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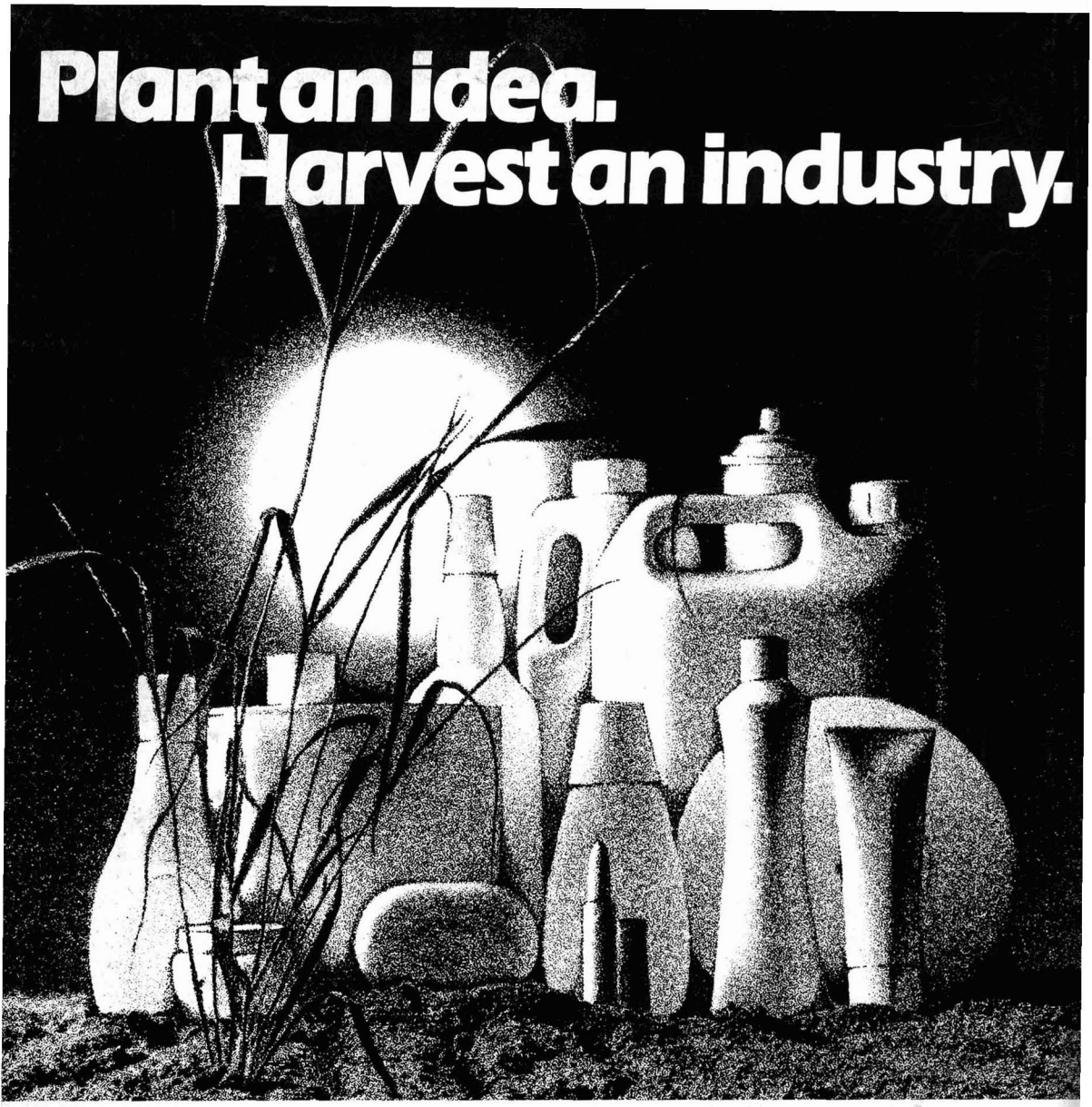

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NOTES AND COMMENTS

International Sugar Agreement

The International Sugar Council met on November 18 and 19 and, in addition to its usual business, took the important step of initiating negotiations for a new Agreement to come into effect in 1984. There has been considerable criticism of the current agreement which has been unsuccessful in the attempted control of sugar prices within a limited range. A year ago it was extended, with all its faults, to the end of 1984 and the quota provisions were such that export entitlements were so much greater than potential demand that the ISA was completely ineffective. There has consequently been growing pressure for a new agreement which would be effective and the Council has decided to acquiesce. A meeting was arranged for December 9-10 to make various procedural arrangements, to be followed in January by the drawing up of a draft Agreement which would include a number of possible alternatives. A decision-making session is to be held in March and then a UN Sugar Conference in Geneva, called by the Secretary-General of UNCTAD, which will, it is hoped, result in a new Agreement, although past experience would suggest the likelihood of a further Conference later in the year to iron out problems arising in the first.

The Council were unable to agree on any interim measures since these could only involve the segregation of additional stocks or adapting the export quota system. The Organization's finances will be strained to meet the cost of the 2.5 million tonnes of special stocks called for by the end of 1983, and financing of additional stocks would be impossible unless the fee were raised sharply. Further, members are reluctant to commit themselves to further stocks before they know the extent to which the EEC plans to withhold supplies from the market in parallel to the ISO measures.

In recent weeks the EEC has shown an increasing willingness to cooperate with the ISO – and a subsidy of £200 per tonne on its exports is another factor – but no firm commitment has yet been given to segregate a specific quantity of sugar from the 1982/83 crop.

For the export quota system to operate effectively, the total in effect should be at or below the level of market demand and it has been suggested that, to achieve this, the limitations on cuts should be abolished, as should be the linkage of quotas to past performances at times when quotas were not in operation. However, exporters with small entitlements are likely to oppose vigorously any attempt to cut these.

EEC producers were angered by the failure of the ISO to agree any interim measures, especially as lack of EEC commitment was indicated as a reason. Studies have been undertaken as to the possibility of diversion of sugar to animal feeding but already the Community's feed compounders could buy sugar at the world price if there was a market for it and the fact that they do not indicates that there is little scope for reducing the EEC surplus by this means. The Brazilians have suggested that the EEC surplus should be turned into alcohol fuel as in their country, but the economics of its conversion are against such a measure. The Community has announced that it will maintain exports at about the same level as last season but the amount of stocks to be withheld is unlikely to be known until the end of January 1983.

World sugar prices

The improvement in world prices which had brought the London Daily Price to £100 per tonne on November 1 was maintained for the first ten days of the month, partly in anticipation of positive measures hoped for from the ISO meeting, as well as the report of Peru's authorization of 100,000 tonnes of imports. Just before the ISO meeting confidence waned again and the LDP fell to £98. The value of sterling fell against other currencies and, as a consequence, the LDP, expressed in that currency, rose to £105 on November 18 and then to £108 on November 22. Afterwards the price eased to £104 but was carried upwards by strong white sugar values, to end the month at £109 per tonne.

The London Daily Price for white sugar followed the LDP quite closely during the first half of the month, the premium remaining steady around £21 per tonne. From November 16 the premium rose to £29-£30 on reports of purchases of as much as 200,000 tonnes by Mexico while the LDP(W) was further strengthened by the sale of a similar quantity of EEC whites to the Soviet Union. The indications from the EEC that sugar would be withheld from the market in 1983, as in 1982, was an additional strengthening factor, and the LDP(W) ended the month at £145 per tonne, against £121 at its start.

World sugar production, 1982/83

F. O. Licht GmbH recently published[1] their first estimate of world sugar production for the year May 1982/April 1983. So far as the European beet sugar crop is concerned, changes since the August[2] forecast involve increases in the estimates for Belgium (140,000 tonnes), West Germany (180,000 tonnes) and the UK (250,000 tonnes) partly offset by a reduction of 280,000 tonnes for Italy. Smaller changes bring the EEC forecast to 14,442,000 tonnes, raw value, against the earlier total of 14,140,000 tonnes and the 1981/82 figure of 15,982,000 tonnes. Small changes in the non-EEC beet countries of Western Europe bring the total to 19,085,000 tonnes against 18,755,000 tonnes earlier and 20,596,000 tonnes in 1981/82.

Apart from a 200,000 drop in the estimate for the USSR, changes for East Europe are very small and the total is now set at 12,050,000 tonnes against 12,210,000 tonnes in the August estimate and 10,997,000 tonnes in 1981/82. Beet sugar production outside Europe is set at 4,846,000 tonnes against 5,350,000 tonnes in 1981/82, bringing total beet sugar production to 35,981,000 tonnes against 36,943,000 tonnes.

Cane sugar output in 1982/83 is set at 61,778,000 tonnes against 62,866,000 tonnes, a rather small reduction in view of the production surplus and consequent low prices. Almost half this reduction is in North & Central America and no less than 400,000 tonnes of this is the reduction expected from the large 1981/82 crop in Cuba, with other reductions in the Dominican Republic and Mexico, and a small increase in the USA. Little change is expected in South America, apart from Brazil, where the crop is set almost 1,000,000 tonnes higher – it has been announced, however, that more cane is to be diverted to alcohol manufacture.

[1] *International Sugar Rpt.*, 1982, **114**, 529-537.
[2] *I.S.J.*, 1982, **84**, 322.

Relatively small increases are expected for many of the cane-growing countries of Africa and these aggregate to a total increase of about 500,000 tonnes, the largest contributions being those of Mauritus (133,000 tonnes) and South Africa (112,000 tonnes). In Asia, a reduction from 21,658,000 to 19,444,000 tonnes, is expected, with a 1,150,000 tonnes reduction from the mammoth Indian crop of 1981/82. Thailand is expected to produce 860,000 tonnes less in 1982/83 while other reductions are expected in Pakistan (181,000 tonnes), the Philippines (100,000 tonnes) and Taiwan (135,000 tonnes). Indonesia, however, is expected to produce 200,000 tonnes more. Increases in Australia, Fiji and Papua-New Guinea raise the total for Oceania by 100,000 tonnes. Overall, Licht sets world sugar production at 97,759,000 tonnes against 99,809,000 tonnes in 1981/82, a fall of 2,050,000 tonnes or 2.05%. It is interesting that the share of beet sugar is expected to fall from some 37.0 to 36.8% of the total; for most of the past 30 years it has been about 40%.

World sugar balance

Early in November, F. O. Licht GmbH published their first estimate of world sugar balances for the period September 1982/August 1983[1]. The production figures are not strictly comparable with those published a little earlier but the period is chosen to avoid splitting crops as much as possible. In the current period, production is set 2.6 million tonnes lower than last; nevertheless it is 4.4 million tonnes more than consumption and final stocks are expected to rise to more than 36 million tonnes or 39% of annual consumption against a level of 24% considered historically to reflect a balanced supply/demand situation.

The accumulated surplus is thus roughly 14 million tonnes or somewhat less than one year's free market trading. However, as Licht notes, consideration has already been given to setting aside rather more than the 2.5 million tonnes called for under the ISA, and the EEC sugar producers also intend to withhold substantial amounts from the market. This does bring some relief but does not rectify the chronic surplus problem, which requires a reduction in production.

