating stability. G. Galvez. *Paper presented to the 17th Congr. ISSCT,* 1980, 11 pp. – The genotype-environment interaction (g x e) for yield and Brix was studied by trials in which 20 clones were grown in two localities during three seasons. A statistically significant g x e interaction was observed and the data were examined by three methods all of which verified the discrimination of genotypes by their stability in relation to environment changes. The Kendall Coefficient of Correlation was calculated to associate all the stability parameters and showed positive and significant correlations between "ecovalence" and deviations from linearity, ecovalence and coefficients of determination and between coefficients of determination and deviations from linearity.

Preliminary studies on the mode of inheritance of resistance to wind breakage in sugar cane. A. Y. Hsu and S. A. Yin. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. – Study of the effects of a typhoon on 397 sugar cane clones indicated that resistance to wind breakage was correlated with the resistance or susceptibility of parent varieties, although regression analysis indicated that the resistance was mainly determined as a maternal effect. It is proposed that both the genes in the nucleus and also certain genetic factors in the maternal cytoplasm are involved in the genetic determination of wind breakage resistance.

CANE SUGAR MANUFACTURE

Accounting of pol losses at the rotary vacuum filter station. S. K. Pandey. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India,* 1979, C.21-C.23. — It is stated that, as in the case of one Indian sugar factory, there is risk of error in estimating filter cake losses where the bagacillo pol content contributes to the loss, since the bagasse pol will already have been accounted for in determination of milling losses. Hence, it is necessary to determine the bagacillo pol and deduct this from the filter cake pol.

Loss to sugar factories due to the supply of excess cane binding material. K. D. Puri, H. S. Malik and R. S. Narwal. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India,* 1979, C.33-C.36. — An investigation showed that the amount of material used to bind cane bundles was much greater than allowed for in establishing payment, which is based on weight alone, not quality.

Sushira, the bagasse loss reducer. S. S. Sirohi and N. K. Garg. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India,* 1979, G.39-G.46. — See *I.S.J.,* 1980, **83,** 122.

Elimination of the filter station in the sugar industry. G. Kashinathan. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India,* 1979, G.73-G.75. — The system used in some Queensland factories, whereby clarifier mud is not filtered but is mixed with some or all of the imbibition water and re-settled, the juice then being used as imbibition and the mud discarded, is considered of sufficient advantage to be advocated for use in Indian factories. A simple procedure is described and its merits listed.

TSC's milling capacity and sugar production in the 1978/79 campaign. Anon. *Taiwan Sugar,* 1979, **26,** 202-204. — In a brief survey of sugar production in Taiwan, mention is made of the need to increase factory milling capacity in order to restrict the crushing season to 140 days (so as to allow the fields to be cleared for the succeeding crop). Information is given on aspects of a 10-year modernization plan, references being made to specific factories and problems. Processes for white sugar production are compared, showing that sulphitation of remelted *A*-white sugar is the most suitable as regards fuel economy and the low level of colour increase. It is the second best process in respect of final sugar colour (the best being active carbon treatment) and was used to produce 100,000 tonnes of sugar in 1978/79.

Automatic process control in sugar factories. R. M. J. Withers and M. J. Jobling. *Paper presented to the 17th Congr. ISSCT,* 1980, 13 pp. — A review is presented of the development of automatic control in sugar processes in recent decades, together with a discussion of cost effectiveness and benefits, its influence on process technology, questions of work organization, levels of automation and the social effects of automation. Details are given of individual installations including a magma mixer at Batangas, and comparisons are made of control practices in beet and cane sugar factories.

On-line purity determination in sugar factories. J. C. Obert. *Paper presented to the 17th Congr. ISSCT,* 1980, 10 pp. The principle of the purity analyser made by the S.E.R.E.S. company is explained. The conductivity at a specific temperature of an impure sugar solution, resulting from inorganic matter in solution, rises with increasing Brix to about 24/26°Bx, remains at a plateau level to about 32/38°Bx and then falls. The purity is related to the plateau or maximum level by a coefficient which depends on the nature of the solution (cane molasses, beet syrup, etc.) but which does not vary much between samples of the same product. An account is given of the instrument and its operation and applications.

The role of conductivity and rheological properties of massecuites in the boiling automation of pan control. R. Consuegra, I. Diaz and J. Lodos. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. — Massecuite conductivity and viscosity is dependent not only on Brix, temperature and crystal content but also on the nature of the individual massecuite. However, it has been found that the ratio of massecuite viscosity to mother liquor viscosity when plotted against crystal content produces a single curve, irrespective of the nature of the processed liquor, and thus could serve as a criterion for use in automation of pan boiling.

Colour transfer factor and its use in sugar boiling evaluations. K. C. Chiu and G. E. Sloane. *Paper presented to the 17th Congr. ISSCT,* 1980, 14 pp. — A colour transfer factor has been derived which is based on a colour and material balance in boiling and expresses the quantity of colour in the crystal as a fraction of that present in the mother liquor during boiling. The relationship takes into account the degree of exhaustion that occurs in the mother liquor during boiling and requires measurement of massecuite colour and purity, molasses purity and crystal colour. Determination of colour transfer factors at four sugar factories showed a wide range of results. Low and similar values for the same factory indicated consistent boiling, while higher and more variable factors at another factory, indicated that the boiling process was not as well controlled. In all cases, the transfer factor decreased slightly as massecuite colour increased. Comparison of experimentally determined values of the factor with the corresponding ratios of crystal colour to massecuite colour showed them to be highly correlated, indicating that variations in recovery have little effect on the factor.

Studies on cane deterioration in Australia. D. H. Foster, P. A. Inkerman and K. E. McNeil. *Paper presented to the 17th Congr. ISSCT,* 1980, 15 pp. — Recent work on cane deterioration in Australia is reviewed. During the burning of cane, temperatures rise above 80°C throughout 20% of the upper portion of the cane stem resulting in appreciable loss of sucrose. Dilution of sugar in burnt cane stalks owing to water uptake leads to an apparent sucrose loss. This dilution occurs chiefly in the outer portion of the stem where the greater proportion of vascular bundles are found. Uptake of water does not appear to be of any consequence in the first 24 hours after burning but can be appreciable after this interval. No micro-organisms are found inside sound green cane but high levels occur in standing burnt cane. Surprisingly, microbial populations may be just as large in chopper-harvested green cane as in chopper-harvested burnt cane. By contrast, dextran and ethanol levels in the former are only a small fraction of those in the latter. Micro-organisms found in green and burnt chopper-harvested cane and in standing burnt cane

include species of *Leuconostoc, Lactobacillus, Klebsiella, Enterobacter, Erwinia* and *Saccharomyces.* The presence of acid-producing organisms as well as *Leuconostoc* explains the poor correlation between pH and dextran. Changes in neither pH, dextran, apparent purity nor c.c.s. are suitable for assessment of cane deterioration between burning and cutting, and measurement of the collective changes is desirable. Only the dextran-forming species of *Leuconostoc* and *Lactobacillus* produce a detectable haze with 50% ethanol; dextran is the only polysaccharide in chopper-harvested cane which is produced in sufficient quantities to cause processing difficulties.

The implications of cane washing. E. C. Vignes. *Paper presented to the 17th Congr. ISSCT,* 1980, 10 pp. Introduction of mechanized cane loading resulted in excessive amounts of extraneous matter entering the factory, especially soil, and this caused heavy wear and tear, with resultant higher maintenance and replacement costs, as well as processing difficulties. This necessitated the use of cane washing and trials in 1977 and 1978 showed that processing difficulties were minimized. This was at the cost of sugar loss in the wash water, a loss which has been measured; it averaged 0.23% on cane or 1.8% of the cane sugar content.

Integral imbibition. E. Hugot. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — In order for imbibition liquid to enter fully the voids in the bagasse blanket when it expands on leaving the discharge opening of a mill, side plates are provided and a trough formed which is filled with liquid above the level of the discharge opening. Thus the bagasse expands under the liquid surface and absorbs this instead of air. The conveyor surface above the trough is perforated so that excess liquid drains away, and the wet bagasse is then delivered to a pair of feeder rollers preceding the mill proper, a small turnplate being located between the lower feeder roller and the feed roller of the main mill. The system is known as integral imbibition and at two factories has raised extraction from 94.6 to 96.19% and from 94.98 to 96.70%, respectively.

Cane slicing, a new approach to extraction and juice purification. S. Barfod, O. M. Jensen and J. B. Svendsen. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. A new technique for extraction and juice purification is described and results given from a 150 t.c.d. pilot plant in which it was applied. The cane is cut in slices across the stalk and the slices extracted in a continuous counter-current diffuser, the exhausted slices being dewatered in a double-screw press. Muds from the clarification process are recycled through the diffuser, eliminating mud filtration. The technique offers a reduction of 30-40% in power consumption, with reduced investment and maintenance costs. Extraction yields are high and the quality of the diffuser juice is close to that of a normal first expressed juice.

The orifice viscometer: a new technique for measuring rheological properties of massecuites and molasses. S. M. R. Maudarbocus. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — Measurements were made with an orifice viscometer and a pipeline viscometer on samples of massecuites and molasses with results which were concordant when extrapolated to the same temperature and shear rate. Statistical analysis showed that the differences were not significant at 95% confidence limits. The orifice viscometer is confirmed as a simple, cheap, efficient and reliable instrument for measurement of apparent viscosity of massecuites and molasses.

The photometric saturation temperature method. P. G. Wright. *Paper presented to the 17th Congr. ISSCT,* 1980, 15 pp. — The photometric adaptation of the Harman saturation cell technique for the determination of the saturation temperature of sugar syrups and molasses, proposed by the author in 1978[1], is described with the improvements it has undergone. These include a more compact light transmission measurement apparatus built round the standard hot stage containing the seeded molasses slide, and a more stable electrical amplifier circuit to give an output which varies with the light output. New data on the response characteristics of molasses with and without seeding with fine sugar slurry, and the repeatability of the measurement both for high purity and low purity molasses are given. Some results of using the technique on low purity cane molasses in laboratory exhaustion trials indicating its accuracy in routine use are also given. In addition, its use as an investigation tool in the examination of control procedures for various raw sugar factory pan strikes is assessed. The use of a microprocessor to control the initial holding mode, and then the scanning of the light output from the sample slide with increasing temperature, to detect and read out the saturation temperature, is described. The new technique for saturation temperature measurement is recommended as a tool for research and even routine control.

Developments in low grade crystallization. G. A. Brotherton, L. K. Kirby, J. N. Ness and R. J. Swindells. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. In the manufacture of sugar from cane the greatest loss is that in final molasses and reduction of molasses purity offers most potential for economic gain. This may most effectively be achieved by reducing the water:non-sugars ratio but, while reduction in low-grade massecuite water content would permit greater crystallization, this is in conflict with the need to maintain sufficient fluidity to permit adequate circulation within the pan. It is important to obtain as much crystallization as possible in the low-grade pans because the second stage of exhaustion in the crystallizers is much slower. Their function is to provide as much crystal sugar as possible, but limitations result from the need to be able to handle the heavy, cooled material. The design of crystallizers to provide both mixing and cooling is discussed, and the operation of continuous crystallizers reviewed, as well as the influence of various design features, as studied by the Bureau of Sugar Experiment Stations in cooperation with the University of Queensland.