	1982/83	1981/82	1980/81
	tonnes, raw value		
Initial stocks	32,358,000	24,501,000	25,239,000
Production	97,242,000	99,885,000	88,166,000
Imports	27,966,000	30,081,000	28,566,000
	157,566,000	154,467,000	141,971,000
Exports	28,476,000	31,163,000	28,279,000
Consumption	92,817,000	90,946,000	89,191,000
Final stocks	36,273,000	32,358,000	24,501,000
" " % consumption	39.08	35.58	27.47

US corn sweetener expansion[2]

Consumption of HFCS in the US has risen consistently ever since it was introduced commercially in 1967 but last year demand for the starch-based sweetener was stimulated by a bumper maize crop and high domestic sugar prices. The 1982 maize grind was expected to total more than 535 million bushels (about 6% of the crop) against around 500 million bushels in 1981 because of the increase in HFCS manufacture, and total HFCS deliveries could total 3.1 million short tons, dry basis, against 2.7 million in 1981.

The American HFCS industry has been held in check over the last couple of years by the decision of major soft drinks manufacturers not to increase their usage at the expense of sugar for the time being, and this led to an excess of manufacturing capacity. However, in May, sugar import quotas were introduced which effectively barred cheap sugar imports and kept the internal price high. HFCS achieved a greater than ever price advantage over sugar, leading to optimistic projections of record industrial offtake in the second half of last year. While refined sugar prices in the US have risen because of the import controls, HFCS prices have fallen by 10-30% so that 42% HFCS is available at a discount of some 40% to refined sugar while 55% HFCS sells at a one-third discount against refined sugar.

EEC sugar balance, 1982/83[3]

As at mid-October 1982, the EEC Commission in Brussels estimated sugar production in the Community at 13,664,000 tonnes, white value, which is 1,355,000 tonnes or 9% less than in 1981/82. Of this total, 320,000 tonnes is cane sugar produced in France's Overseas Departments. The total of A-quota sugar for the ten member countries is 9,358,000 tonnes and that of the B-quotas is 2,242,225 tonnes, but these amounts also include the 991,000 tonnes of C-sugar from 1981/82 which was withheld from the market in 1982, and a net amount of 3,252,000 tonnes of C-sugar is therefore projected for 1982/83.

On the assumption that sugar consumption will not increase in 1982/83 the EEC will be 142% self-sufficient, with more than 6,000,000 tonnes available for export. However, it can be expected that 1,000,000 tonnes of C-sugar will again be withheld from the market (and the Community has said that exports would be about the same as the 5,100,000 tonnes delivered from the previous crop. The balance is as follows:

	tonnes, white value	
Supplies as at October 1, 1982		
Free stocks	1,311,000	
Minimum stocks	533,000	
Total stocks		1,844,000
Production	14,655,000	
Less C-sugar production	3,252,000	
Production within A- and B-quotas		11,403,000
Imports:		
(a) from ACP countries	1,305,000	
(b) from East Germany	22,000	
(c) from other countries	13,000	
(d) as sugar in manufactured goods	162,000	
		1,502,000
Total availability		14,749,000
Requirements		
Domestic consumption and chemical industry requirements	9,500,000	
Exports of sugar in manufactured goods	300,000	
Food aid (UNRWA)	6,000	
	9,806,000	
Planned stocks on September 30, 1983	1,844,000	
Total requirements		11,650,000
A- and B-sugar available for export		3,099,000
C-sugar available for export		3,252,000
Total available for export		6,351,000

[1] *International Sugar Rpt.*, 1982, **114**, 563.
[2] *Public Ledger's Commodity Week*, October 30, 1982.
[3] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 593-594.

Mechanical lubrication of cane mills

By R. H. BAKER
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Introduction

Whatever the theoretical considerations – whether tribological or others – there are three practical factors which govern lubrication design for sugar factories, whether cane or beet. To ignore them normally means to invite trouble. However, if these three requirements in the design and selection of a lubrication system are satisfied, over 90% of potential problems are eliminated before they occur.

These three considerations are:

(1) During a campaign which normally runs for several months, there must be no breakdown of the plant. The lubrication system must be designed accordingly.
(2) The conditions of operation are not conducive to complex gadgetry. "The simpler and sturdier, the better" is a good rule to follow in the design of the lubrication systems.
(3) The best lubricant is of no use, if it does not reach the moving surfaces at the right time. It is undoubtedly true that most lubrication failures investigated on this and other medium and heavy plant, were due not to the wrong kind of lubricant being used, but to the lubricant not being *where* it was required *when* it was required.

Methods of lubrication of cane mills

In the olden days, cane mills were lubricated with rising drop lubricators. Problems occurred; to obviate these heavier and stickier lubricants were used, for instance bitumastic lubricants, which were not easily washed off. However, the nature of these lubricants led to unreliability of the system. Dual-line systems were then tried and, in the absence of more suitable equipment, are still used by some American mill manufacturers. Dual-line systems operate on hydraulic, i.e. pressure principles. They have serious disadvantages when applied for cane mill lubrication.

One of these is that, in practice, it is almost impossible to arrange for a pumping cycle of less than 2½ minutes, whereas the journal bearings of a cane mill require either continuous application of the lubricant or application cycles of no more than 15 seconds. In 2½ minutes a bearing can be well on its way to "firing up." In addition, in the case of a top bearing that has run really hot, the lubricant will run off the shaft, down the cheeks and be lost. Comparatively large amounts of lubricant and relatively long intervals do not solve this problem. The old saying "little and often" applies more to cane mill lubrication than to most other plants.

Another shortcoming of the dual-line system lies in its pressure operation. In other words it does not lubricate bearings progressively and in rotation. It serves the bearing with the least resistance first, then builds up pressure and feeds last those requiring the lubricant most. The pressure has to be set high – which increases the time cycle. If set too low, one or several of the most important bearings may not receive any lubricant before the cycle is reversed.

The operation of each outlet can, of course, be checked by the tell-tale operation of the distribution blocks. However, on a 21 roller 84-inch mill, there can be 84 tell-tales to watch. Which plant or shift engineer is likely to check all 84, every shift, especially when a cycle takes 2½ minutes? No, the first sign of trouble is usually a hot bearing.

Direct feeding lubricators do not suffer from these disadvantages. They operate on a "positive volume" principle and are not pressure-dependent. In other words, a plug of lubricant is put into a pipe, which leads from the pump to the point to be lubricated, and gets there irrespective of pressure resistance, and independent of the pressure in all other lines.

Because the FWA lubricator operates without spring or valves, and on a positive displacement principle, it has been found highly suitable for operation in hot and/or wet and/or dirty conditions – not only on cane mills, but also in cement works, iron works, steel mills, and heavy cranes and other applications. It has become the most popular lubricator for cane mill lubrication largely because of its reliability and simplicity, two not wholly unconnected features.

R. H. Baker

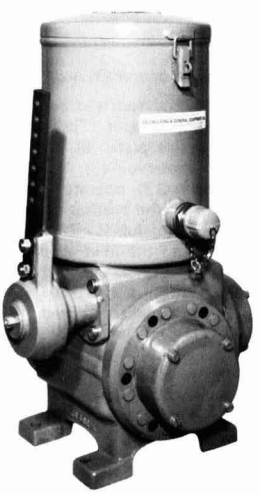
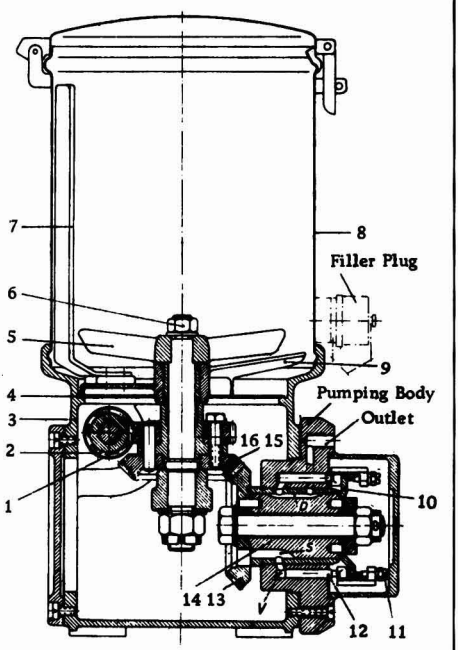


Fig. 1. FWA lubricator



1. Wormwheel
2. Worm
3. Main Body
4. Strainer
5. Fixed Paddle
6. Nut
7. Scraper
8. Container
9. Wedge Plate
10. Cam Plate
11. Adjusting Screw
12. Feed Plunger
13. Bevel Gear
14. Distributing Sleeve
15. Bevel Gear
16. Carrier Sleeve

Fig. 2. Diagram of FWA lubricator

Principle of operation of the FWA direct-feed lubricator

The lubricant is fed from the container (8) by the action of the rotating scraper (7), the fixed paddle (5) and the rotating wedge plate (9), through strainer (4) into the main body reservoir (3). Up to a maximum of twelve feed plungers (12) operate in rotation in each pumping body. During the suction stroke a feed plunger (12) draws a quantity of lubricant through the holes in the bevel gear (13) into the inlet groove (S) in the distributing sleeve (14) and then into the feed plunger inlet port (V); during rotation of the distributing sleeve (14) its outlet groove (D) connects the feed plunger inlet port (V) with the outlet port, and the plunger concerned makes its delivery stroke, thereby forcing the lubricant into the channel leading to its respective outlet. This procedure is repeated for each plunger. The lubricator is supplied with 1, 2 or 3 pumping bodies, depending on the number of outlets required.

Lubricant and application

The purpose of a lubricant in a rolling bearing is usually to keep extraneous matter out. Most bearing failures reported are due to dirt, water and other matters finding their way into the bearing and not due to a lack of lubrication or to the wrong lubricant.

The best way to avoid trouble is to find a good, water-resistant grease, say a calcium- or lithium-based lubricant of No. 2 consistency and feed sufficient to provide a small grease "collar" at the outside of the bearing, which will act as an excellent seal.

The old view that too much grease can damage a rolling bearing applies to small, high-speed bearings (e.g. on electric motors) but not to the type of bearing used on cane mills. Seals – if any – have to face outwards, so as to prevent pressure build-up in the bearing and facilitate the formation of a grease collar.

Concerning lubricant application, industrial mills and the conditions under which they operate must be considered individually. However, as a general guide, for lubrication of the plain bearings (journal bearings) of cane mills, a pump should be selected that gives output as per the chart below, and a safety factor of 2 should be allowed – if conditions are very difficult this factor could be 4. The output of such an outlet is, of course, capable of being reduced from maximum to zero and can be set as required. Generally one feed per bearing is used for 66-inch or smaller mills and two feeds for 72 and 84-inch mills.

Lubricator drive

Practices here vary: some operators prefer a motorized unit. If this is selected, a geared unit, driven by a 1 h.p. (sometimes ½ h.p.) motor, totally enclosed and continuously rated, is supplied.

Other operators prefer to mount the lubricator on the headstock, so that the drive shaft is at the same level as the top roller. The lubricator can then be driven via two sprockets, the driver bearing fixed to the end of the mill pintle.

In certain cases, it is not possible to arrange the drive from the top roller, in such cases the lubricator can be mounted between the two bottom rollers and driven from either the feed or the discharge roller.

However, this is a dirty place and contamination easily occurs when the lubricators are filled and when the mill cheeks are hosed down with water.

When chains and sprockets are used to drive the lubricator, ½-in x ⅜-in chains should be the minimum – ½-in x ⅛-in chains have been found to be too light.

Container and pipes

Containers holding 30 kg (66 lb), which can be filled using a transfer pump via a filler plug in the container, are recommended.

Piping of ⅜-in o.d. (or 10 mm o.d.) by 16 gauge, in copper or brass, is suitable. It is important to lay the pipes in a good engineering manner, using clips that prevent whipping, and to use double-ended connectors.

Check valves near the bearings are preferred by some users. Some others also use Tee-pieces with bayonet-type grease nipples, through which additional grease may be pumped into the bearings in the case of emergency.

Button-head and hydraulic-type nipples should not be used, since the pressure generated by the grease gun can be so high as to push out the peening that retains the spring and ball valve. In such case the spring and ball will be pushed into the bearings and may cause severe damage; this cannot occur with the bayonet type of nipple.

For pipes running from the pintle to the gear side of the mill, it is strongly advisable to run these through 2-inch pipe, with unions at either end.

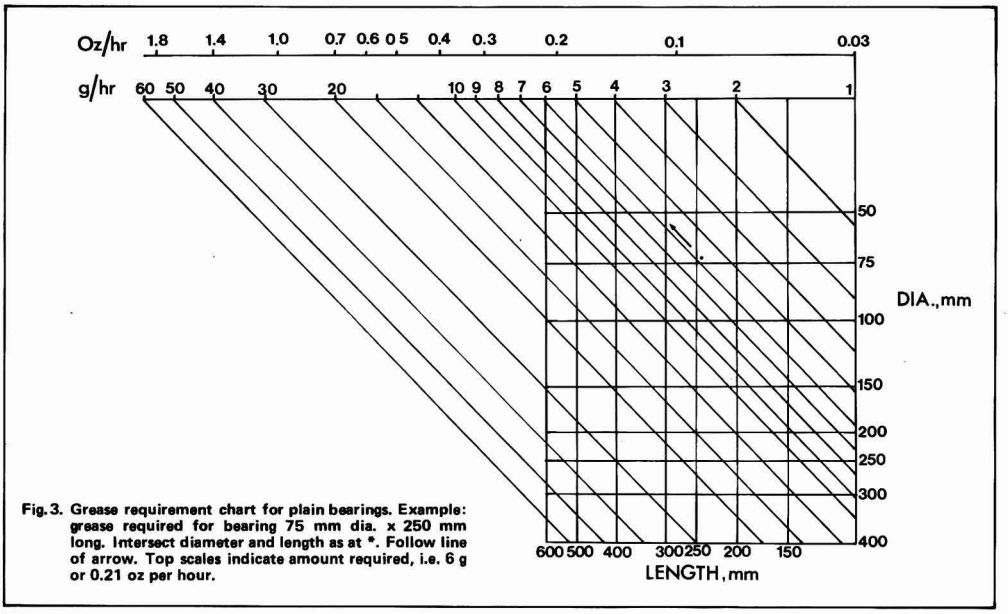


Fig. 3. Grease requirement chart for plain bearings. Example: grease required for bearing 75 mm dia. x 250 mm long. Intersect diameter and length as at *. Follow line of arrow. Top scales indicate amount required, i.e. 6 g or 0.21 oz per hour.

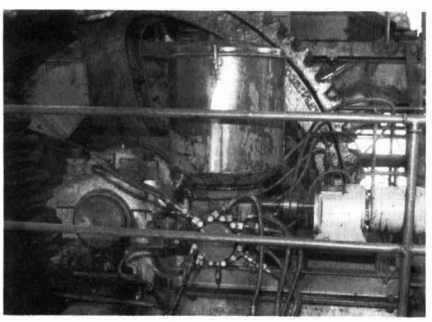


Fig. 4. Central lubrication of gearing of a 5-tandem cane milling train

Inspection

For any hydraulic or pressure operated system, e.g. dual-line systems, flow indications are necessary. However, in practice, they require a great deal of attention. For instance, as has been described above, on an 84-inch mill when there are 84 tell-tales, a shift engineer cannot be expected to check these frequently. Practice has shown that where a direct feeding lubricator is used, i.e. a positive volume system, its reliability is such that no indicators are required. The oil/grease, once in the pipeline, is bound to get into the bearing with which the outlet is connected — unless there is a fracture of the pipe, which is easily detected but which is a very rare occurrence if pipes are laid properly.

Maintenance

Filling the container from below, via the filler plug, is always advisable. It will prevent dirt from getting into the grease, thus protecting the lubricator and the bearings.

At the end of each campaign, the lubricator should be stripped and washed in kerosene (paraffin).

It is highly recommended that the following spares are kept:—

At least 1 or 2 spare pumping heads per mill
1 drive unit
1 set worm and worm wheel parts

The importance of effective lubrication of cane mills cannot be over-estimated. It is for this reason that the writer of this paper, with many years of experience in designing and supplying automatic dual-line systems throughout the world, considers the lubrication requirements of cane mills are best and most reliably achieved by using FWA direct feeding systems, thus ensuring that lubrication is assured throughout the campaign.

Summary

Aspects of cane mill lubrication are discussed, including the method, lubricant and its application, lubricator drive, container and pipes, inspection and maintenance.

Lubrification mécanique des moulins

On discute les aspects de la lubrification des moulins à canne, comprenant la méthode, l'agent de lubrification et ses applications, le système d'injection, réservoir et conduites, son inspection et son entretien.

Mechanische Schmierung von Rohrmühlen

Aspekte der Rohrmühlenschmierung werden diskutiert, einschließlich der Methode, Schmiermittel und ihre Anwendung, Schmiergeräteantrieb, Behälter und Rohre, Inspektion und Wartung.

Lubricación mecánica de molinos de caña

Se discuten aspectos de lubricación de molinos de caña como el método, lubricante y su aplicación, accionamiento del lubricador, envase y tubería, inspección y entretenimiento.

Gypsum and other pulp pressing aids*

By M. SHORE, J. A. ADAMS, N. W. BROUGHTON,
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PART I

Introduction

The ever-increasing cost of fuel for drying pulp is a stimulus to improving the efficiency of pulp pressing because it is considerably cheaper to remove water by mechanical means than by evaporation in a dryer[1,2].

This paper is based on studies in which simple inorganic compounds were added as aids to pulp pressing at the King's Lynn factory of British Sugar. Particular attention was paid to the use of gypsum, which is a hydrated form of calcium sulphate.

Such pressing aids are usually cheap to use and, as demonstrated in this paper, can cause a marked increase in pressed pulp dry substance. The consequent saving in fuel cost may be partially offset by the effects of these additives on molasses production, and this aspect of their use has been considered. Using analytical data from the factory studies about the distribution of the added cations and anions between pulp and juice, it has been possible to make corresponding allowance for such effects in costing the benefit from using these pressing aids.

King's Lynn diffuser operations, 1981/82 campaign

The RT2 diffuser at King's Lynn factory was operated in a virtually sterile condition throughout the 1981/82 campaign by shock addition of formaldehyde solution and maintenance of adequate temperatures, such that lactic acid concentrations in circulation juice were typically less than 20 mg/litre. Sucrose loss by fermentation was thus negligible in the diffuser. Table I below shows typical lactic acid concentrations[3] based on daily analyses throughout the campaign by the factory laboratory staff using a new, headspace, gas chromatographic technique[4] which is simple, quick and accurate.

To promote good and consistent pressing in these conditions, sulphuric acid was added not only to diffusion supply water, but also to midbay juice, in accordance with principles previously described[5,6]. For supply water acidification, 77% w/w sulphuric acid was pumped directly into diffusion supply water at a rate controlled to give a steady value in the range pH_{20} 5.5-5.9. Midbay juice was acidified to pH_{20} 5.5 in the region of compartment 15 by continuously pumping dilute sulphuric acid containing about 7 g actual H_2SO_4/100 cm^3 into compartments 12 and 13 of the diffuser at a rate of about 30 gallons (135 litres)/100 tonnes beet sliced.

Table I. Typical lactic acid concentrations in King's Lynn juices

Sample	Lactic acid (mg/litre)	
	Typical value	Typical range
Circulation juice	18	10 - 25
Diffuser midbay juice	16	8 - 22
Diffusion supply water	9	4 - 16
Pulp press water	15	8 - 30

A total amount of 22 kg 77% w/w sulphuric acid/100 tonnes beet sliced was used for diffuser acidification in the 1981/82 campaign at King's Lynn. Of this, about 13 kg/100 tonnes beet sliced were added to the diffuser midbay as described, and the rest to diffusion supply water.

The almost invariant diffusion pH conditions in which these measures resulted promoted the maintenance of a constant slice rate. The combined effect of steady slice rate and steady pH conditions was the generation of a steady flow to the presses of wet pulp of consistent and good pressability. Conditions were therefore well suited to quantifying the effects of various pressing aids on pressed pulp dry substance.

The diffusion system, with formalin and acid addition points, is shown schematically in Figure 1.

King's Lynn press station, 1981/82 campaign

The factory has six Stord presses as detailed in Table II below.

Each press was fed with wet pulp down an 8.7 m feed chute. The speeds of the last two presses in the line were automatically adjusted by means of a sensor in the feed chute of the last press, No. 6, so that all the presses were full. Excess wet pulp, if any, was diverted to the pressed pulp feed to the dryers.

Pressing aids could be introduced by addition either to diffusion supply water between the head tank and the diffuser or to exhausted cossettes after draining and prior to pressing.

* *Paper presented to the 26th Technical Conference, British Sugar plc*, 1982.

1 Anon.: *Stord Bartz Review*, 1978, **4**, 19-22.
2 Cronewitz: *Zuckerind.*, 1980, **105**, 129-139.
3 Harvey *et al.: Paper presented to British Sugar 45th Works Managers Conf.*, 1982.
4 Shore *et al.: I.S.J.*, 1982, **84**, 163-168.
5 Oldfield *et al.: ibid.*, 1977, **79**, 126-130, 157-162.
6 Idem: *Sucr. Belge*, 1979, **98**, 109-116.


M. Shore


J. A. Adams


N. W. Broughton


N. Bumstead


G. C. Jones

Table II. Pulp presses at King's Lynn factory

Press No.	Press type	Press speed, rpm	Press horse power
1	BS 64S	3.25 fixed	100
2	BS 64S	3.25 fixed	100
3	BS 64	3.57 fixed	100
4	BS 64S	3.25 fixed	100
5	BS 64	1-5 variable	40 - 120
6	BS 64	1-5 variable	40 - 120

PRESSING AIDS AND THEIR EFFECT ON PRESSED PULP DRY SUBSTANCE

Gypsum

Calcium chloride has been used as a pressing aid in British Sugar since the 1956/57 campaign[7, 8], but there has been much recent interest in use of gypsum as an alternative source of calcium ions. Gypsum is a slightly impure grade of calcium sulphate dihydrate, $CaSO_4$, $2H_2O$, which has the advantage that it is less than half the price per tonne of calcium than calcium chloride. It also makes a smaller extra quantity of molasses than calcium chloride, as discussed below.

Assurances were sought from the supplier about the amounts of trace elements such as copper, arsenic, lead and flurine in the grade of gypsum used at King's Lynn factory as these elements are subject to statutory controls in feedingstuffs[9-11]. Gypsum application as at King's Lynn factory would not increase the concentration of any of these trace elements in shredded pulp above its statutory limit, even if all the added amount were to be absorbed by the pulp.

Table III below shows the typical composition of the grade of gypsum used at King's Lynn on the basis of analytical data from the supplier.