Redox potential and oxygen concentration (pO_2) as criteria for the evaluation of the effectiveness and application of biocides. W. Mauch and M. Nickisch. *Paper presented to the 17th Congr. ISSCT,* 1980, 6 pp. — Aerobic micro-organisms require oxygen for growth and a sample containing them, when added to an oxygen-saturated solution, will reduce the partial pressure. Similarly, redox potential depends on the numbers of micro-organisms present in a solution and is reduced when a biocide is added, the extent of the reduction depending on the proportion of killed micro-organisms. If disinfection is not complete the redox potential increases again when the survivors multiply. The two parameters are thus suitable for assessing the performance of biocides against microbial infection in the sugar industry and for monitoring process streams to detect the onset of infection.

[1] *I.S.J.,* 1978, **80**, 40-44.

BEET SUGAR MANUFACTURE

The TL-1000 pulp press. R. Bretschneider *et al. Listy Cukr.*, 1980, **96**, 8–16 (*Czech*). – The TL-1000 horizontal triple-scroll beet pulp press is described and its performance discussed.

Effective ranges of beet pulp dewatering. V. A. Bondarenko. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1978, **25**, 82–87 (*Russian*). – The mechanics of pulp dewatering are examined, and values set for assessment of the performances of types of equipment, ranging from light pressing (to give up to 10% dry solids) to drying to 86–88% dry solids.

Experience with the progressive reception and storage technique introduced at Velikooktyabr'skii sugar factory. A. V. Lyubchak *et al. Sakhar. Prom.*, 1980, (2), 14–18 (*Russian*). – The beet yard system installed at the title factory is described, and results of treatment of stored beet with the sodium salt of maleic hydrazide are reported, showing that it reduced rotting and daily sugar losses by comparison with controls.

Experience at Makharinetskii sugar factory in the use of excess ammoniacal condensates as diffuser feed. V. N. Obodynskii *et al. Sakhar. Prom.*, 1980, (2), 18–21 (*Russian*). – Details are given of the scheme adopted in the 1978/79 campaign, under which 75–80% of the diffuser water requirements are met by condensate from the evaporator. SO_2 treatment brings the pH to an optimum of 6.4–6.8; the system has reduced diffusion losses and molasses yield and sugar by comparison with the previous scheme of using condenser water which had been highly contaminated.

Practical experience with molasses desugaring by chromatographic separation. O. Adriaensen. *Sucr. Belge*, 1979, **98**, 377–383 (*French*). – Details are given of the Finnsugar batch chromatographic separation process, using a strongly acid cation exchange resin in Na^+ form, installed at Moerbeke sugar factory in 1977. The molasses, of 80°Bx and 60 purity, is treated at the rate of 105 tonnes per day to give a guaranteed 271.7 tonnes of juice of 92 purity and 17°Bx which is subsequently evaporated to 72°Bx and then has a purity of 90, a pH of 10 and a colour content of 11,410 ICUMSA units. It is stored during the post-campaign period for further treatment during the subsequent campaign, when it is re-introduced between the prelimer and main liming vessel in a quantity corresponding to about 10% of the sugar in process. The sugar content of the residual molasses, which is used in animal fodder manufacture, is deliberately kept at 15% to facilitate flow.

Pollution control equipment at American Crystal. I. Fordyce. *Sugar J.*, 1979, **42**, (7), 18-19. – Measures adopted at certain beet sugar factories owned by American Crystal Sugar Co. include installation of electrostatic precipitators on boilers, and inauguration of a beet flume-wash water treatment system that will handle 21 short tons of BOD daily. The anaerobic digester will be seeded with effluent from a municipal sewage plant, and the resultant methane gas is to be utilized in factory operations. Reference is made to various official regulations concerning pollution reduction and environmental protection in the USA.

Trials on the efficacy of some indigenous anti-foaming agents with sugar beet juices. I. K. H. Rao, R. K. Jain, V. K. Jain and R. Srivastava. *Proc. 43rd Ann. Conv. Sugar Tech. Assoc. India*, 1979, M.103-M.122. – The performances of five unnamed preparations in prevention and reduction of foam in beet juice are discussed.

The effect of juice softening with ion exchange resins on its quality. Z. D. Zhuravleva, T. K. Leiteizina, K. P. Goncharova and V. P. Egorova. *Sakhar. Prom.*, 1980, (3) 17 (*Russian*). – The lime salts, colour, purity, pH and reducing sugars were determined in thin juice before and after ion exchange, showing the benefits of treatment but also indicating the adverse effect of treating juice from sub-standard beet, and hence of high lime salts content, on the resin, which had to be regenerated frequently; in addition, the quantity of effluent and sugar losses in it rose, as did the amount of NaCl used as regenerant. It is recommended that the juice should contain no more than 0.05% CaO before treatment, giving a residual content after ion exchange of 0.02-0.03% CaO. For minimum lime salts, 1st carbonatation should be conducted at pH ⩽11.0 and 2nd carbonatation at pH ⩽9.2.

The effect of aluminium sulphate on transfer of nucleic acids and their hydrolysis products to diffusion juice. N. V. Remeslo, A. A. Lipets and Yu. B. Navrotskii. *Sakhar. Prom.*, 1980, (3), 17-19 (*Russian*). – Laboratory and factory tests were carried out to determine the effect of treating diffusion water with aluminium sulphate on juice quality. Results showed that treatment to give a water pH of 5.3-6.0 increased both raw juice and 2nd carbonatation juice purity by comparison with SO_2 treatment. The effect was attributed to reduction of colloids and high-molecular compounds, nucleic acids and acid-soluble compounds as well as lime salts and, hence, colour.

Means of raising the degree of utilization of carbon dioxide gas in carbonatation. V. M. Logvin, L. P. Reva, V. P. Burlaka and V. V. Tantsyura. *Sakhar. Prom.*, 1980, (3), 20-21 (*Russian*). – Trials conducted on a patented method of increasing CO_2 utilization are reported. The method involves saturating the CO_2 after the scrubbers with water vapour to the equilibrium partial pressure at the temperature of the juice entering the carbonatation vessel. As a result, gas flow through the gas-juice interface is not restricted by water vapour coming out of solution and saturating the CO_2, as normally happens. In laboratory tests, the method raised utilization from 49.5% to 75.0%; on a pilot plant scale, the utilization was raised by an average of 33%, and with remelt liquor in refining utilization rose from 28% to 48%.

Methods of heating *C*-massecuite before centrifugalling. M. Koch. *Gaz. Cukr.*, 1980, **88**, 16-17 (*Polish*). – The advantages and disadvantages of reheating low-grade massecuite in a distribution trough with rotary mixing/heating element, in a vertical heater provided with a

fixed heating coil, or in a resistance heater are discussed.

Thoughts on the heat economy in modern sugar factories. S. Zagrodzki. *Gaz. Cukr.*, 1980, **88**, 25-29 *(Polish)*. Various aspects of steam usage in a modern sugar factory are discussed, including how to meet the demand for process steam when there is a lack of uncontaminated condensate for use as boiler feed as well as a deficiency of turbine exhaust steam. The advantages of an economizer and a Ljungström heater are described. The roles of the turbo-generator and of turbo-compression are examined, and ways of reducing evaporator steam consumption discussed.

Use of flocculants to intensify the settling of suspended particles in 1st carbonatation juice. I. A. Oleinik, E. N. Shirokikh, O. I. Mazur, R. M. Polishchuk and S. D. Sobko. *Sakhar. Prom.*, 1980, (3), 24-25 *(Russian)*. Comparative tests with four flocculants are described. All had positive effects on filtration and settling, and the aim of the tests was to find a flocculant that was more suitable than polyacrylamide, which dissolves in water at too slow a rate, does not store well and requires preparation (alkaline hydrolysis) before use. The results are given in graph and tabular form.

A new scheme for beet cleaning and washing. N. F. Kulinich, N. S. Karpovich and A. S. Zaets. *Sakhar. Prom.*, 1980, (3), 26-31 *(Russian)*. – Descriptions are given of individual types of washing and rinsing equipment incorporated in a scheme which, in tests conducted in 1979/80, gave highly satisfactory results, although some modifications are considered necessary.

Sucrose losses as a result of conversion to colloid colorants. L. P. Reva, E. A. Grivtseva, N. A. Arkhipovich, V. S. Samoilenko and A. R. Sapronov. *Sakhar. Prom.*, 1980, (3), 40-41 *(Russian)*. – The content and composition of colorants in molasses colloids were studied as a function of molasses source within the USSR, time of sampling and campaign length; the amount of sucrose lost in the form of such colorants was also determined. It was found that the colorants represented between 20.6% and 48.3% of the colloids (by weight) and that the major fraction was made up of alkaline degradation products (representing 0.025-0.103% sucrose loss on weight of beet); caramelization accounted for only 0.001-0.008% sucrose loss.

Energy savings with a four-effect evaporator and turbo-compressor. S. M. Zagrodzki. *Sugar J.*, 1980, **42**, (9), 9-13. – From examination of the steam balance of a quadruple-effect evaporator using condensate heat and a turbo-compressor, it is concluded that under best conditions the steam consumption can be reduced to below 29 tons/100 tons of beet. Use of the turbo-compressor alone may reduce consumption by 4-10 tons/100 tons of beet by permitting higher juice Brix; use of a triple-effect evaporator with turbo-compression is practical, elimination of the fourth effect partly offsetting the cost of the turbo-compressor.

Application of the Remat 20 process control refractometer in the investigation of technical sucrose solutions. E. Junghans, H. G. Uhlitzsch and W. Graup. *Jena Rev.*, 1979, 214-216. – See *I.S.J.*, 1980, **82**, 91.

Equipment for raw juice preliming. W. Stankiewicz. *Gaz. Cukr.*, 1980, **88**, 49-52 *(Polish)*. – The Brieghel-Müller prelimer is considered inefficient as regards failure to achieve the required final pH of about 11 (optimum for colloid coagulation) and heat loss from the juice. A number of prelimer types are described, with the aid of diagrams, and details are given of a patented prelimer designed by Stankiewicz & Bieszk. This is a vertical vessel in which a central shaft carries a number of disc rotors, with turbine-type blades, placed one above the other to form compartments. Open ducting leads juice to and from the rotor blades and forms a spiral. Juice is fed at the bottom of the vessel, and milk-of-lime towards the top and bottom. The juice is carried up and mixed with the lime, being recycled a number of times at each stage, as a consequence of the swirling action of the rotor, until it is discharged via an outlet at the top.

Reduction of sugar losses by thin juice demineralization in an alkaline medium. H. Zaorska, S. Zagrodzki, D. Sucharzewska and K. Lisik. *Gaz. Cukr.*, 1980, **88**, 52-56 *(Polish)*. – See *I.S.J.*, 1980, **82**, 381.

Basic thoughts on boiling in pans provided with stirrers. K. Austmeyer. *Zuckerind.*, 1980, **105**, 227-231, 242-244 *(German)*. – The history of the development of massecuite stirrers is briefly recounted, and experiments conducted on a white sugar pan and a low-grade pan equipped with stirrers are reported. Results showed that, in addition to shortening the boiling time, increasing crystal yield and improving crystal quality, stirrers have a considerable effect on heat and material transfer. Investigations have shown that, at the start of boiling, the power consumption of the stirrer is markedly dependent on massecuite level and cannot be used as a process control means where viscosity is involved; however, once the calandria is completely covered, the power consumption is governed exclusively by massecuite Brix and/or viscosity, so that it then becomes a possible control means. The importance of rapid and uniform mixing of syrup feed with the magma is stressed.