Table III. Typical gypsum composition

Component	Typical Proportion (% w/w)
Free water	0.20
Solids	99.80
$CaSO_4, 2H_2O$	99.00
$CaCO_3$	0.25
Clay	0.55
Ca	23.10
SO_4	55.20

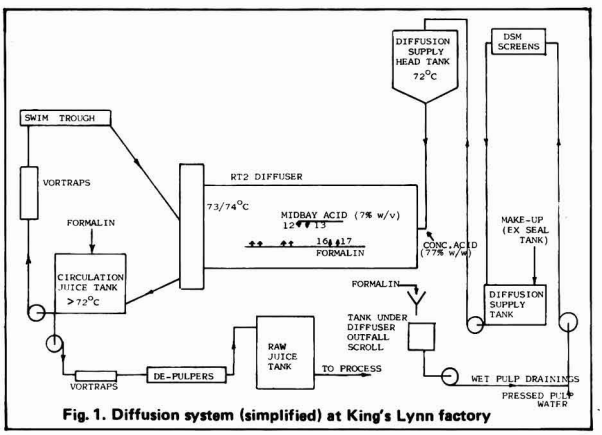


Fig. 1. Diffusion system (simplified) at King's Lynn factory

Gypsum addition system

The technique of adding calcium chloride to wet pulp as a 36% w/w solution containing about 175 g calcium/litre is not suitable for gypsum as the solubility of the latter chemical was found by experiment to be only about 0.6 g calcium/litre. King's Lynn management decided upon a system that added gypsum as a slurry to diffusion supply water in the expectation that the powder would all dissolve in the water end of the diffuser, thus making all of the added calcium available for interaction with the exhausted cossettes.

The system is shown schematically in Figure 2. In essence, a batch of gypsum suspension sufficient for at least one shift was prepared by adding gypsum to water in a mixing tank where the gypsum was kept in suspension by compressed air and a stirrer. The total calcium content of samples of the suspension was determined after acidification with excess nitric acid to dissolve all the gypsum; results indicated that the suspension contained 3.5% w/v calcium, i.e. approximately 15% w/v gypsum. The suspension was pumped continuously round the recirculation system up to the level of the diffusion supply water head tank and back to the mixing tank, and was bled at the required rate into the outlet of supply water head tank through a Doppler flow meter and control valve. The standard rate was 16 litres.min^{-1}.

Gypsum addition and pressed pulp dry substance

Using the technique described above, gypsum was added routinely at King's Lynn factory for most of the second half of the 1981/82 campaign. The average addition rate was 72 kg gypsum/100 tonnes beet sliced, i.e. about 16.6 kg calcium/100 tonnes beet sliced. This rate was based on one previously reported[12] for calcium sulphate as giving a worthwhile improvement in pressed pulp dry substance.

Table IV compares pressed pulp dry substances in two substantial periods of factory operations, one with, the other without, gypsum addition. The dry substances were determined by the standard factory laboratory infra-red dryer technique which had been extensively calibrated against the conventional factory 4-hour oven drying procedure.

7 Carruthers & Oldfield: *I.S.J.*, 1957, **59**, 277-281.
8 Idem: *ibid.*, 1961, **63**, 241-243, 271-274.
9 The Fertilisers and Feeding Stuffs (Amendment) Regulations 1979, U.K. Statutory Instrument 1979 No. 1617.
10 EEC Directive 74/63/EEC (as amended) on the fixing of maximum permitted levels for undesirable substances and products in feedingstuffs, O.J. L38 1974.
11 EEC Directive 70/524/EEC (as amended) concerning additives in feedingstuffs, O.J. L270 1970.

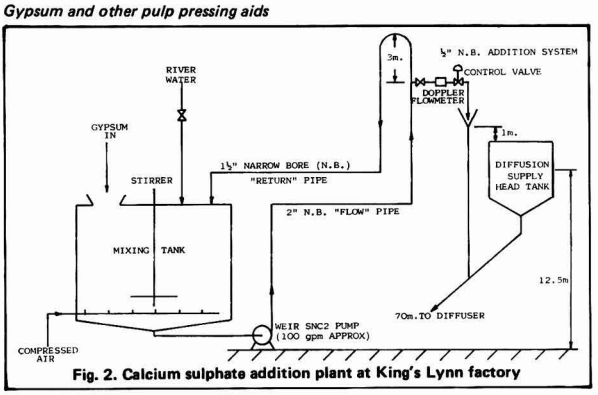


Fig. 2. Calcium sulphate addition plant at King's Lynn factory

Table IV. Gypsum addition and pressed pulp dry substance

Period	Gypsum usage, kg/100 tonnes beet sliced		Pressed pulp dry substance %	
	Mean	s.d.	Mean	s.d.
Oct. 6 – Nov. 23, 1981	0	0	19.7	0.8
Nov. 24, 1981 – Jan. 15, 1982	72	13	23.6	0.7

The use of 72 kg gypsum/100 tonnes beet sliced increased the pressed pulp dry substance by 3.9 units, from 19.7 to 23.6% dry substance. Statistical examination of other parameters which might have influenced pressing efficiency, such as diffuser midbay juice pH and slice rate, showed that these were not significantly different between the two periods.

The factory laboratory confirmed the effect of using gypsum at this rate in some studies[3] in which usage was discontinued for a day so that pressed pulp dry substances could be compared on immediately adjacent days with and without gypsum. The pressed pulp had an average 20.4% dry substance during the last two shifts on the day without gypsum, compared with 23.8% dry substance for the previous day when using gypsum at 74 kg/100 tonnes beet sliced.

For research purposes, a more detailed study was undertaken to provide comprehensive data about press performance when gypsum was in use. In these investigations, a 20-minute composite of pressed pulp was prepared for each press on 7 occasions over a 25-hour period. The dry substance of replicate portions from each composite was determined by drying for 16 hours at 110°C. The dry substances of composites of fresh cossettes and exhausted cossettes as discharged, collected over the corresponding 20-minute periods, were also measured. The performance of the presses was monitored at these times by recording the current taken by the motor driving each of the four fixed-speed presses (Nos. 1-4) and the speeds of rotation of the two variable-speed presses (Nos. 5 and 6). The mean dry substance data are recorded in Table V. Over the period of these analyses, gypsum addition to supply water remained steady at 74 kg/100 tonnes beet sliced. The slice rate only fluctuated over the range 205-214 tonnes.hr^{-1} during this time and the mid-diffuser juice was of pH_{20} 5.3-5.6.

These findings confirmed the factory observations. Individual composites of pressed pulp were in the range 22.4-25.0% dry substance and the mean for all 42 composites was 23.7% dry substance with standard deviation 0.7% dry substance.

It was interesting to note that the first press in line tended to produce the driest pressed pulp. Also, the third press produced a lower dry substance pulp than either of the adjacent presses, which were of rather slower speeds; this effect of press speed is, of course, well established[13-15].

Throughout the period of these measurements the six presses coped with the total wet pulp feed, the variable-speed presses operating at 2.7-3.7 rpm. All the pressed pulp produced was dried in conventional rotary dryers after molasses addition.

Table V. Pressing data for gypsum addition to supply water (December 30/31, 1981)

Material	Dry substance, %	
	Mean	s.d.
Fresh cossettes	22.2	0.4
Exhausted cossettes	9.7	0.2
Pressed pulp:		
Press 1	24.6	0.4
2	23.0	0.3
3	22.8	0.3
4	23.6	0.3
5	24.3	0.5
6	23.9	0.5

The relative effects of midbay acidification and gypsum addition on pressed pulp dry substance

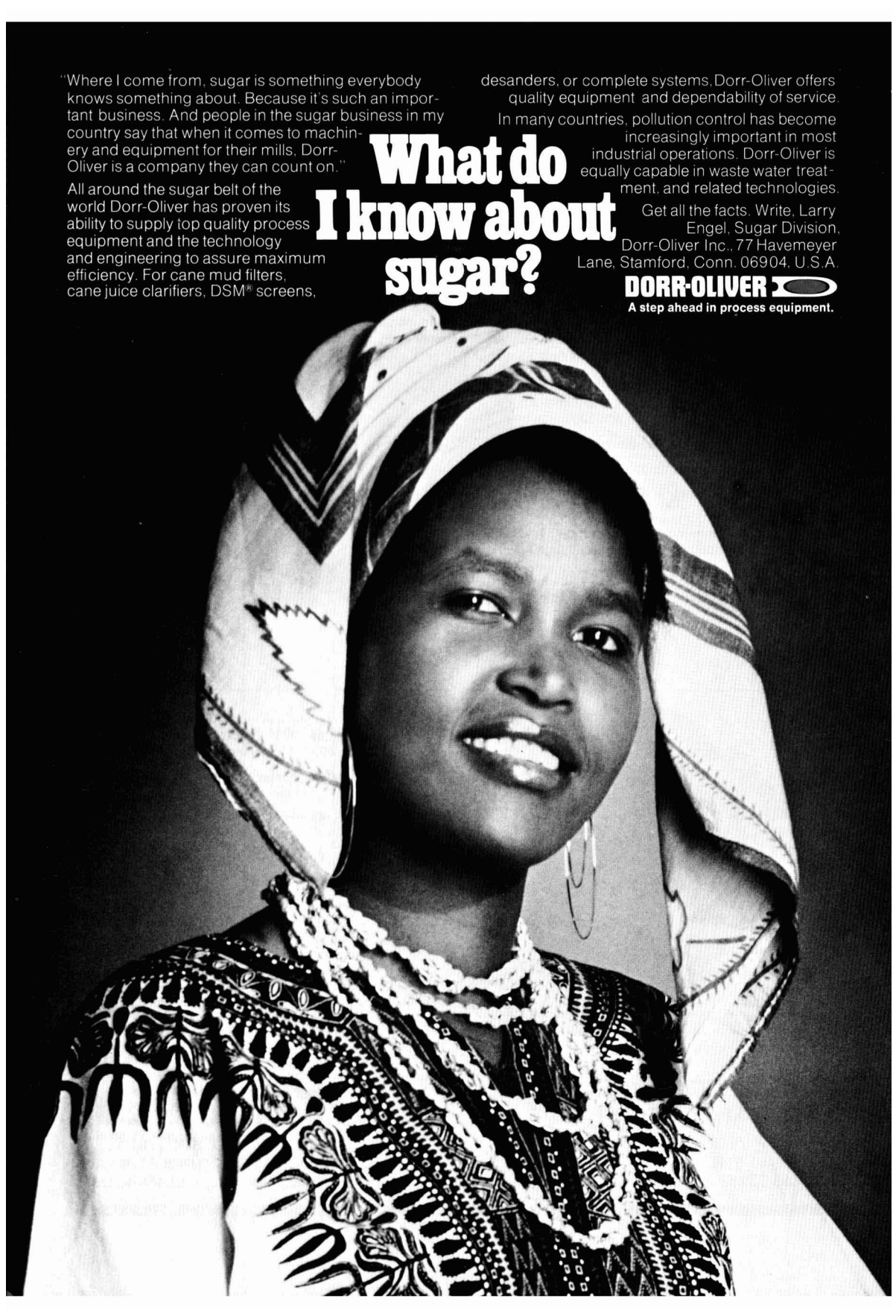
The relative effects on pressed pu.p dry substance of the midbay acidification described above and of gypsum addition at the standard rate were investigated under four different operating conditions:

(a) sterile diffusion with standard midbay acidification and standard gypsum addition to supply water,
(b) sterile diffusion,
(c) sterile diffusion with standard midbay acidification, and
(d) sterile diffusion with standard gypsum addition.

Conditions (a) were normal operating conditions; results for these were measured on three separate days after the factory had been operating steadily for at least 16 hours. On each of these days, a change was then made to one of the other operating conditions by discontinuing the appropriate addition (midbay acid, gypsum or both), and results for the new conditions were monitored for several hours before reverting to conditions (a).

Dry substances were determined on 20-minute composites of fresh cossettes, exhausted cossettes as discharged, and pressed pulp from each press, by drying

12 Rousseau & Carrière: *Sucr. Franç.*, 1979, **120**, 301-309.
13 Lloyd & Snaith: *Paper presented to the 18th Tech. Conf., British Sugar Corp.*, 1966.
14 Mathismoen: *Zuckerind.*, 1981, **106**, 965-981.
15 Morrish: *Paper presented to the 12th Tech. Conf., British Sugar Corp.*, 1959.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replicate portions for 16 hours at 110°C. pH values for supply water (DSW), midbay diffusion juice and pulp press water (PPW) were determined at hourly intervals by the factory laboratory. Slice rate was also monitored.

Results for the various investigations are summarized in Table VI. Sets of 20-minute composites were collected at intervals for up to 8 hours, and it was apparent from these results that the new dry substance equilibrium was reached about 4 hours after changing from conditions (a) to one of the other conditions. Therefore, only the results for the last set of composites in each case are shown in Table VI. It was only for conditions (b) that this last set may not have corresponded with attainment of the new equilibrium, although undoubtedly close to it.

Table VI includes the mean dry substances (D.S.) of pressed pulp (P.P.) from presses 1-4 (fixed speed) and presses 5 and 6 (variable speed) for each set of conditions, and other relevant data.

The results obtained for the three repetitions of conditions (a) were similar and in good agreement with those found typically for these conditions. The pH values were in accordance with the factory targets and showed only slight variation. The pressed pulp samples were all above 22.8% dry substance, the mean for the composites being 23.8% dry substance.

When both midbay acid and gypsum were discontinued, i.e. conditions (b), all the pH values increased markedly. The dry substance of the exhausted cossettes decreased, despite an increase in dry substance of fresh cossettes, and pressed pulp was only about 19% dry substance. As commented above, these results for conditions (b) may not quite have been the equilibrium values, and it is possible that the true pressed pulp dry substance at equilibrium without midbay acid and gypsum would have been slightly lower than recorded here.

The use of midbay acid only, i.e. conditions (c), gave rather similar pH values to those for conditions (a), but exhausted cossettes and pressed pulp were of low dry substance relative to conditions (a). The pressed pulp samples were about 19.5-20.5% dry substance, and comparison of these values with those for conditions (b) shows the benefit of the midbay acid.

The addition of gypsum only, i.e. conditions (d), gave considerably higher pH values than conditions (a). As would be expected, these values were similar to those for conditions (b), as no midbay acid was used in either (b) or (d). The exhausted cossettes were again of lower dry substance than in the corresponding conditions (a). The pressed pulp samples were of comparable dry substances to those for conditions (c), i.e. midbay acid only.

The measured changes calculated from Table VI are given in Table VII.

Table VI. Midbay acidification, gypsum addition and pressed pulp dry substance

Operating Conditions	Slice rate, tonnes. hr^{-1}	Dry substance, %		pH 20			Press			Mean P.P. D.S., %
		Fresh cossettes,	Exhausted cossettes	Midbay juice	PPW	DSW	Nos.	Mean motor current, amp	Mean speed, rpm	
(a) Normal	196	21.7	9.5	5.4	5.5	5.3	1-4	66	3.33	23.5
							5,6	-	2.0	26.0
(b) Neither acid nor gypsum	179	22.5	9.0	6.3	6.4	5.9	1-4	51	3.33	18.9
							5,6	-	4.1	18.8
(a) Normal	215	22.3	10.3	5.4	5.5	5.6	1-4	64	3.33	23.4
							5,6	-	2.95	23.7
(c) Acid only	217	21.9	9.4	5.6	5.8	5.2	1-4	56	3.33	20.8
							5,6	-	5.0	19.7
(a) Normal	216	22.1	10.3	5.5.	5.4	5.4	1-4	64	3.33	23.9
							5,6	-	3.65	24.2
(d) Gypsum only	217	21.4	9.9	6.4	6.1	5.9	1-4	50	3.33	20.5
							5,6	-	5.0	19.4

Table VII. Pressed pulp dry substance changes with midbay acidification and gypsum addition

Change in operating conditions	Decrease in exhausted cossette D.S. (units of D.S.)	Press No.	Decrease in mean P.P. D.S. (units of D.S.)	Decrease in mean press motor current, amp	Increase in mean press speed, rpm
(a) to (b)	0.5	1-4	4.6	15	-
		5,6	7.2	-	2.1
(a) to (c)	0.9	1-4	2.6	8	-
		5,6	4.0	-	2.0
(a) to (d)	0.4	1-4	3.4	14	-
		5,6	4.8	-	1.4

[16] Genotelle & Carrière: *Ind. Alim. Agric.*, 1974, **91**, 925-929.

These results show clearly that any change from addition of both midbay acid and gypsum resulted in a considerable decrease in pressed pulp dry substance. This decrease was markedly greater for the variable-speed presses than for the fixed-speed presses, and the additional factor here was the speed increase needed to handle all the wet pulp under any conditions other than normal. Exhausted cossettes contained more water under such conditions.

As was expected from previous investigations[5,16], discontinuation of both midbay acid and gypsum gave a bigger reduction in pressed pulp dry substance than stopping only one of the two additives. Indeed, the effect of using both additives was found to be greater than the sum of their separate effects. Thus, the pressed pulp was 18.9% dry substance when neither additive was in use, 20.1% dry substance for gypsum only, 20.5% dry substance for acid only and 23.8% dry substance for both additives, so that, whilst the combined effect was an increase of 4.9 units of dry substance, the sum of the separate effects was 1.2 + 1.6 = 2.8 units of dry substance. As mentioned above, the mean dry substance with neither additive may have been slightly above the true equilibrium value, but it would have had to have been 16.8% dry substance for the two separate effects to add to the same value as the combined effect.

(To be continued)

A quantitative method for dextran analysis*

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Introduction

Dextran is an α-1,6 linked glucose polymer with random α-1,3 and α-1,4 branching. It is produced from sucrose by a large number of micro-organisms[1]. The most prevalent of these is *Leuconostoc mesenteroides* which is generally the source of the dextran in sugar cane products. The presence of dextran in sugar represents not only a loss of sucrose but also an increase in substances which cause problems in the manufacturing and refining processes. Imrie & Tilbury[2] published an excellent review of dextran formation and the problems it causes in process.

A method was devised by Nicholson & Horsley[3] for the determination of dextran and revised by Hidi *et al.*[4] This method is commonly known as the alcohol haze method, or CSR method[5]. This is, so far, the only method suitable for practical factory control analysis but it has a number of shortcomings. It is not specific for dextran and the results obtained are dependent upon the molecular weight of the dextran in the sample, and the molecular weight of the dextran used as standard.

This report describes a new quantitative method for dextran in which all the polysaccharides are separated from the sugar and the dextran is selectively precipitated with alkaline copper sulphate[6]. The dextran in the precipitate is then determined colorimetrically[7]. Neither starch nor the indigenous sugar cane polysaccharide (ISP) is precipitated by copper sulphate and therefore does not interfere in the method. Protein and salt do not react with the colorimetric reagents. The method is fairly rapid, the results are reproducible and independent of the molecular weight of the dextran. Because the dextran is separated from the sugar sample, this test is suitable for use in dark coloured liquors and syrups.

Earl J. Roberts

EXPERIMENTAL

Reagents

Absolute ethyl alcohol.

80% Alcohol: Dilute 80 ml of absolute alcohol with 20 ml of distilled water.

2.5N Sodium hydroxide solution: Dissolve 100 g of sodium hydroxide in water, dilute to 1000 ml and saturate with sodium sulphate.

Copper reagent: Prepare a stock solution by dissolving 3.0 g of $CuSO_4,5H_2O$ and 30.0 g of sodium citrate separately in small amounts of water, mix the two and dilute the mixture to 1000 ml with distilled water. To prepare the reagent dilute 50 ml of the stock solution with 50 ml of water and dissolve in this 12.5 g of anyhydrous sodium sulphate. This reagent must be freshly prepared each day.

5% Phenol solution: Dissolve 5.0 g of pure phenol in water and dilute to 100 ml.

Wash solution: To 50 ml of water add 10 ml of the copper sulphate reagent and 10 ml of 2.5 N sodium hydroxide.

10.0% Trichloroacetic acid solution: Dissolve 10.0 g of trichloroacetic acid in water and dilute to 100 ml.

2.0N Sulphuric acid: Dissolve 98 g of concentrated sulphuric acid in water and dilute to 1000 ml.

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* *Paper presented at the 1st Conference of Sugar Processing Research Inc.*, 1982.

1 Jeanes *et al.*: *J. Amer. Chem. Soc.*, 1977, **76**, 5041-5052.
2 *Sugar Technol. Reviews*, 1972, **1**, (4), 291-362.
3 *J. Agric. and Food Chem.* 1959, **7**, 640-643.
4 *Sugar J.* 1976, **39**, (2), 25-31.
5 Meade — Chen: "Cane Sugar Handbook," 10th Edn. (Wiley, New York) 1977, pp. 741-744.
6 Hint & Thorsen: *Acta Chemica Scandinavica.*, 1947, **1**, 808-812.
7 Dubois *et al.*: *Anal. Chem.*, 1956, **28**, 351-356.

Preparation of standard curve

Weigh 500 mg of dextran T2000 in a weighing dish and dry in an oven at 105°C for 4 hr. Weigh and calculate the moisture content by difference. Dissolve another sample containing 500 mg of dry solids, i.e. allowing for the moisture content, in distilled water and dilute to 500 ml in a volumetric flask to give a solution containing 1.0 mg of dextran per ml. The pre-dried dextran is not used because of the possibility of retrogradation and reduced solubility. Dilute 100 ml of this first solution to 1000 ml to give a second solution containing 0.1 mg of dextran per ml. Aliquots of this stock solution are diluted as follows:

ml stock solution	dilute to (ml)	Dextran content, mg/ml
10	100	0.01
20	100	0.02
30	100	0.03
40	100	0.04
50	100	0.05
60	100	0.06
70	100	0.07
80	100	0.08
90	100	0.09
100	–	0.10

A 2 ml quantity of the 2.5N sodium hydroxide reagent is placed in each of 10 centrifuge tubes. 10 ml of a prepared dextran solution (see above) is added and 2 ml of the copper reagent. The tubes are placed in a boiling water bath for 5 minutes to precipitate the dextran-copper complex. At the end of 5 minutes the tubes are removed and allowed to cool for 15-20 minutes. The tubes are then centrifuged at 5000 *g* for 20-30 minutes to compact the sediment so the supernatant solution can be decanted without disturbing it. Then 10 ml of the wash solution is added to each tube, and the tubes swirled to suspend the sediment in the solution. The tubes are centrifuged again; the supernatant liquid is decanted and the tubes are inverted on a blotting surface and allowed to drain for 5 minutes. The sediment is dissolved in 2 ml of 2N sulphuric acid and the solution transferred quantitatively to a 10 ml volumetric flask. A second 2 ml portion of 2N sulphuric acid is added to each tube as a wash and this also transferred quantitatively to the 10 ml volumetric flasks. The solutions are then diluted to the mark with distilled water.