Vacuum pan stirrers – experiences at DDS. R. F. Madsen. *Zuckerind.*, 1980, **105**, 234-237, 242-244 *(German)*. – Advantages of massecuite stirrers are listed, and optimum design of stirrer and vacuum pan discussed. The difference between the theoretical ideal and reality in the case of stirrers is due to a number of problems, of which the most important that needs solving is the powerful rotation which the massecuite undergoes as well as axial movement when it leaves the propeller. Stirrer design has two very important aims: (1) to ensure that as much of this rotary energy as possible is converted into linear motion energy, and (2) to inhibit the adverse effect of the rotation on systematic circulation. This adverse effect is due to the high velocities created below the tubes in the vicinity of the downtake and the consequent reduction in pressure; the rotating massecuite is then subjected to suction and possibly even reverse flow in the calandria tubes, as found in tests on a DDS pan. Installation of a fixed tube (used as syrup feed) below the propeller converted some of the rotary movement to flow in the required direction, gave a satisfactory speed distribution and increased circulation at constant energy consumption. Comparison between DDS pans with and without stirrers shows that use of stirrers considerably reduces conglomeration as well as crystal colour, turbidity and ash. The advantages of stirrers are most evident in low-grade work.

SUGAR REFINING

Impact on the refinery of improved raw sugar (high pol raws). J. L. Meikle. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 100-102. – Improvement in Hawaiian raw sugar purity, colour and grain size resulted in a reduction in the colour of the raw liquor to char at Crockett refinery as well as rise in purity of the affination syrup and hence decrease in the amount of remelt massecuite that had to be boiled to reduce the quantity of excess non-sugars in molasses for soft sugar manufacture. The consequent fall in the colour:non-sugar ratio of the raw material for soft sugar (which contains a significant portion of affination syrup) led to a considerable improvement in colour removal by bone char treatment.

Huletts Refineries' giant new resin plant. *S. African Sugar J.*, 1979, **63**, 463-464. – Photographs and a brief description are given of the 4-vessel ion exchange plant used for liquor decolorization. After a cycle of 18 hours, the resin is regenerated with 10% brine solution during 6 hours. The system is automatically controlled, a mimic panel indicating when valves are open, and an annunciator panel monitoring conditions. Flow of liquor, water and brine to each vessel is measured and a DP cell system used for level control. Operating costs are substantially lower than those of the previous bone char system, and significant savings have been achieved in labour. The total cost of NaCl, HCl and NaOH is much lower than that of oil used for the char revivification furnace. However, a major cost factor is the transportation to a sea outfall of effluent which is unsuitable for discharge into the local sewer system; a pilot effluent treatment plant is in operation and will, it is hoped, indicate the possibility of recycling much of the regenerant.

The effects of ash content percent raw sugar on the refining process. J. V. López-Oña and G. S. Baumert. *Sugar y Azúcar*, 1979, **74**, (8), 43, 46-47. – The adverse effect of a high raw sugar ash content on refining is discussed. Refining problems occur when the ash content after laboratory affination exceeds 0.12%; regression analysis has shown that a 0.10% increase in the ash content in whole raw sugar gives a 0.0412% increase in ash in laboratory-affined sugar. The problems caused include a fall in decolorization performance of bone char, increased steam usage, high chemical losses as a result of sugar re-processing, increased molasses production and purity, and reduction in refined sugar quality. Sources of raw sugar ash are briefly discussed.

New types of vibratory screen for refined sugar. J. Ruzicka and J. Hluze. *Listy Cukr.*, 1979, **95**, 169-174 *(Czech)*. – The theoretical and design aspects of two new types of vibratory screen developed in Czechoslovakia for refined sugar are explained, and details given of their performances.

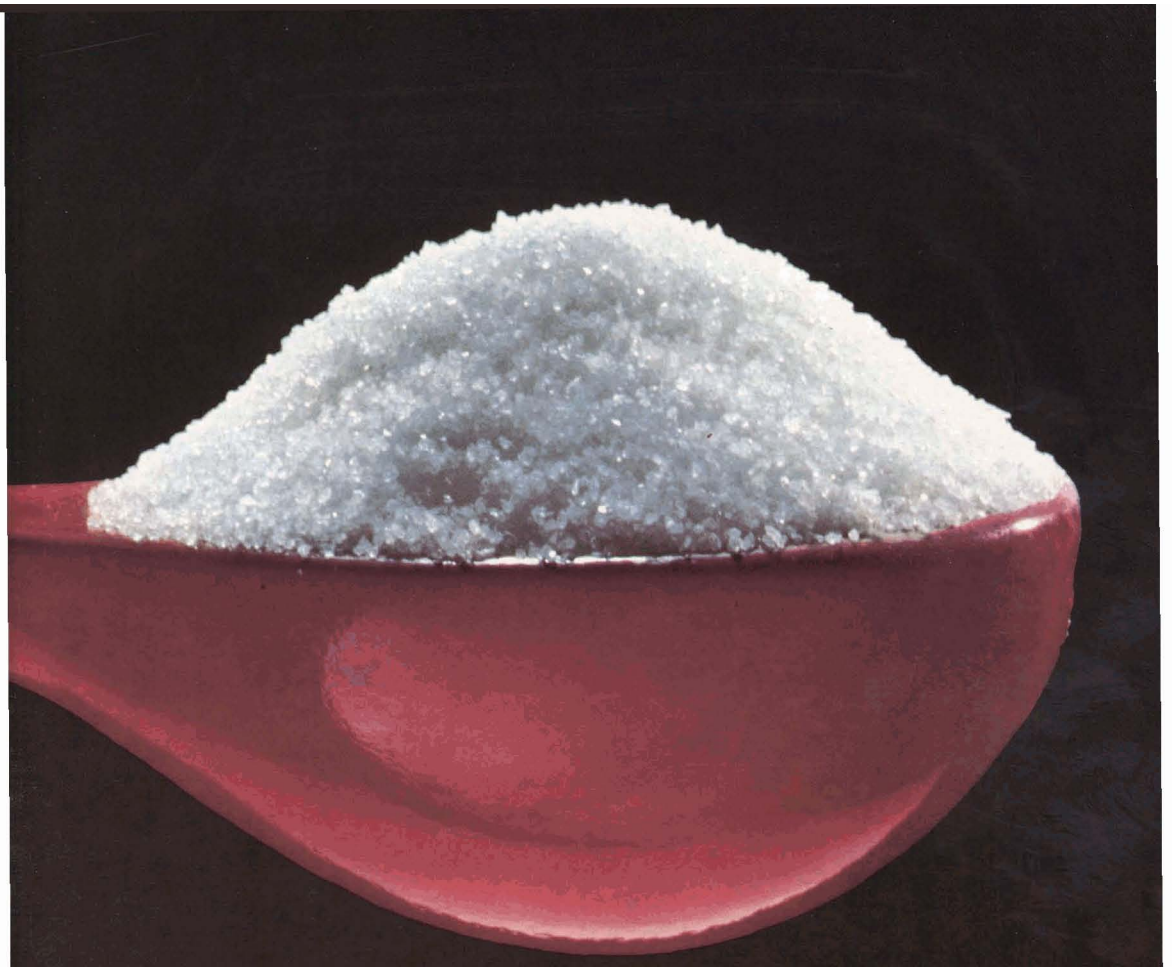
Regenerating properties of electrolytes and the swelling capacity of AV-16GS and AV-17-2P anion exchange resins. V. M. Rogozina, M. V. Rozhkova and G. A. Chikin. *Izv. Vuzov, Pishch. Tekh.*, 1979, (5), 41-44 *(Russian)*. – Investigations are reported in which 0.5N HCl, 0.5N NaOH and a mixture of 6% NaCl and 0.2% NaOH were used as regenerants and the decolorizing capacities of the title resins determined in tests on treatment, with both new and regenerated resin, of 38% sugar solution (having a viscosity at 20°C equivalent to that of a 60% solution at 80°C) and a solution to which molasses was added to simulate (in terms of colour and viscosity) 1st and 2nd refinery liqors. Results showed that the swelling capacity of AV-16GS resin had a decisive effect on regeneration, while the specific form of attachment of the colorant molecules to the ion exchange sites in the resin governed regeneration of AV-17-2P resin. Acid regeneration was found to give better results with both resins.

Installation of a continuous vacuum pan at Notre-Dame refinery, Oreye. A. Genart. *Sucr. Belge*, 1979, **98**, 337-345 *(French)*. – Details are given of a Fives-Cail Babcock horizontal continuous vacuum pan installed for *B*-massecuite at Oreye in 1978. Advantages of the pan and its satisfactory performance are described.

Liquid sugar. N. Marignetti and G. Mantovani. *Sugar Tech. Rev.*, 1979, **7**, 3-47. – A review is presented, with 301 references to the literature, of the various forms of liquid sugar (sucrose and invert, glucose, fructose and high fructose syrups), with descriptions of the manufacturing processes used, the advantages and applications of liquid sugar, its storage and standard specifications.

Conception of a macrosystem design for raw sugar factories and a central factory. I. Formulation of the optimization work. J. Havel, J. Buriánek and J. Hercík. *Listy Cukr.*, 1980, **96**, 34-44 *(Czech)*. – An algorithm and associated nomograms are presented for calculation of material balances with the aim of establishing optimum conditions in a system where, in order to increase the capacity of a central factory processing raw sugar from a number of small satellite plants, syrup is stored during the campaign and processed during the refining campaign together with beet or cane raw sugar.

Method of sugar refining with ozone. M. Gomez, R. Perez and R. Ramos. *Paper presented to the 17th Congr. ISSCT*, 1980, 7 pp. – Laboratory trials were carried out in which clarified refinery liquor was treated by bubbling through it a 7:1 v/v ozone:oxygen mixture at temperatures between 30° and 90°C, the pH being controlled automatically at either 7 or 8.5, and the liquor Brix at either 50° or 60°C. The pH was found to be the main factor influencing decolorization, temperature having hardly any effect, while colour removal was lower at higher Brix. Neutral pH was best because the ozone attacked the sucrose molecule at alkaline pH, and hydrolysis is known to occur at pH below 7. The degree of decolorization achieved after 10 minutes was comparable to that achieved with active carbon and increased with further treatment up to 60 minutes. The sucrose content was unchanged, although acids were formed in solution; they are attributed to the reaction between the ozone and the colouring matter in the liquor. Analysis of sugars boiled from the treated liquor showed that they fulfil international quality requirements for refined sugar.