Phenol-sulphuric acid colour development with dextran: 2 ml of each dextran-copper complex solution is placed in a 20 mm x 150 mm test tube. 2 ml of water is placed in another test tube for use as a blank. To each tube is added 1 ml of 5% aqueous phenol solution. Then 10 ml of concentrated sulphuric acid is added rapidly from a barrel pipette with a large-bore opening so that the acid mixes completely with the aqueous solution producing a maximum of heat. Alternatively, an automatic plastic syringe pipette may be used to add the acid. The tubes are placed in a boiling water bath for 2 minutes to ensure complete colour development[8]. When the solutions have cooled to room temperature (20-30 min) the colour is read on a spectrophotometer at 485 nm against the blank prepared with 2 ml of water. The colour readings are then plotted on graph paper. If the colour is read as % transmission it must be plotted on semi-log graph paper. If the colour is read as optical density or absorbance the values are plotted on square paper, as shown in Figure 1. The curve is used to determine the dextran corresponding to the colour measurements in the unknown solutions.

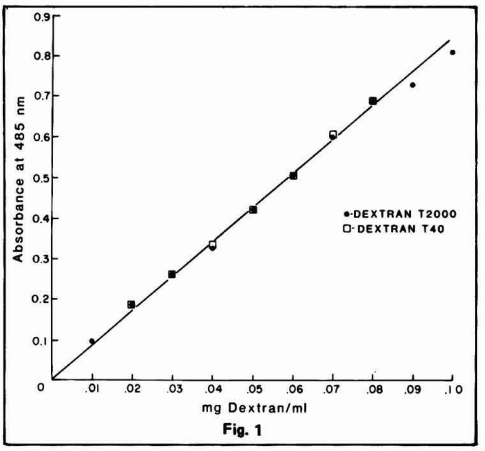

Fig. 1

Determination

Sugar and syrups: A sample of 40 g of the sugar (or weight of syrup to contain 40 g sugar) to be tested is dissolved in 60 ml of water and adjusted quantitatively to 100 ml in a volumetric flask. Then 10 ml of the sugar solution is placed in a 100 ml beaker, and 0.3-0.4 g of analytical filter aid and 40 ml of absolute alcohol are added. The precipitate which forms is collected with the filter aid on a 15 ml coarse-sintered glass Buchner filter. The precipitate, which contains the dextran, is washed by filling the filter with 80% alcohol five times, allowing each portion to be completely drawn through the precipitate before the next portion is added. When the last portion has been drawn through the precipitate, the precipitate plus filter aid is tranferred to a 25 ml volumetric flask. This may conveniently be done by first placing a long stem funnel in the volumetric flask, turning the Buchner funnel containing the precipitate upside down in the long stem funnel, filling the stem of the Buchner funnel with water from a wash bottle and blowing the precipitate and filter out. The Buchner funnel is washed with water from a wash bottle several times, allowing the wash water to go into the volumetric flask. The volume is then adjusted to the mark with distilled water and the solution is filtered through a Whatman No. 42 fluted filter paper. The dextran is in the filtrate. The dextran determination is carried out with 10 ml of the filtrate following the procedure described for the standard curve.

Cane juice: The Brix of the juice is determined and 10 ml is placed in a 100 ml beaker, 0.3-0.4 g of analytical filter aid and 1 ml of the 10% trichloroacetic acid solution are added and mixed, and 40 ml of absolute alcohol is added. The same procedure as described for sugar is then followed.

Calculation: The dextran content, in p.p.m. (mg/kg) on solids, is calculated as follows:

Weight (g) of sample solids diluted to 100 ml = A

Volume (ml) of aliquots taken for alcohol precipitation = B

Volume (ml) of solution of alcohol precipitate = C

Volume (ml) of aliquot taken for copper precipitation = D

[8] The author is indebted to Dr. Richard Kitchen of B.C. Sugar Refining Company, Vancouver, B.C., Canada, for suggesting this modification. This heating step ensures completeness of colour development.

Volume (ml) of final solution of copper-dextran complex = E
The dextran (mg/ml) from the standard curve = F

$$\text{Dextran (ppm)} = F \times E \times \frac{C}{D} \times \frac{I}{B} \times \frac{I}{A} \times 10^5$$

Example: If the dextran read from the standard curve is 0.06 mg/ml and the volumes, as described, are

A = 40
B = 10
C = 25
D = 10
E = 10
F = 0.06

then, by substituting in the formula,

$$\text{Dextran} = 0.06 \times 10 \times \frac{25}{10} \times \frac{1}{10} \times \frac{1}{40} \times 10^5 = 375 \text{ p.p.m.}$$

DISCUSSION

It is necessary for the above procedure to be followed precisely and exactly in every detail if accurate results are to be obtained. The copper sulphate stock solution is stable for several months if stored in a dark place but the copper reagent must be prepared each day. The purpose of adding the sodium sulphate to the solution is to speed up the coagulation of the copper complex. The precipitated polysaccharides in the filter aid must be washed by filling the 15 ml Buchner funnel 5 times with 80% alcohol, allowing the preceding portion to be drawn completely into the filter mat before adding the next portion. The purpose of this is to remove all of the sugar from the precipitate. The precipitate should not be allowed to sit for an extended time (more than one hour) before it is placed in the 25 ml volumetric flask. If it is allowed to dry out, as it would if left overnight, some retrogradation of the dextran may occur which could prevent it from redissolving in water.

The copper-dextran complex is insoluble in alkaline solution but slowly soluble in water. For this reason, the sediment in the centrifuge tubes should be washed with alkaline copper sulphate wash solution, rather than water, to remove any traces of sucrose which may be present and would produce added colour with the phenol-sulphuric acid reaction.

The phenol-sulphuric acid reaction is extremely sensitive to all carbohydrate materials and great care should be taken to keep the test tubes and pipette free of dust particles which may contain carbohydrate material. The test tubes used should be exactly the size specified because these large diameter tubes allow the sulphuric acid to mix rapidly with the dextran solution. The colour reaction is dependent upon the heat produced when the sulphuric acid mixes with the water. The heating step after addition of the acid ensures that colour development will be complete and results reproducible. The phenol-sulphuric acid does not react with dextran *per se* but the hot acid hydrolyses the dextran to glucose which reacts with the reagent to produce the colour. For this reason, this test analyses for all glucose units in the dextran and therefore the analysis is independent of the molecular weight of dextran used as standard.

Figure 1 shows a standard curve prepared with dextran T40 and T2000 by the copper precipitation method. The molecular weight of the standard does not affect the curve. The curve reads total weight of dextran (mg/ml) *vs.* absorbance, which is why there is no difference in the results obtained with the two dextrans of different molecular weight. However, the accuracy of the method does diminish above 0.08 mg per ml; consequently, the samples to be analysed should be diluted so that the spectrophotometer reading will be between 20% and 80% transmission.

Table I shows the recovery of dextrans in known concentrations by the copper precipitation technique. The recovery ranged from 97% to 102% with an average of 99.38%.

Table I. Recovery of known Dextran T40

Dextran taken, mg/100 ml	Dextran found, mg/100 ml	Recovery, %
0.30	0.29	96.7
0.40	0.41	102.5
0.50	0.50	100.0
0.60	0.59	98.3
	Average	99.38

Table II shows the recovery by the copper and haze methods of dextran T2000 added to solutions of refined sugar containing no measureable dextran. The recovery by the copper method ranged from 99% to 102% while the recovery by the haze method ranged from 60% to 90%.

Table II. Recovery of Dextran T2000 from refined sugar by copper and haze methods

Dextran added, p.p.m.	Dextran recovered by copper method p.p.m.	%	by haze method p.p.m.	%
375	373	99.5	225	60.3
500	510	102.0	337	67.4
625	620	99.2	524	83.8
750	750	100.0	666	88.8
1000	992	99.2	980	98.0
Average Recovery		99.98%		79.66%

Table III shows the recovery by the copper and haze methods of dextran T40 added to solutions of refined sugar containing no measurable dextran. The recovery by the copper method ranged from 96% to 103% while the recovery by the haze method ranged from 49% to 73%. The haze values for both the T2000 and T40 dextrans were read from a standard curve prepared with T2000. It is obvious that the recovery of the T40 was slightly lower than that of the T2000 by the haze method. This observation indicates that the haze method gives lower results for dextrans of lower molecular weight than for those of higher molecular weight. Results also indicate that the haze method loses accuracy as dextran levels decrease below 500 ppm.

Table III. Recovery of Dextran T40 from refined sugar by copper and haze methods

Dextran added, p.p.m.	Dextran recovered by copper method p.p.m.	%	by haze method p.p.m.	%
375	375	100.0	187	49.8
500	516	103.2	300	60.0
625	609	97.4	450	72.0
750	743	99.1	506	67.4
1000	957	95.7	730	73.0
Average Recovery		99.10%		64.44%

Table IV shows the effect of soluble starch on the copper method. Two raw sugar solutions were prepared to which 500 p.p.m. of soluble starch was added. The dextran was determined by the standard copper procedure before and after addition of the starch. It is obvious from these results that starch up to the level of 500 p.p.m. does not interfere in the method.

Table IV. Effect of starch on copper dextran method

Sugar	Dextran p.p.m. No starch added	500 p.p.m. starch added
1	1844	1846
2	388	387

Table V shows the effect of indigenous sugar cane polysaccharide (ISP) on the copper method. Two raw sugar solutions were prepared to which 500 p.p.m. of ISP was added. Dextran determinations were made on each sample by the standard copper procedure, before and after addition of ISP. It is obvious that ISP up to 500 p.p.m. does not interfere in the determination.

Table V. Effect of indigenous sugar cane polysaccharide (ISP) on copper dextran method

Sugar	Dextran p.p.m. no ISP	500 p.p.m. ISP
1	1093	1091
2	337	330

Table VI shows a comparison of the dextran values obtained when typical raw sugar samples are analysed by the copper method and by the haze method. The results show that the results obtained by the copper method are considerably higher than that by the haze method. This may be due in part to the effect of molecular weight of the dextran in the raw sugars and the variation in completeness of precipitation in 50% alcohol with molecular weight. Because the copper method determines total dextran present, it had been expected that results by this method would be higher than those from haze analysis.

Table VI. Comparison of copper method and haze method for dextran

Sugar	Dextran, p.p.m. $CuSO_4$	Haze
1	337	114
2	270	0
3	1000	443
4	388	262
5	1844	1598
6	1065	578

Table VII shows a comparison of the copper and haze methods in another series of raw sugars. The dextran determinations were made in duplicate by the copper method. The haze method values on the same samples were determined by the refinery that supplied the raw sugar samples (a sponsoring company of S.P.R.I.). Here again the values obtained by the copper method are considerably higher than those of the haze method.

Table VIII shows the results of seven repeat determinations made on aliquots of the same sample of sugar. The mean value was 1004 p.p.m., the standard deviation was ± 19.6, and the coefficient of variation was 1.95%.

Table VII. Comparison of copper method and haze method for dextran

Sugar	Dextran, p.p.m. $CuSO_4$	Haze
1	750 780	309
2	750 750	581
3	462 475	328
4	1000 1000	882
5	859 843	619
6	294 300	300
7	578 588	337

Table VIII. Repeatability of copper method on a raw sugar sample

Replication	Dextran found p.p.m.
1	1000
2	1031
3	1000
4	1031
5	984
6	1000
7	984

Mean = 1004
Standard deviation = ± 19.6
Coefficient of variation = 1.95%

It is hoped that this test will be simplified with further development. However, again it must be emphasized that the current procedure must be followed *exactly* for accurate and reproducible results.

Summary

A precise method, giving reproducible results and suitable for analysis of dextrans of any molecular weight in juice, syrup or sugar, is described. It is suitable for routine control purposes in the sugar factory or refinery.

Une méthode quantitative pour l'analyse du dextrane

On décrit une méthode précise pour l'analyse des dextranes de tout poids moléculaire. Elle donne des résultats reproductibles et elle convient pour les jus, le sirop ou le sucre. La méthode peut faire partie du contrôle de routine dans la sucrerie ou la raffinerie.

Eine quantitative Methode für die Dextrananalyse

Eine präzise Methode wird beschrieben, die reproduzierbare Ergebnisse liefert, und die für die Analyse von Dextranen jedes Molekulargewichtes im Saft, Sirup oder Zucker geeignet ist. Sie ist für die Routinekontrolle in Zuckerfabriken oder Raffinerien geeignet.

Un método cuantitativo para análisis de dextrano

Se describe un método preciso que da resultados reproducibles y que es conveniente para análisis de dextranos de cualquier peso molecular en jugo, sirope o azúcar. Es conveniente para control rutino en el ingenio azucarero o refinería de azúcar.

The Canesorb carbon/bone char system at Atlantic Sugar*

By WILLIAM F. BARTON† and WILLIAM J. KNEBEL‡

PART I

Introduction

Canesorb is a registered trademark and service associated with a new granular activated carbon and its use in admixture with bone char to attain a new adsorption system with superior decolorization capabilities. This system is covered by U.S. Patent No. 4,252,571 of the Calgon Corporation, in reference to the admixture of bone char and granular activated carbon for use in decolorizing and de-ashing cane sugar liquors§. The use of Canesorb carbon in admixture with bone char provides a mechanism for optimization of the decolorization and de-ashing requirements in accordance with the specific needs of an individual cane sugar refinery. The viability of the regeneration scheme is based on the successful low-temperature regeneration of granular activated carbon which has been continuously adopted over the past six years at the Revere Sugar Corporation, Charlestown, Mass., USA.

In early February 1979, and after extensive laboratory studies, Calgon presented the Canesorb carbon/bone char process concept to Atlantic Sugar. A joint developmental program resulted between the two organizations and further development studies on process feasibility continued and extended from the pilot column scale, through a multi-cistern plant trial to the successful full-plant scale implementation of the dual adsorbent system described in this paper.

Background

Atlantic Sugar's processing scheme is, as it has been since 1915, one of affination, phosphatation/clarification, and decolorization/demineralization by adsorption. This system is utilized with the boiling and evaporation processes for granulated and liquid sugar production, for soft sugar production and for remelts recovery.

The first major revision to the refinery was completed in the year of 1962. These modifications resulted in doubling the melt processing rate of the refinery. Specifically, the refinery acquired a new affination station, two Herreshoff kilns, a completely new granulated system encompassing the processing steps from the evaporator to the storage silos, and some new packaging equipment. Equipment and process technology in the treatment of raw sugar liquor and in the decolorization/demineralization station (i.e., the char house in itself), remained essentially the same as they had been in 1915, except for some mechanical process alterations which allowed the refinery to handle the increased melt.

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After the revisions of 1962, the quest for technological improvement continued with the primary objectives of improving overall product qualities and of reducing operating expenditures. This quest resulted in fruitful accomplishments in the following areas:

(a) Automation of the granulated sugar pans including automatic seeding in 1971; this accomplishment was made concurrently with the partial automation of a recovery pan.

(b) Modification from 30-inch deep raw sugar centrifugal baskets to 36-inch deep units in order to increase the cycle time by 12.5% without affecting throughput.

(c) Evaluation of the washed-raw sugar liquor handling systems in terms of capital investment, operating costs and quality improvement; this evaluation, which started in 1970 and concluded in 1977, resulted in the installation of the Talofloc phosphatation clarification system for raw sugar and remelt sugar liquors and a clarification process for mud sweetening-off.

(d) Evaluation of the decolorization/demineralization systems started in mid-1976; the sequence of granular carbon followed by decolorizing and demineralizing ion-exchange resins was considered initially as a possible solution to the needs of the refinery but the operating costs for the ion-exchange system alone exceeded that of the existing bone char system so that consideration of this process was discontinued in 1977. The use of individual operating systems of granular carbon and bone char was then evaluated in a joint study with Calgon. Since two kilns were already available, this process might have become an attractive alternative, and pilot studies on this sequential treatment began in 1978.

During 1977 and 1978, the Talofloc phosphatation process had proved so successful that the refinery changed from a two-char, two-kiln house to a one-char, one-kiln system in 1979. The one-char house operation used a follow-on system whereby clarified washed sugar liquor was followed by clarified remelt sugar liquor, and then by two passes of soft yellow sugar liquor.

In February 1979, Calgon introduced to Atlantic Sugar the concept of using an intimate admixture of bone char and Canesorb granular carbon as a possible substitute for the series systems of char and carbon already under evaluation. Since only minimal capital investment was involved, all char handling and revivification equipment appeared to be compatible with the new mixed-bed concept, and production liquor qualities would be potentially improved with an accompanying reduction in

* *Paper presented to the 41st Meeting, Sugar Industry Technologists,* 1982.

† Atlantic Sugar, Ltd., Saint John, N.B., Canada.
‡ Calgon Corporation, Pittsburgh, Pa., USA.

§ The word "mixture" used in this article has the same meaning as the word "admixture" used in the patent specification and has the same legal significance.

operating costs, Atlantic Sugar agreed to become involved in the evaluation of this new process. Studies were begun to evaluate this new adsorption method with the various sugar liquors from the refinery.

Feasibility studies of the process

Independently recognizing the need for greater decolorization capacities within most char houses of the cane sugar refining industry, Calgon had earlier begun an investigation into the feasibility of utilizing a blend of Canesorb granular carbon and bone char as the adsorbent for purification of cane sugar liquors. In early 1978, several laboratory column studies with bone char (BC) and Canesorb granular carbon/bone char (CS/BC) mixtures were conducted on the purification of phosphatated sugars liquors.

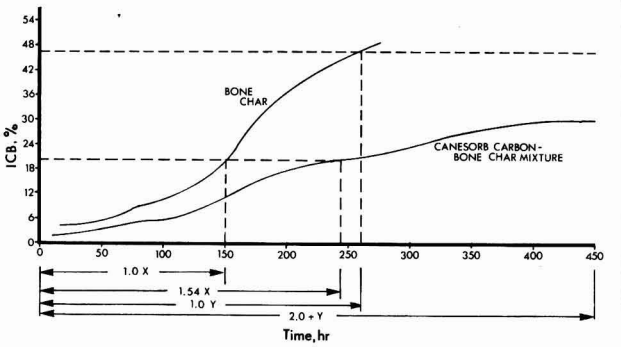


Fig. 1. Initial laboratory study on decolorization performances of bone char and Canesorb bone char mixture in terms of instantaneous colour breakthrough (%) *vs.* time (hr)

Process features: Column: 1.0 in i.d. x 20.4 ft depth
Liquor flow rate: 0.4 US gal $min^{-1} ft^{-2}$

Properties of phosphatation sugar liquor feed: Influent colour = 650 ICUMSA units
Influent ash = 0.07% (w/w)

Several test runs consisting of two parallel column studies were conducted under conditions which simulated in-plant operations, using filtered sugar liquors continuously over times in excess of 400 hours. Breakthrough curves for colour and ash levels were developed at various intermediate bed depths and at an overall 20-ft bed depth. The initial test results for colour removal showed that, over twenty feet of adsorbent bed depth, the mixture performed substantially better than the straight bone char system for colour removal at all service times (Figure 1). For an average colour removal of approximately 80% by each of the adsorbent systems, the service life for the CS/BC mixture was estimated as 1.8 times that for the straight char system.

With reference to ash breakthrough and over an adsorbent bed depth of 20 feet, the CS/BC mixture showed very similar ash removal capabilities for ash breakthrough levels up to 40%. Over significantly extended bone char service times, the bone char system gave significantly better ash removal properties than did the mixture.

The pH values of the effluents from the mixture were lower than those obtained for the effluents from straight char. Over twenty feet of adsorbent bed depth, the effluent pH from bone char was about pH 7.0 and from the mixture about pH 6.6. Sweetening-off and sweetening-on studies showed that the times required for the mixture were 30-50% longer than for straight bone char.

The initial test run with bone char and the Canesorb-carbon mixture was repeated using the same materials which had been regenerated from the previous test run. The regenerations were conducted under conditions which simulated, as closely as possible, plant operations within a char house. Over four additional adsorption cycles, the performance results were clearly consistent and repeatable in regard to colour and ash removal, pH profile, etc., with reference to each of the adsorbent media. In all cases, the mixture clearly outperformed straight bone char in sugar liquor decolorization.

Hardness, abrasion, corrosion, and segregation studies of various mixtures, of straight Canesorb carbon, and of straight bone char indicated no significant negative effects which would discount the merits of the mixed bed concept.

Pilot column studies at Atlantic Sugar

The major benefits to the refinery of the new concept had been presented to Atlantic Sugar management in February 1979 as (1) an adsorption service life of 50%-plus more than that of the existing char stock,

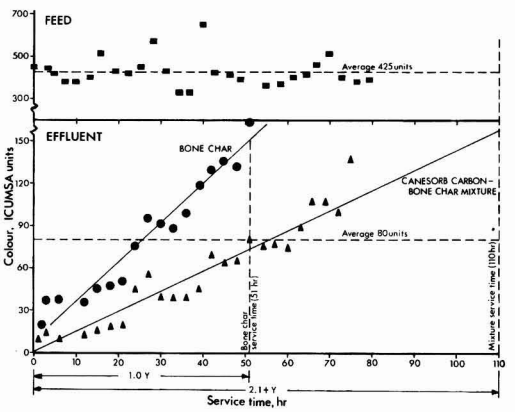
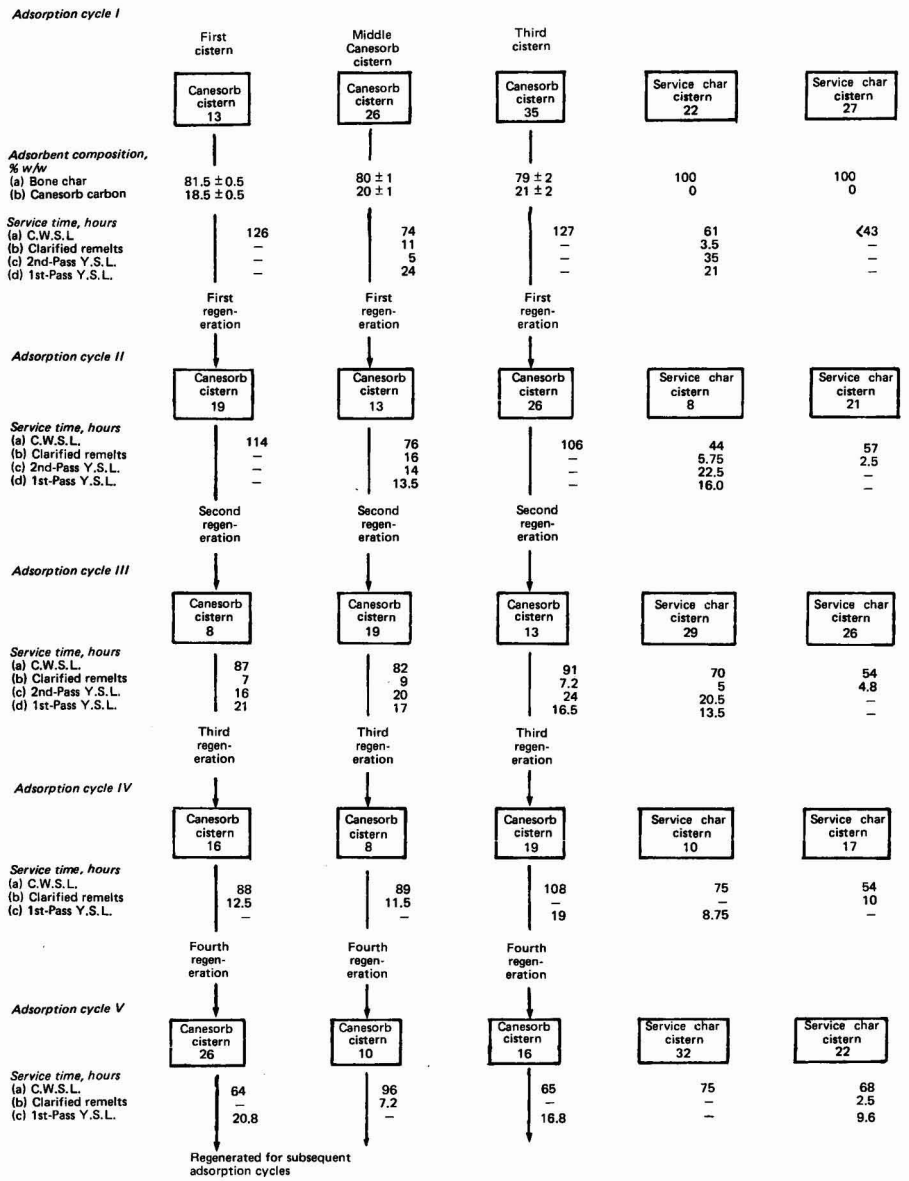