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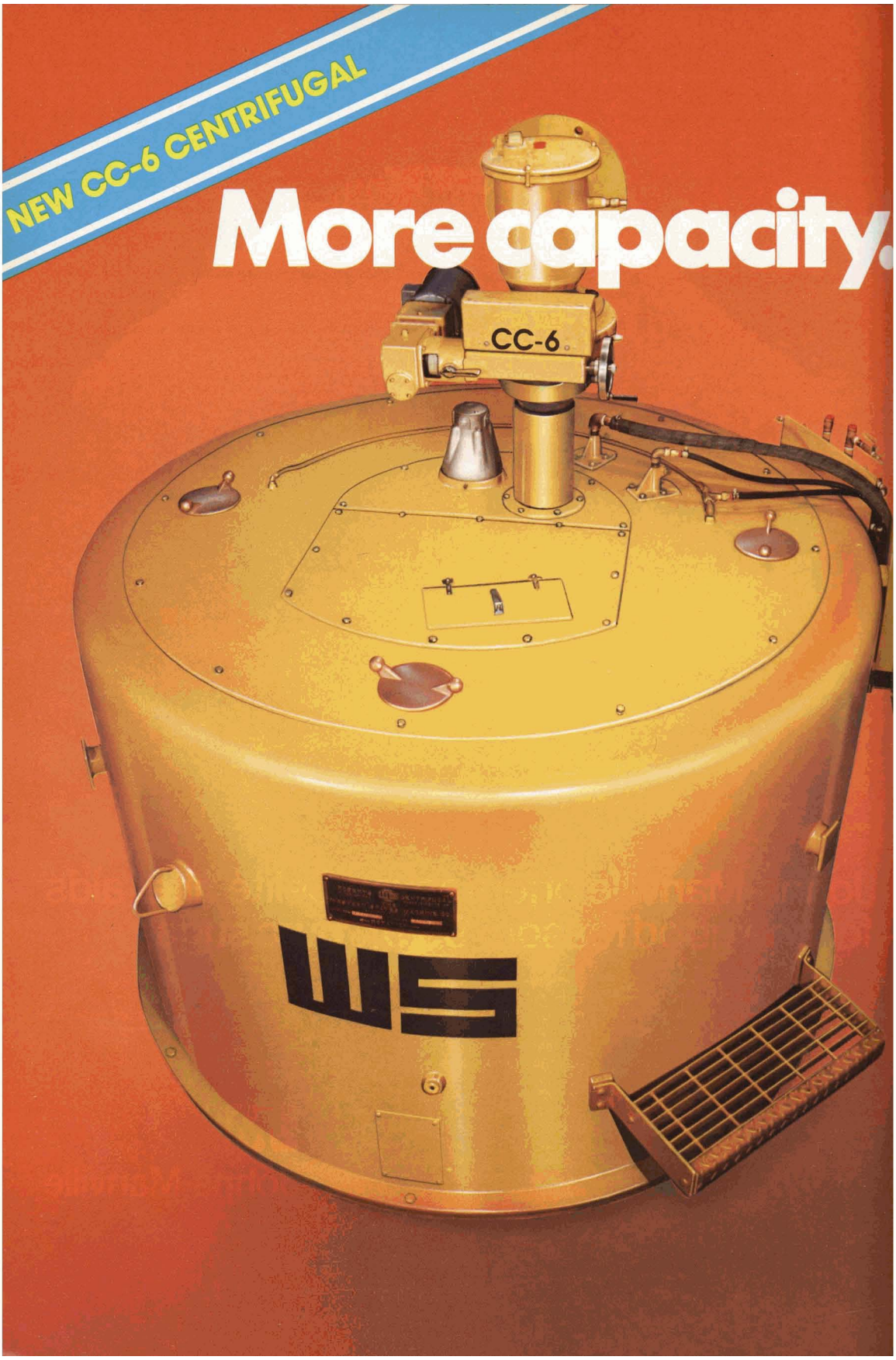

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NEW BOOKS

Hawaiian sugar manual 1980. 41 pp; 15.2 x 21.7 cm. (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, HI 96701, USA.) 1980.

The 1980 edition of this handbook of statistical information gives data on the Hawaiian sugar industry, the US Mainland and Puerto Rico sugar industries and on world sugar, as well as a concise glossary of terms used in the sugar industry. The information on the USA includes corn sweeteners and other edible syrups not produced from cane. For such a slim volume, there is much that will interest readers wishing to know more about the Hawaiian and US industries.

Green gold at Kenana. The story of an economic transformation. 36 pp; 29.7 x 21 cm. (Kenana Sugar Co. Ltd., P.O. Box 2632, Khartoum, Sudan.) 1981.

To mark the inauguration of the largest integrated sugar factory and refinery in the world, a colourful brochure has been produced which depicts the various aspects of the processing and agricultural activities on a 124,500-acre site which, before the project was started 10 years ago, had little of agricultural value, with water virtually unavailable outside the rainy season. With a nominal crushing capacity of 17,500 tcd over a 7-month season and a refined sugar output of 330,000 tonnes/year, the installation will have a workforce of 12,000 and will act as model for other development projects in Sudan. (See also *I.S.J.*, 1979, **81**, 355–358.)

Tätigkeitsbericht 1978/79 und 1979/80 (Activity report 1978/79 and 1979/80). 42 pp; 16.8 x 23.7 cm. (Zuckerforschungs-Institut, A-1030 Wien, Zaunergasse 1–3, Austria.) 1980.

Because of certain difficulties, it was not possible to produce a report for 1978/79; hence the combined report. Representatives of the various departments of this important sugar research institute outline activities conducted during the period 1978-80, covering agronomy, technology and medicine. Works published and papers presented by institute staff are indicated by a system of cross-references.

The industrial utilization of sugar and mill by-products. A literature survey. M. J. Kort. 252 pp; 20.7 x 29.2 cm. (Sugar Milling Research Institute, University of Natal, King George V Avenue, Durban 4001, South Africa.) 1980.

Dr. Kort continues his admirable work of surveying the world literature on sugar and by-product utilization. The task must have reached mammoth proportions in view of the size of the latest of the eighteen reports compiled. The total of 2662 references collected have been condensed into 2576 references in this report, which represents a 30.6% increase over the number in the previous report. The greatest number of references (727) relates to sweeteners (natural and synthetic) other than sugar, although most attention has been focused by research workers on only a few, particularly glucose, high fructose corn syrup, lactose, maltose and xylitol. By-product utilization has also received much attention (688 references in the section "By-products from sugar manufacture" and 340 in "Livestock feeding"); predictably the field of fuel alcohol fermentation has attracted considerable interest. The other sections in the survey are "Industrial uses of refined sugar" (316 references), "Sucrochemistry" (235 references) and "Nutrition and toxicology" (270 references). The references are placed at the end of each appropriate section, sub-divisions in which are easily found by use of the contents pages. Reading of the clear type is extremely easy, and the author is to be congratulated on the standard achieved.

Annual report 1979. 86 pp; 21 x 29.7 cm. (Mauritius Sugar Industry Research Institute, Réduit, Mauritius.) 1980.

While only 38 pp. of this report are devoted to sugar cane agronomy, processing and by-products utilization, this section contains much of interest, and carries some very clear colour photographs concerning agricultural aspects.

Standard fabrication practices for cane sugar mills. E. Delden. 254 pp; 16.5 x 25 cm. (Elsevier Scientific Publishing Co., P.O. Box 211, Amsterdam, Holland.) 1981. Price: $61.00.

This book, the first in a new Sugar Series, is intended both for those actually engaged in the sugar manufacturing processes and for those who, although employed in the cane sugar industry, are not involved in technical operations. The author mentions, in the preface, that there are specialized schools for sugar technologists in only a few countries and that the best way to educate new technologists is through practice with the aid of older colleagues having efficient manuals at their disposal. The purpose of the book is not to replace others, but to enlarge on some of the material in order to improve the technical skill of new personnel. The author has served the industry for 52 years and is therefore in a good position to judge what is needed in his book.

The contents cover the range from cane storage and transportation to sugar handling, but each subject is handled briefly, in a matter-of-fact way, so as to provide essential information without going into great detail. Step-by-step information is provided on evaporator cleaning, sugar house operations (with particular attention to low-grade work), sulphitation and carbonatation. The 40 chapters also cover items such as cane purchasing, instrumentation, paint and colour specifications, laboratory reports and their interpretation, drawing-up solids balances and off-season work for regular staff. A subject index is appended. For those seeking a source of outline information on cane sugar factory processes and particularly involved in the training of personnel, this book will undoubtedly serve a very useful purpose. It is easily readable and constitutes a new departure in sugar literature.

Annual report 1979-80. 58 pp; 19.5 x 27.3 cm. (Taiwan Sugar Research Institute, Tainan, Taiwan.) 1980.

This annual report conveys a good impression of the various activities at the Institute, covering both agricultural and processing aspects as well as by-products utilization. Colour photographs add interest to the contents, and the Institute is to be congratulated on the results they have achieved.

LABORATORY STUDIES

Foaming components in raw cane sugars. H. Ito, T. Miki, S. Saito and M. Kamoda. *Paper presented to the 17th Congr. ISSCT,* 1980, 13 pp. — Foaming occurs during refining of certain raw sugars from particular origins, notably Australia, Taiwan and domestic Japanese raws, and an attempt has been made to identify the components responsible. The main one has been identified as a steroid saponin formed from an unsaturated sterol ring and sugars consisting of glucose, xylose, rhamnose, arabinose and an unidentified sugar.

Measurements and identification of colouring matter in raw sugars and refinery liquors. A. A. El-Kader, A. M. El-Sherbini and A. A. Yassin. *Paper presented to the 17th Congr. ISSCT,* 1980, 9 pp. — Chromatographic analysis was used to identify 15 free amino acids present in Egyptian raw sugar and the same amino acids were detected in the hydrolysates of colouring matter isolated from the raws. The same acids were present in the syrup after bone char decolorization of the raw liquor. Infra-red analysis of the colorants isolated from syrups in the different stages of the refining process showed that they included melanoidins, degradation products from reducing sugars, and caramel. Carbonatation of the melt liquor removes 35% of the colour initially present while bone char treatment removes a further 54%; however, neither chemical nor physical treatments commonly used in refining can completely eliminate colour.

Process advantages and disadvantages associated with the inhibition of enzyme-catalysed colour formation in sugar cane juice. J. Coombs, B. C. Goodacre and G. W. Vane. *Paper presented to the 17th Congr. ISSCT,* 1980, 22 pp. — The possibilities of an alternative process for the production of a low-colour cane sugar based on inhibition of the primary colour formation (due to the activity of *o*-diphenyl oxidase) are discussed. The characteristics of the sugar cane phenol oxidase and the natural substrate, chlorogenic acid, are detailed and a number of chemical compounds which are effective in inhibiting enzyme activity — and hence colour formation in raw juice — are listed. The disadvantage of such chemical compounds arises from their poisonous or hazardous nature. Alternative methods of inhibiting the phenol oxidase include application of heat by steaming the cane. However, it is shown that the time required to heat intact cane to inhibit enzyme activity sufficiently to reduce colour formation is too long (>10 min) for a realistic process. Steaming of shredded cane reduces the colour in the juice to an extent comparable with that obtained in juice extracted from cane pith, such as that produced by the Tilby separation process. While it is possible to obtain a low colour sugar by direct transformation of juice in which phenol oxidase activity had been inhibited, such sugar has a strong and persistent taste. White sugar of low taste may be obtained from such juice by conventional crystallization, however.

Quantitative studies on the phenolics present in direct white sugars. A. P. Gupta and S. S. Srivatsa. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. Analyses were made of colour (optical density at 420 nm) and free and combined polyphenolic compounds in a range of white sugars made in India. The colour of sugar produced by a double sulphitation process was generally higher than that of double carbonatation sugar but the latter contained more phenolics. Phenolics content was also higher in large-grained sugar than small-grained and such observations support the claim that colour and lustre of sugar deteriorate quicker in carbonatation sugar and large-grain sugar than sulphitation white sugar and small-grain sugar.

Composition of polysaccharides in carbonated beverage floc from raw cane sugar. T. Miki, S. Saito, H. Ito and M. Kamoda. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — Floc from samples of Australian, Philippine, Cuban and South African raw sugars was isolated and the polysaccharide fraction hydrolysed with acid and also enzymatically using α-amylase, amyloglucosidase and dextranase. By thin-layer and gas-liquid chromatography glucose, mannose, arabinose, xylose and rhamnose were identified in the hydrolysates. An alcohol precipitate from raw sugar was purified by a copper-complex precipitation procedure and then fractionated on DEAE-cellulose in phosphate form; the fractions have a floc-forming potential and are polysaccharides comprised of mannose, glucose and galactose. Polysaccharides in which mannose predominates play an important role in the formation of carbonated beverage floc.

Mechanisms and application of thermal and of alkaline degradation of sucrose — a summary report. G. N. Richards, M. Manley-Harris and L. Poncini. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. — Novel hypotheses are presented for the detailed mechanisms responsible for the first steps in alkaline degradation and thermal degradation of sucrose. The understanding of the mechanism of the latter process has led to the development of new methods using sucrose for the synthesis of fructosides and of "grafted" polysaccharides. These products may be industrially useful and thus present a new avenue for non-food uses of sucrose.

Solubility-crystallization characteristics of Queensland molasses. R. Broadfoot and R. J. Steindl. *Paper presented to the 17th Congr. ISSCT,* 1980, 24 pp. — Molasses samples from five different areas of Queensland were examined in order to characterize the dependence of sucrose solubility, viscosity and crystal growth rate on impurity composition and concentration. Over defined ranges, the values of the solubility coefficient of the molasses have been correlated, using statistical analysis, with the impurities:water ratio, the reducing sugars:ash ratio and the molasses temperature, with an expression involving a root mean square error of 0.017 in its fit to the data. Crystal growth rate, measured in a modified version of the apparatus of Smythe[1], decreased linearly with the exponential of the impurities:water ratio and also showed a strong dependence on molasses viscosity under the growth conditions, indicating a strongly diffusion-limited growth regime. Crystal growth rates were measured at two different rates of shear. Molasses viscosity measurements were correlated with solids concentration, temperature, purity and viscometer shear rate with a standard error of 27%.

[1] *Proc. 10th Congr. ISSCT,* 1959, 323-336.

BY-PRODUCTS

Process for manufacturing liquid sugar from cane molasses. H. J. Hongisto. *Paper presented to the 17th Congr. ISSCT,* 1980, 13pp. — The chromatographic separation process of the Finnish Sugar Co. Ltd., when applied to cane molasses, gives fractions rich in sugars and in non-sugars. By pre-treatment to remove colour and inversion of the sucrose in the molasses it is possible to obtain liquid invert sugar of commercial quality at competitive cost.

Steam economy in distillery waste disposal involving spent wash concentration through an integrated heat cycle. A. R. Patil and J. T. Jadhav. *Paper presented to the 17th Congr. ISSCT,* 1980, 16 pp. — One method which has been proposed for disposing of distillery waste involves neutralization and evaporation to about 60°Bx in a multiple-effect evaporator and then in a single-effect vessel to about 80°Bx after which it is mixed with bagacillo or dried filter cake and the solid mixture used as a K-rich fertilizer. Steam consumption is so high, however, as to make the method economically unpractical, but a new system is proposed which reduces the heat consumption to economical levels. Steam is generated in a boiler at 10-21 bar and used in a thermo-compressor to raise the pressure of vapour from the first effect of a triple-effect reverse-feed pressure evaporator from 2.95 to 3.85 bar; the vapour is fed to the calandria of the first effect by way of a desuperheater. Vapour from the last effect, at 1.47 bar, is bled to the distillation column of the distillery. Alternatively, feed to the first effect calandria may be steam from a turbo-alternator exhausting at 3.85 bar.

Energetic conception for distilleries of anhydrous or potable ethanol, with simultaneous production of liquid fuel, biofertilizer and electrical energy. G. Filgueiras. *Paper presented to the 17th Congr. ISSCT,* 1980, 5 pp. — A number of known techniques are combined to give an overall scheme for utilization of cane for production of energy. Cane is harvested without burning and the leaves and trash separated and subjected to anaerobic fermentation to provide methane gas to be stored and used during the off-season. Cane juice from the stalks is concentrated to 22°Bx in a pre-evaporator heated by turbo-generator exhaust steam and produces a vapour which is sent to the distillery columns. Half the concentrated juice is evaporated in a quadruple-effect to 55°Bx, treated with invertase to reduce the sucrose content to less than 20% to avoid crystallization and the syrup brought to 85°Bx for off-season processing. The remainder of the 22°Bx juice is fermented to give a wash containing 8% ethanol, centrifuged for recovery and recycling of the yeast, and distilled to give alcohol. The vinasse, as well as the bagasse, is returned to the anaerobic fermenter to produce more methane, and the residual waste from the fermenter is concentrated by evaporation and returned to the fields as a fertilizer. The process affords, per tonne of cane, 75 litres of anhydrous alcohol, 110 kW of energy for sale and 220 kg of fertilizer (dry weight). Further, it enables distillery operation to continue throughout the year.

Need to develop cane wax production by the world sugar industry. P. J. M. Rao. *Paper presented to the 17th Congr. ISSCT,* 1980, 13 pp. — The sources and properties of different types of wax and their industrial uses are surveyed and a brief review given of laboratory and commercial-scale trials which have been made in different countries for the extraction of cane wax from filter cake. The process and plant used for cane wax extraction at a sugar factory in India are described and lines on which work should be carried out to develop further a cane wax industry are indicated.

A potential fermentation product — L-lysine from cane molasses in Taiwan. Y. T. Liu and S. L. Sang. *Paper presented to the 17th Congr. ISSCT,* 1980, 15 pp. — A process is described for producing L-lysine by fermentation of cane molasses using a homoserine-requiring mutant of *Corynebacterium glutamicum* which was able to give a concentration of 44 $g.l^{-1}$ of L-lysine in a pilot-scale fermenter. With a fermentation time of 70 hours a yield of 30% on total sugar is afforded and the product of direct concentration and drying of the broth is a solid material containing 25% of lysine and 20% of crude protein. Details are given of the process including isolation of the micro-organism strain.

Microbial fat synthesis from blackstrap molasses. O. Almazan, M. Klibansky and M. A. Otero. *Paper presented to the 17th Congr. ISSCT,* 1980, 14 pp. — An account is given of work on development of a process of producing simultaneously fat and protein by cultivation of *Rhodotorula gracilis* on a final molasses medium. In batch fermentations the specific growth rate for total biomass reached 0.34 hr^{-1}, while that for fat reached 0.1 hr^{-1}. Variation in the phosphate content of the medium did not produce any response as to fat yield; however, by fermenting in two stages and eliminating N from the second stage medium, it was possible to raise the fat:protein ratio.

Economics of *in natura* stillage utilization as a fertilizer. J. R. C. Branco, P. A. Lacaz and C. C. Ribeiro. *Paper presented to the 17th Congr. ISSCT,* 1980, 28 pp. — The volume of vinasse produced in a distillery is 12-13 times that of the alcohol and annual vinasse production in Brazil will reach 60 million m^3 by 1983 with implementation of that country's fuel alcohol program. Disposal will be a problem and the economics are discussed of utilization of the vinasse as a fertilizer. The cost of establishing a fleet of vehicles for transport of the vinasse to the fields and the cost of distribution have been calculated for different daily production figures while the cost benefit of reduced requirement of conventional fertilizer is also considered. The problems and opportunities of concentrating the vinasse to improve the economics of handling it are also assessed.

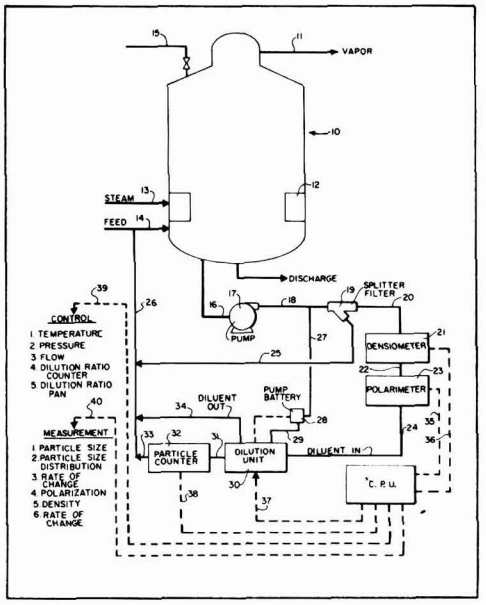
Recovery plant of Central Azucarerza Don Pedro. R. G. Isidro. *Paper presented to the 17th Congr. ISSCT,* 1980, 11 pp. — Important technical and economic factors in the establishment of a liquid CO_2 plant integrated with an existing sugar factory and distillery complex are presented and the process, equipment, capital investment, product quality and marketability for a plant designed to produce 24 tons of liquid CO_2 per day discussed. The significant contribution of the plant to the economics of the Don Pedro sugar factory is indicated.

PATENTS

UNITED STATES

Pan boiling control. E. A. Randolph, of Baton Rouge, LA, USA. **4,155,774.** August 9, 1977; May 22, 1979.

The pan 10, schematically represented with a vapour outlet 11, vacuum pump connexion 15, calandria 12 and steam feed 13, also receives a syrup feed 14 containing added seed crystals of about one-third the size of the crystals to be present at discharge. A sample is withdrawn intermittently or continously through line 16 by pump 17 and split into two streams, the first going to a filter or strainer 19 where the mother liquor is separated, while the crystals are recycled through line 25 to the pan feed 14. The mother liquor is analysed for total solids and sugar content by means of densitometer 21 and polarimeter 23, the information obtained being passed through links 35 and 36 to a central processing unit (C.P.U.) or computer.

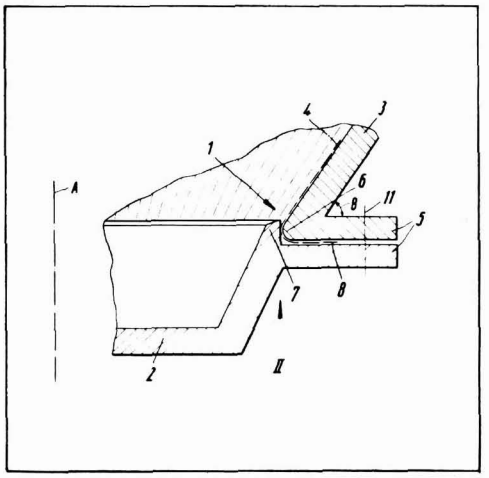


The second stream is sent through line 27 and by pump 28 and line 29 to a dilution unit 30 where it is mixed with mother liquor from the polarimeter and sent by line 31 to a particle counter 32 where the crystal content and size distribution of the diluted sample (and so of the original stream) is measured, before returning the sample to the pan feed line. Signals from the particle counter are sent to the C.P.U. which provides calculations of the various measurements and also governs the various factors (temperature, pressure, flows, etc.) to attain the required supersaturation for optimum boiling.

Separating ketoses and aldoses. I. Iwami, T. Asano and M. Yamaguchi, *assrs.* Asahi-Dow Ltd., of Tokyo, Japan. **4,156,618.** August 31, 1977; May 29, 1979. – One or more ketoses (fructose) is separated from a mixture (in water, alcohol or aqueous alcohol) with one or more aldoses (glucose) by bringing the mixture into contact (at 10° – 80°C) with a high polymer having primary (aliphatic, aromatic or aralkyl) amine moieties having a formula $=CY-Z-NH_2$ where Y may be H, a halogen or methyl and Z is an aliphatic chain of 0 – 6 (4) C atoms, $-CO-NH-CH_2-CH_2-O(CH_2)_n-$ where n is 2 or 3, or $-C_6H_9(OH)-$. The amino group may alternatively be attached directly or through an aliphatic chain to a methyl- or nitro-substituted or unsubstituted phenyl group forming part of the polymer. The polymer is insoluble in water, alcohols or aqueous alcohols, and the aldoses are removed from the solution by bonding to the high polymer.

Continuous separation of fructose from a mixture of sugars. H. Odawara, M. Ohno, T. Yamazaki and M. Kanaoka, *assrs.* Toray Industries Inc., of Tokyo, Japan. **4,157,267.** August 22, 1977; June 5, 1979. Fructose is selectively absorbed from a mixture with glucose when a solution is brought into contact with solid (0.05 – 5 mm) particles of crystalline aluminosilicate or zeolite (in the form of a faujasite type X, Y or L), using a simulated countercurrent flow system formed by three circularly interconnected zones including a desorption zone, a rectification zone and a sorption zone, each zone being divided into a number (5 – 40) of sequentially interconnected sections (in which the liquid flows at 0.05 – 20 $cm.sec^{-1}$).

Conical centrifugal basket. V. Hentschel and G. Warner, of Brunswick, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **4,158,573.** March 10, 1978; June 19, 1979.

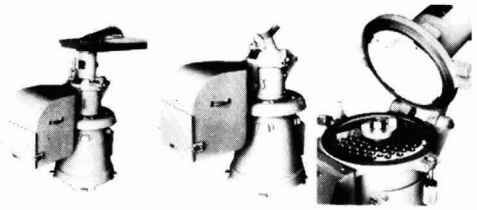


Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specification are obtainable from: The Commissioner of Patents, Washington,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

No cane testing laboratory is complete without one or both of these JEFFCO MACHINES

Cutter-Grinder

This is used to reduce cane samples into a fine condition to facilitate determination of fibre content, etc. The cut cane is retained in a receiving bin which is sealed to minimise windage and resultant moisture loss. The juice is evenly spread throughout the product.

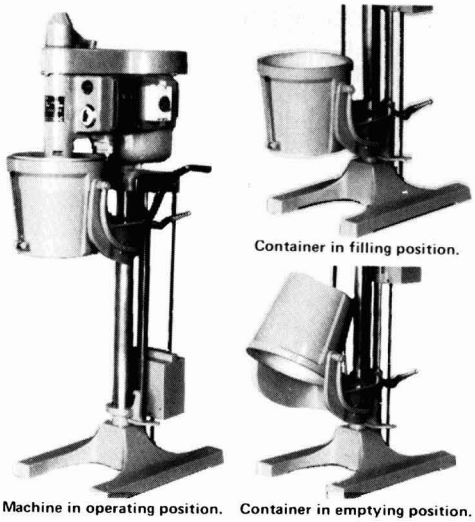


Above left: **Model 268B** will cut prepared cane or that which has come from a pre-breaker. It will also take full stalks including the tops and roots. The opening through which the cane is fed is 152mm. Power by 7.5kw motor.

Above centre: **Model 268BM** is identical to the Model 268B except that it has two smaller inlet funnels and will only handle stalks. Inlet diameter 55mm. It is fast in operation. It has a water inlet on top so that the machine can be flushed out at the end of tests while still running. This shows machine with receiving bin.

Above right: Illustration of internal cutting arrangement. The cutters which are mounted on a vertical spindle perform a scissors action with the four hardened inserts in the head of the machine. Screen plates with holes of various sizes are available.
DIMENSIONS - with receiving bin.
Unpacked-155 x 115 x 74cm Packed-150 x 126 x 92cm
Cubic - 1.74m3 Weight Packed - 547kg

Wet Disintegrator



Container in filling position.

Machine in operating position. Container in emptying position.

Above: **The Jeffco Wet Disintegrator Model 292** processes a measured quantity of cane and water resulting in the removal of sugar juice from fibre. It operates by a 2.2kw motor and is available in model numbers 291 - 9 litre and 292 - 14 litre capacity containers incorporating a water jacket for temperature control. Container tilts for easy emptying. Built in timer stops machine automatically at preselected time.
DIMENSIONS
Unpacked-165 x 89 x 56cm Packed-173 x 104 x 57cm
Cubic - 1.02m3 Weight Packed - 337kg

Approved by Leading Sugar Cane Research Centres.

JEFFRESS BROS. LTD. ENGINEERS
351 Melton Rd., Northgate, Brisbane. 4013

Phone: (07) 266 1677

To **JEFFRESS BROS. LTD.** 351 Melton Road, Northgate East, Brisbane, Qld. 4013 Australia.
Please forward full details on ☐ Wet Disintegrator ☐ Cutter/Grinder.
Name .....
Address .....
..... Post Code .....

The continuous centrifugal basket is in at least two sections 2, 3 having different angles to the vertical to correspond to the changing nature of the material passing over them. The upper part of section 2 and lower part of section 3 are provided with flanges 5 which may be joined by bolts as at 11. Section 2 also overlaps section 3 by the rim 7, forming a corner into which the rounded bottom 6 of section 3 fits.

The screen 4 is slotted at its lower end 8 to enable it to be bent round the bottom 6 of section 3 and it is clamped between the flanges 5. The massecuite which passes over the rim 7 thus goes straight onto the working section of screen 4 and this is not interrupted by any bolts, etc., holding it in place.

Maple sugar product. A. C. C. Chen, S. J. Drescher and C. P. Graham, *assrs.* Amstar Corporation, of New York, NY, USA. **4,159,210.** June 15, 1978; June 26, 1979. Maple syrup (of at least 63% sucrose content)is concentrated to 93 – 98% solids content (by heating to 162° – 196°F at 19 – 27 in Hg vacuum to 90% solids, and then at 250° – 265°F under atmospheric pressure) and subjected to impact beating within a crystallization zone until transformation and crystallization occur, giving an aggregate of 3 – 50 μm sucrose crystals and a moisture content of 2 – 4%; the aggregate is then dried to <1% moisture (and contains about 6% of invert sugar and non-sugar solids). It may be incorporated with other sugars to impart flavour.

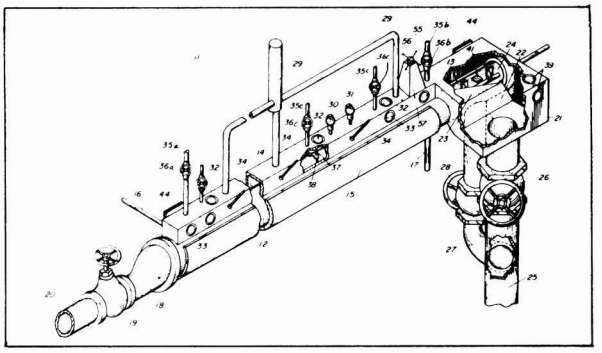
Animal fodder supplement. J. J. Schroeder and J. W. Sawhill, of California, USA. **4,160,041.** February 14, 1977; July 3, 1979. – About 0.5% by weight of MgO, Al_2O_3, CaO or a mixture of these (CaO) is mixed with a solution of 10 – 90% sugar (molasses, molasses mixed with condensed whey or an ammonium or alkali metal lignin sulphonate), the oxide hydrated to give a sugar solution with soluble metal ions having a pH of 9 – 11 (9.5 – 10.5), and thereafter reacting with a monoalkali metal or ammonium orthophosphate or phosphoric acid (phosphoric acid) at a concentration equivalent to 2 – 5% w/w as P_2O_5, to give a pH of 3 – 6 (3.5 – 5.0), the amounts of metal oxide and phosphoric acid being sufficient to form a solid block. The block may also include 5 – 20% w/w of an edible animal fat (yellow grease, palm oil), 5 – 40% w/w of a protein equivalent additive (2 – 15% of urea, biuret, ammonium phosphate, dried blood, cottonseed meal, soya meal, etc.) and sorbic or benzoic acid or a salt of this acid as a preservative.

Purifying an aqueous solution. W. Pannekeet and R. Smakman, *assrs.* Akzona Inc., of Asheville, NC, USA. **4,160,675.** September 12, 1977; July 10, 1979. – An aqueous solution of e.g. sucrose or high fructose corn syrup, etc., is brought into contact with an acid cation exchanger and subsequently with a polymer or polycondensate (a phenol-formaldehyde resin) which contains sulphur in the form of thiol groups (at least 1200 meq per litre of resin) bonded to C atoms [built up from a monovinyl aromatic compound (styrene) and 0 – 80% of a cross-linking monomer (a di- or polyvinyl aromatic compound) (divinyl benzene)]. As a consequence of the treatment, organic impurities, e.g. colour bodies and colour precursors, are removed.

Drying complex sugar solutions. P. L. Veltman and J. J. Blouin, *assrs.* W. R. Grace & Co. Inc., of New York, NY, USA. **4,162,926.** January 11, 1978; July 31, 1979. High fructose corn syrup is dispersed in a current of heated gas in a drying zone, in the presence of 1 – 10 parts of separately introduced recycled conditioned solids per part by weight of solids in solution. This produces a solid product and reduced the gas temperature from 100° – 300°C at the inlet to 60° – 120°C at the outlet. The solid product is then conditioned by treating with a gas having a R.H. less than 50% and a temperature below (10° – 60°C below) the melting point of the formed solid for such a time that the water content is reduced to ⩾0.5%, and a portion of this dried solid product is recycled. The product is then abrasively compacted to increase its density.

Crystallizing sugar solution and mother liquors continuously by evaporation. R. Morfin-Alvarez, of Martinez de la Torre, Ver., Mexico. **4,162,927.** May 11, 1977; July 31, 1979.

Feed material enters the unit 11 through pipe 20, valve 19 and connexion 18 and passes along a cylindrical body 12, eventually discharging as a massecuite into the overflow box 21 and so via valve 26 to the outlet duct 25. Within the cylindrical body 12 is a driven shaft carrying paddles 41; this is supported by suitable means and serves to mix and convey material in body 12 from the feed to the discharge end. The top of the body is provided with a slot 13, covered by a rectangular cover 14, while the body is provided with a jacket 15 into which steam is admitted through pipe 16 and from which condensate is removed through drain pipe 17. The cover 14 is provided with horizontal and lateral sight glasses 32, 33 and similar glasses 39 are provided in the overflow box.



A connexion 29 is provided to link the unit with a source of vacuum and pressure and suitable gauges 30, 31 are provided on cover 14. Seed magma can be introduced at the feed end and syrup or water at intervals along the unit through pipes 35a and 35c, respectively, under the control of valves 36a, 36c. A gate valve is provided at the discharge end of body 12, its shaft 55 being operated by capstan 56; this valve acts as the end of the boiling section and massecuite overflows above it into the remaining section where it is diluted with returned mother liquor, admitted through pipe 35b via valve 36b, and after mixing by paddles 41 overflows from body 12 onto plate 22 and so through pipe 25. When the unit is to be emptied, the feed is stopped and,

when overflow into box 21 ceases, the gate valve is opened by means of capstan 56 and the contents of the unit allowed to flow into pipe 27 and so into pipe 25 under the control of valve 28.

Method and apparatus for explosively defibrating cellulosic fibre. H. Mamers and J. E. Rowney, *assrs.* Commonwealth Scientific and Industrial Research Organization, of Campbell, Australia. **4,163,687.** April 24, 1978; August 7, 1979. — A specially designed nozzle is claimed which is used in the separation of fibre from raw material (including bagasse) for paper pulp making, whereby the material passes from a high pressure region to a low pressure region through a system of internal bars to provide a tortuous path.

Beet cleaner. A. Robache, of Feucherolles, France, *assr.* Fives-Cail Babcock. **4,164,052.** March 28, 1978; August 14, 1979.

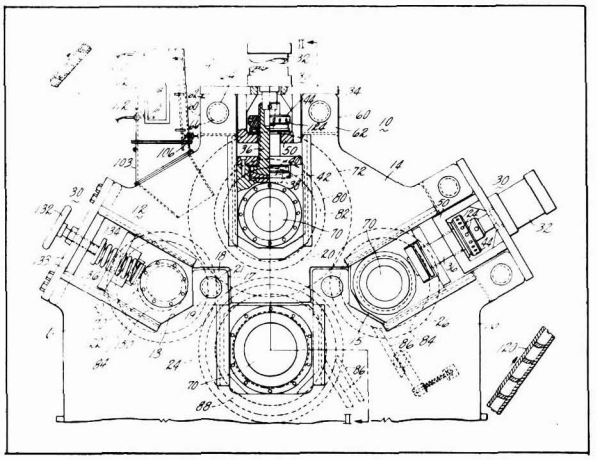
Production of selected crystallization seeds for use in a sugar refinery. A. Mercier, of La Madeleine, France, *assr.* Fives-Cail Babcock. **4,164,429.** December 13, 1977; August 14, 1979. — A suspension of crystals produced in a sugar boiling is separated and the crystals made into a new suspension with a small amount of the mother liquor. It is then subjected to two centrifugal screenings; in the first, oversize crystals are removed, subjected to impact crushing and recycled to the initial suspension. In the second. fines are separated and the oversize crystals retained as product while the fines are remelted in mother liquor. The product crystals are thus. all within a predetermined range of crystal sizes and, when resuspended in mother liquor, may be used as magma for boiling of sugar strikes which will have better crystal size regularity in the final product.

Combined anaerobic reactor and settler. E. Wind and R. de Vletter, *assrs.* N. V. Centrale Suiker Mij., of Amsterdam, Holland. **4,165,285.** June 21, 1977; August 21, 1979. — The invention relates to an installation for anaerobic purification of waste water or effluent which comprises a reactor, an after-settler device in the top part of the reactor which separates an upper settling zone from an anaerobic decomposition zone, and means are provided for using the methane gas produced as a transport aid for the sludge particles, and for separating the gas from the particles.

Insolubilizing enzymes. M. S. Masri, V. G. Randall and W. L. Stanley, *assrs.* US Secretary of Agriculture, of Washington, DC, USA. **4,167,447.** March 24, 1978; September 11, 1979. — A soluble active enzyme (a sugar-hydrolysing enzyme, invertase, glucose oxidase, etc.) is dissolved in water and mixed with a solution in water of chitosan (or chitosan sulphate formed by treating 10 — 60 mesh pieces of chitosan with sulphuric acid or by dissolving chitosan in water at pH 3 — 7 and adding sulphate ions) (or the two dissolved together at pH 3 — 7). The enzyme is precipitated in active but insoluble form (by treating with an alkaline agent or sulphate ions in the case of chitosan itself).

Cane mill. A. S. Zelle, of Fairfield, CT, USA, *assr.* USM Corporation. **4,168,660.** October 19, 1977; September 25, 1979.

The mill 10 is provided with two housings 14 which support an upper cane roll 20, a feed roll 22, an anvil roll 24 and a bagasse roll 26, all but the anvil roll being provided with hydraulic pressure devices 30 or a spring loading system 132, 134, 136.



Cane feed is delivered through chute 104 to the nip between the cane roll and feed roll, passes then between the cane roll and anvil roll and finally between the cane roll and bagasse roll after which it is discharged for treatment in a subsequent mill. The use of gravity to aid feeding permits elimination of chevron grooving on the rolls and so increases the area of contact. The turnplate is eliminated and drive couplings are rendered simpler.

Animal feed blocks. (A) L. V. Skoch and D. E. Hodge, *assrs.* Ralston Purina Co., of St. Louis, MO, USA. **4.171.385.** April 5, 1978; October 16, 1979. (B) L. V. Skoch, B. G. Harmon and C. W. Dickerson, *assrs.* Ralston Purina Co., of St. Louis, MO, USA. **4,171,386.** April 5, 1978; October 16, 1979.

(A) A mixture is made of 18 — 74% molasses, (1 — 8% of) either ammonium polyphosphate or tetrasodium pyrophosphate (2 — 8% ammonium polyphosphate) (1 — 6% tetrasodium pyrophosphate) as a water-soluble P source, 0.5 — 5% w/w of a water-absorbent clay and 5 — 30% water under high-speed shearing action for sufficient time to disperse the clay; about 5 — 30% w/w of animal fat (edible animal or vegetable fat) and [5 — 20% (6%)] MgO are mixed with the above to give a viscous nutrient mixture that solidifies to a hard weather-resistant block having a water activity of 0.8 — 0.9.

(B) About 18 — 65% w/w of molasses is mixed with 4 — 9% of a monobasic salt of phosphoric acid (0 — 3% mono ammonium phosphate) (0 — 5% tetrasodium pyrophosphate), about 0.5 — 5% of a water-absorbent clay and 5 — 20% water under high-speed shearing conditions for sufficient time to disperse the clay, and the product mixed with 5 — 30% animal fat, 8% ferrous sulphate and 3 — 15% (7%) MgO, to give a viscous nutrient mixture that solidifies to a hard, weather-resistant feed block in less than 1 hour, having a water activity of 0.8 — 0.9.

BREVITIES

Sugar economy studies. — Four more volumes in the series of studies entitled "The World Sugar Economy: Structure and Policies", on the sugar economies of individual countries have been issued by the International Sugar Organization during recent months. The new volumes are: — Volume 7: Colombia, Guyana, Panama and Volume 8: Malawi, Swaziland, Zambia at £1.50 each plus postage, and Volume 9: Japan, Malaysia and Volume 10: Chile, Costa Rica, El Salvador at £2.00 each plus postage. The studies review developments in production, consumption and trade of the countries concerned since 1960. They are available in English and Volumes 7 and 8 are also available in Spanish. Translation into Spanish of Volumes 9 and 10 is in hand. Copies of these and the other volumes of the series may be obtained from International Sugar Organization, 28 Haymarket, London SW1Y 4SP, England.

Corrigendum. — The vertical column in Figure 2 on page 108 of our April 1981 issue should be labelled "Output concn., meq.cm $^{-3}$" and not as given.

Texas sugar crop, 1980/81. — The 1980/81 season in Texas, which started on October 14, 1980, came to a close on May 31, 1981, although 95 days of the 230 were lost owing to wet weather. 359 hectares had to be stood-over to the 1981/82 season while another 58 ha of burnt cane were abandoned. The trash averaged 11.1%, bringing the 973,361 tonnes of gross cane to 865,318 tonnes of net cane. A total of 82,631 tonnes of 96° sugar was produced, a recovery of 9.55% on net cane. While wet weather affected juice quality, the overall recovery was reduced by cane damage by an insect pest new to the region. The rice borer, *Acigona loftini*, previously known only in north-west Mexico, was identified in early August and had devastated 925 ha by the start of the season. This area yielded only 38.6% of that of unaffected cane, giving 2.47 tonnes of sugar per hectare against 6.40 tonnes. Productivity of harvesting operations was reduced by the numerous stops and starts through adverse weather, yet levels remained high with an average of 30.05 tonnes gross cane cut per hour per machine, operating at an average of 0.41 ha per hour each. An increase of 1096 ha is expected for the 1981/82 crop, bringing the cane area to 15,213 ha, of which 17% will be plant cane.

World Sugar Journal conference on international sweetener and alcohol policy and legislation. — *World Sugar Journal* has announced that it is to organize a new conference during October 15-17, 1981, at Bal Harbor in Florida, on policy and legislation aspects of sugar, corn sweeteners and alcohol. The conference will provide a platform where sectors affected by provisions of International Sugar Agreements — but who do not have the opportunity to participate in the governmental level negotiations — can express their views and comment on the opinions of others, with the prime object of influencing what new measures or revisions should be included in the next ISA. The conference will also discuss the EEC sugar regime; the need or otherwise for a new ISA and the role of the current Agreement in stabilizing the world market; means for achieving the objectives of GEPLACEA; GATT and the conciliation of disputes concerning sweeteners; alcohol policy and legislation in Brazil, Philippines and the USA; effects of national and international legislation on sugar trade; white sugar trading under EEC rules, etc. The fee of $425 will cover all refreshments, cocktails, luncheon, three receptions and a printed set of the conference proceedings. Registration may be arranged through N. G. Osman & Associates Ltd., Hamilton Road, Slough, Berks SL1 4QY, England; Telephone 0733-72137/8 and Telex 848469.

Portugal sugar policy. — The long-term contract under which Portugal has bought 70,000 tonnes of sugar per year from Cuba since 1976 expires this year but it is not intended to seek a renewal in view of Portugal's impending membership of the EEC. Portugal will continue to purchase Cuban sugar but on an as-required basis. It was stated last year that the EEC had agreed to exempt Portuguese refiners from a levy on imported cane raws since this would jeopardize their economic viability; no formal acknowledgement of this agreement has emerged so far, however. Portugal has indicated that, in spite of the sugar production surplus in the Community, it was intended to start a beet sugar industry in order to benefit from the high internal prices in the EEC once Portugal became a member. The aim will be to cover one-sixth of domestic requirements, currently estimated at 360,000 tonnes, raw value.

US sugar exports, 1980[1]

	1980	1979
	—tonnes, raw value—	
Algeria	23,631	0
Bahamas	4,480	1,516
Canada	13,121	3,767
Caribbean Islands	3,362	682
Chile	69,142	0
Dutch Antilles	5,190	3,905
EEC	0	152
Egypt	23,687	3
Iraq	12,359	0
Jamaica	3,262	1,366
Jordan	14,010	0
Mexico	209,419	211
Peru	48,695	0
Portugal	13,078	35
Syria	14,826	0
Trinidad & Tobago	20,869	1
Turkey	11,799	0
US Oceania	0	999
USSR	8,180	0
Venezuela	85,056	4
Other countries	2,880	1,669
	587,046	14,310

New device for cane harvesting. — Australian engineers are developing a device aimed at finding an accurate way of cutting sugar cane just above ground level. At present operators of sugar cane harvesters — of which Australia is a major manufacturer — are unable to judge the precise height of the base-cutting mechanism. This means that cane cut too low often contains rocks and dirt while cutting too high leaves part of the best of the crop in the field. At James Cook University of North Queensland in Townsville, researchers under Professor Peter Arlett, head of the Department of Electrical and Electronic Engineering, have developed a microprocessor-based height-sensing instrument as a major step towards production of an automatic height controller. A measure of the hydraulic oil pressure in the harvester's base-cutter motor is converted into a voltage which is transmitted to the microprocessor. The operator simply makes his adjustments by monitoring a screen readout of the height variations. Control engineers at the University, Dr Robert R. Bitmead and Mr Phillip C. Musumeci, said the main difficulty with cane harvesting was that ground level was not well-defined. Most cane fields have two furrows with a row of cane in the middle; the harvester drives up with its wheels on the furrows and the stools of cane sit in the middle. Cane-cutting is a very dirty job, and it is almost impossible to see the ground, so that an operator can be cutting several centimetres below ground level before he realizes it. This problem of height detection is compounded because the cutting motors on cane harvesters are very much over-powered. A key to the solution was to establish a reliable method of detecting variations in the load on the cutting motors — and feed this to the operator as a measure of height. Eventual production-line cost of a microprocessor system which could be used in many types of harvesting would be about $A 300. James Cook engineers also are testing a sonar device which could produce an even more accurate method of harvesting.

Mexican sugar shortfall in 1981[2]. — Mexico will produce 2,500,000 tonnes, tel quel, of sugar in crop year 1980/1, about 60,000 tonnes less than the previous year, according to the President of the Mexican Sugar Workers Union. This total is some 200,000 tonnes down on earlier estimates and Mexico will have to import between 500,000 and 600,000 tonnes of sugar in 1981. A total of 739,000 tonnes was imported last year to compensate for a previous disastrous season, and a slight surplus remained. Production in 1981/82 was estimated at 3 million tonnes and is expected to reach the self-sufficiency target of 3.3 million tonnes by 1982/3.

Paraguay sugar production, 1980[3]. — Sugar production in Paraguay increased by 30% in 1980 to 89,000 tonnes, with an exportable surplus of 24,236 tonnes.

Chile refinery closure[4]. — Cía. de Refinería de Azúcar de Viña del Mar will soon close its sugar refinery permanently because of losses incurred since 1979. The losses resulted from buying raw cane sugar from overseas at higher prices than those at which the company could sell refined sugar in the domestic market. Domestic market prices are fixed in line with world market prices and these have fallen in recent months, increasing the losses. The company's other operations, including two beet sugar factories in southern Chile, will continue in operation.

[1] C. Czarnikow Ltd., *Sugar Review*, 1981, (1537), 51.
[2] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 317.
[3] *Bank of London & S. America Review*, 1981, **15**, 101.
[4] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 317 – 318.

Dominican Republic sugar exports, 1980[1]

	1980	1979	1978
	tonnes, raw value		
Algeria	10,500	0	0
Haiti	4,536	0	0
Morocco	0	0	4,161
Portugal	11,695	0	0
Senegal	28,298	6,695	6,386
USA	525,084	817,713	601,616
USSR	9,450	0	46,761
Venezuela	201,191	202,582	270,411
West Indies & Caribbean Islands	1,980	7,970	7,343
	792,734	1,034,960	936,678

Zimbabwe sugar project[2]. — Government sources in Salisbury said that a 91,000 tonnes-per-year sugar project, which would also produce 72 million litres of ethanol, is being considered by the government. The project, which is to be located at Chisumbanje in the south-east of the country, is being studied by the government-backed Industrial Development Corporation and money would be raised by the Corporation or a publicly-floated company. The project would substantially boost Zimbabwe's sugar output, which totalled 358,000 tonnes in 1980, of which 229,000 tonnes was exported.

Philippines fuel alcohol program[3]. — Fifteen companies have applied to the Philippine National Alcogas Commission to produce the 1,600,000 litres of anhydrous alcohol daily to support the government's fuel alcohol program. Of these, six companies will use sugar cane as raw material, six will use cassava, two sweet potato and one, Canlubang Energy Industries, intends to produce alcohol from molasses. Any excess alcohol production will be used as a supplement to diesel fuel or as a raw material for production of ethylene, the base stock for a chemical industry. Firm bids from 16 international companies for the supply of alcohol distilleries for the program have been received.

New Indonesian sugar factory[4]. — In February a new sugar factory project for West Java was announced; the factory, to have a crushing capacity of 3000 t.c.d., is expected to cost $40 million and has a target completion date of 1983. With average cane yield and sugar recovery for Java, the factory could produce 40 – 50,000 tonnes of sugar per year. In addition to 11 new factories a program of rehabilitation of 27 old ones will involve new investment in sugar milling, largely from government sources, which could total hundreds of millions of US dollars by the end of the present five-year plan in 1984.

South African sugar refinery[5]. — A refinery with a design capacity of 150,000 tons of sugar is to be built at Noodsberg sugar factory and will be commissioned during the 1982/83 season. It will cost 14½ million rand and will convert 95% of the Noodsberg mill's output into refined sugar. The Pongola refinery is to be expanded while the Sezela refinery is to be closed to make sufficient room for the planned expansion of the raw sugar factory. This will take milling capacity from 350 to 450 t.c.h. and will cost R 21 million over the next three years.

Martinique sugar industry decline[6]. — In 1981 only 3000 hectares of cane may be planted on the island of Martinique, against 6000 ha in 1976 and 8000 ha in 1968. In recent years cane production has been strictly regulated in order to eliminate exports; enough sugar is to be produced to satisfy local consumption and the remaining cane will be used by the rum industry. To this end, the larger of the island's two remaining sugar factories, at Lareinty near Fort-de-France, the island's capital, is to be closed. Its sugar cane fields, like many others, have been largely converted to banana and pineapple plantations. The Lareinty factory and the sole remaining one at Le Galion, are in a poor state of efficiency owing to antiquated and poorly maintained mill equipment. The closure of Lareinty will permit new investment to be made at Le Galion by its owners, Société Cointreau, with the help of a 30% operational subsidy from the government. Cointreau also controls 60% of the island's rum industry. In 1978 rum distilleries took 110,676 of the cane harvest of 302,691 tonnes; in 1979, the cane crop fell to 290,298 tonnes and the proportion used for rum rose by 13.5% to 125,667 tonnes.

India sugar exports, 1980[7]

	1980	1979	1978
	tonnes, raw value		
Afghanistan	0	0	10,804
Bangladesh	10,804	17,780	0
China	0	22,149	76,873
Djibouti	0	0	1,405
Egypt	12,479	87,407	46,999
Indonesia	0	206,690	273,669
Kenya	0	44,568	0
Korea, North	5,672	0	33,278
Maldives	0	5,591	2,592
Nepal	1,621	0	0
Pakistan	0	21,176	0
Somalia	0	23,067	0
Sri Lanka	0	239,909	91,999
Sudan	12,479	12,965	76,278
Tunisia	0	0	11,128
UK	26,406	27,525	25,714
Yemen	0	0	36,735
	69,461	708,827	687,474

Thailand cane area expansion[8]. — For 1981/82 Thailand's goal is to increase its harvested cane area further, from 480,000 to 512,000 hectares. To achieve this goal and also to control possible over-production, the Agriculture Ministry has initiated a "crop zone program" for cane; farmers who register their cane areas and participate in the program will benefit through subsidized fertilizer, free insecticides and a guaranteed cane price. To date, farmers have registered nearly 90% of the target area for 1981/82 production. With normal yields of about 44 tonnes.ha^{-1}, Thailand would expect to crush 22.5 million tonnes of cane which could give around 1.9 million tonnes, raw value, enough to cover domestic and export requirements. Output in 1980/81 reached 1.6 million tonnes, tel quel, against 1,040,000 tonnes in the previous season.

Greece sugar statistics[9]. — In 1980/81 Greece produced a total of 198,069 tonnes of sugar. Its 1980 calendar year consumption was 363,647 tonnes, raw value, maintaining the steady increase of recent years (consumption rose by 33,253 tonnes in 1979 and by 26,065 tonnes in 1980). Calendar year-ending stocks were reduced substantially from 206,467 tonnes to 40,889 tonnes on December 31, 1980. No sugar was exported in 1980.

PERSONAL NOTES

We regret to report the death on April 28, 1981, of **J. L. du Toit**, at the age of 69. "Lokkie" du Toit joined the South African Experiment Station in 1935 as an assistant chemist after graduating from Stellenbosch University, and was concerned with cane nutrition, planning and supervising many of the fertilizer trials carried out in South Africa during his career. He became Chief Research Officer in 1961 and Deputy Director in 1968, retiring in 1971. During the period he published many papers and served with distinction as an officer of the South African Sugar Technologists Association. Not surprisingly, he was entrusted with the organization of the Golden Jubilee ISSCT Congress in South Africa in 1974 and such was the success of this meeting that he was appointed General Vice-Chairman of the Society's meetings in 1977 in Brazil and 1980 in the Philippines. He was appointed to the Board of Trustees and had already visited Cuba in regard to the 1983 Congress. His death removes a considerable talent from the sugar industry and is a personal loss to his many friends throughout the sugar world.

Dr. Chung-Chi Chou has been promoted to the position of Manager – Technical Division of the American Sugar Division of Amstar Corporation. Dr. Chou joined Amstar in 1968 as a research scientist and has published many technical papers both within and outside the sugar industry. He has twice received the George and Eleanore Meade award of Sugar Industry Technologists Inc.

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[1] *I.S.O. Stat Bull.*, 1981, **40**, (3), 32.
[2] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 299.
[3] *Standard Chartered Review*, May 1981, 30.
[4] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 344.
[5] *S. African Sugar J.*, 1981, **65**, 18-19.
[6] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 338.
[7] *I.S.O. Stat Bull.*, 1981, **40**, (3), 50.
[8] F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 344.
[9] *World Sugar J.*, 1981, **3**, (11), 32.

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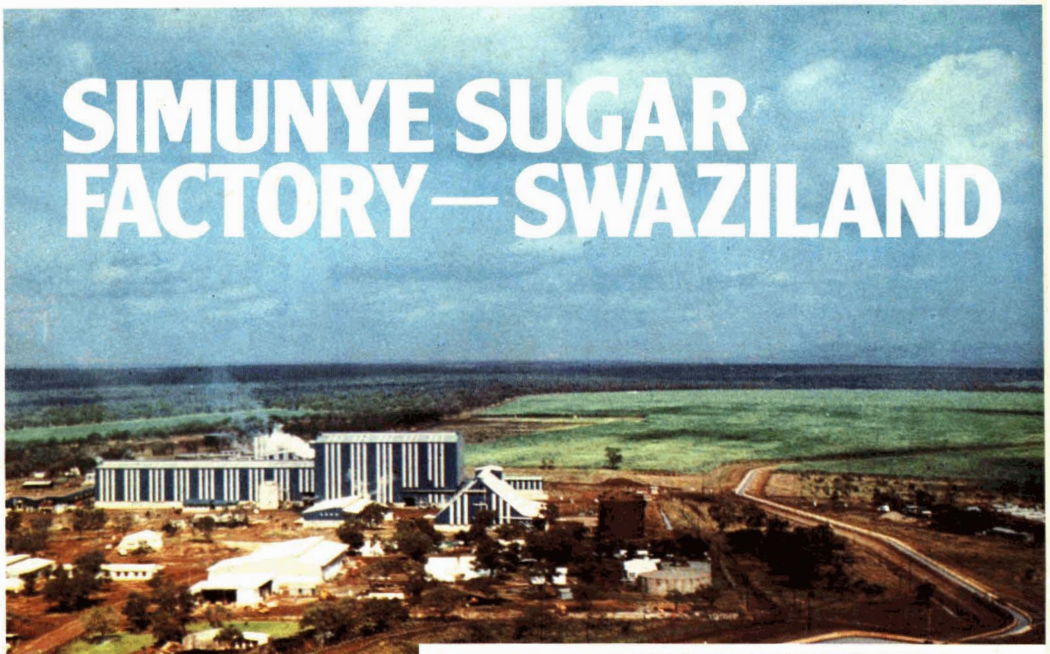

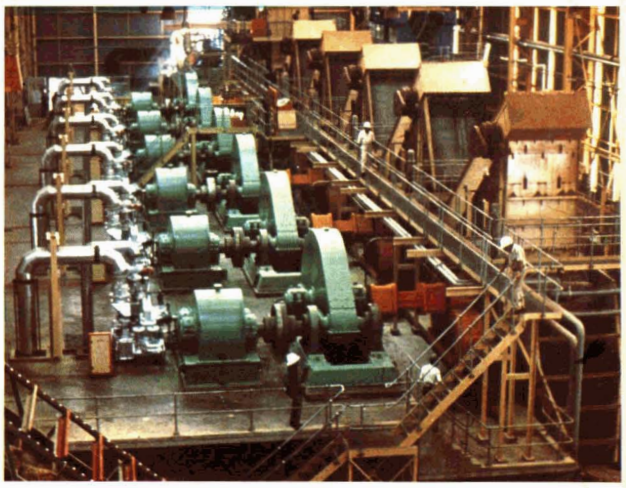

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