Fig. 2. Pilot study on decolorization performances of bone char and Canesorb mixture on C.W.S.L. at Atlantic Sugar Ltd.

Liquor flow rate approx. 0.4 gal.min^{-1}.ft^{-2}; superficial contact time 280 min

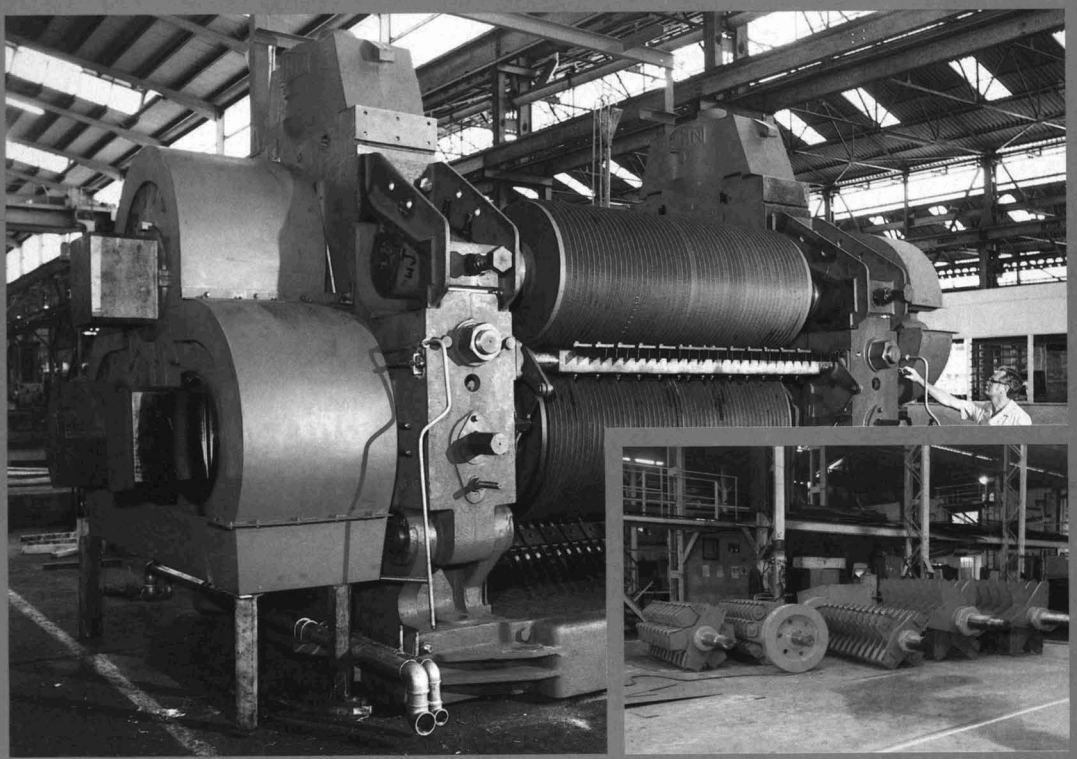


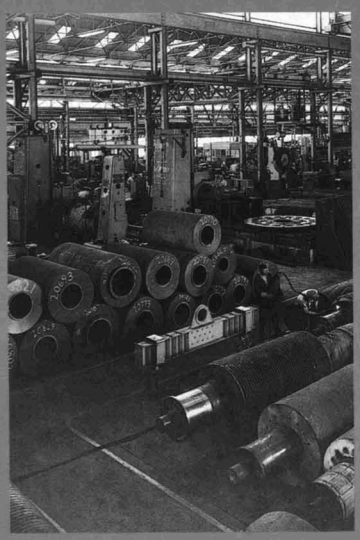
(1) Plant trial was initiated on June 28, 1979 and five adsorption/regeneration cycles were completed on August 23, 1979.

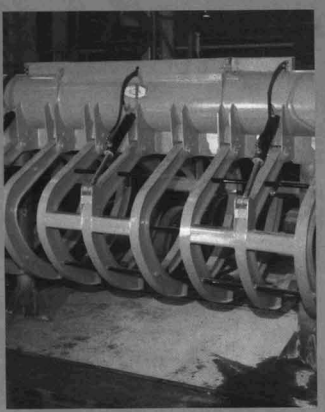
(2) Dashes denote the liquors that were not processed on the cistern.

Fig. 3. Logistics of the plant cistern trial of the Canesorb/bone char process at Atlantic Sugar Ltd.

WE RECORD OUR SUGAR ACHIEVEMENTS







Elgin Engineering Co. Ltd
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(2) a significant saving in char house operating costs, and
(3) minimal capital investment for plant implementation of the new adsorption process.

Atlantic Sugar gave its commitment to a joint developmental program in which studies would be conducted which might confirm the earlier results obtained by Calgon and/or which would determine the applicability of the new concept to Atlantic Sugar's refining operations. Specifically, the major objectives of the work were (1) to demonstrate the performance characteristics of the Canesorb carbon/bone char process on Atlantic Sugar's refinery liquors, (2) to treat successfully the various purity liquors for yellow sugar production, and (3) to regenerate successfully the mixture that was used for the sequential processing of clarified white sugar liquors, clarified remelt liquors, second-pass and first-pass yellow sugar liquors.

The pilot column work was conducted during April/ May 1979. Typical breakthrough curves from the decolorization of clarified white sugar liquors, as obtained from the pilot study, are presented in Figure 2.

The results from the pilot studies at Atlantic Sugar were essentially a confirmation of the earlier exploratory findings obtained by Calgon. The CS/BC mixture also performed significantly better than straight service char for colour removal from clarified remelt liquors, and the two yellow sugar liquors. The system's performance in de-ashing and as to product qualities (e.g., taste and odour) of the treated low-purity liquors was acceptable to the refinery management. In addition, the CS/BC mixtures could be regenerated in the laboratory under conventional bone char regeneration conditions, even when subjected to a liquor treatment sequence of white sugar liquors to the various grades of yellow sugar liquors during the adsorption cycle.

On successful completion of the pilot studies it was recommended that the evaluation program proceed to the next phase of the work, namely, that of a plant cistern trial at the Atlantic Sugar refinery.

Three-cistern plant trial

The plant cistern scale trial was initiated in late June 1979. A mixture of 20% Canesorb carbon and 80% service char by weight was prepared for three cisterns; the purification performances of the mixture were monitored during five adsorption cycles and compared with those of two reference cisterns of service bone char during each adsorption cycle. The trial was completed in late August 1979.

The major objectives of the plant trial were:

(1) to examine on a plant cistern scale the decolorization performance of the Canesorb carbon/bone char mixture by comparison with that of service bone char in processing all grades of sugar liquors,
(2) to evaluate the effectiveness of the regeneration of Canesorb carbon mixtures under bone char regeneration conditions over multiple adsorption cycles,
(3) to determine qualitatively Canesorb carbon losses on handling and on regeneration of the dual adsorbent mixtures, and
(4) to demonstrate the compatibility of Canesorb carbon/bone char mixtures with the process equipment and operating conditions within an existing char house.

A summary of the operational logistics and the process conditions is presented as Figure 3. An outline of the primary performance characteristics by the middle cistern over adsorption cycles I-V is presented in Table I. An illustration of the absolute and relative colour breakthrough characteristics of the Canesorb carbon/ bone char mixture and service bone char is presented as Figure 4.

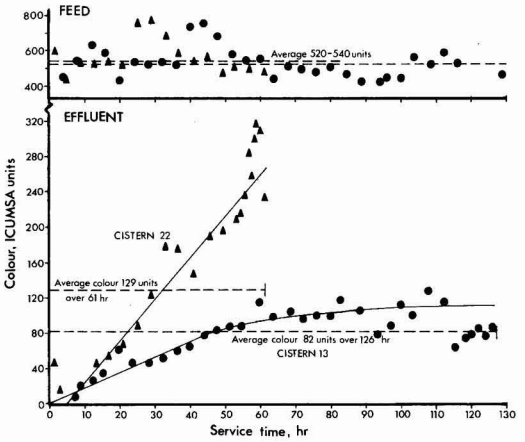


Fig. 4 Plot of influent and effluent colour *versus* service time when processing C.W.S.L. feedstocks on Canesorb cistern 13 and bone char cistern 22 during plant trial evaluation of the Canesorb carbon adsorption process (Cycle I)

The technical and engineering findings disclosed from the three-cistern plant trial were essentially compatible with those from the earlier pilot studies and may be summarized as follows:

(a) *Decolorization.* The decolorization performances of the Canesorb carbon/bone char mixtures were significantly superior to that of service bone char on processing all grades of sugar liquors. For clarified white sugar liquors, the Canesorb carbon mixtures should generate an equivalent effluent colour quality over adsorptive service times of approximately twice that afforded by service bone char. The mixture also exhibited superior decolorization of clarified remelts, second-pass and first-pass yellow sugar liquors. Results indicated that they could provide either an equivalent effluent colour quality over an adsorptive service time of approximately 1.5-2.0 times that afforded by service bone char, or approximately twice the decolorization performance of service bone char over equivalent service times.
(b) *Regeneration.* Over adsorptive cycle service times 50% longer than those of service bone char, the

colour removals from C.W.S.L. feedstocks by the middle Canesorb carbon mixture cisterns were 84%, 90%, 86%, 87% and 91% over adsorption cycles I-V, respectively (Table I). These results show conclusively that the CS/BC mixtures were successfully regenerated under bone char regeneration conditions in a Herreshoff kiln.

Table I. Decolorization and de-ashing performances by the middle CANESORB carbon cisterns and representative bone char cisterns when processing clarified white sugar liquors[1]

	Adsorption cycles									
	I		II		III		IV		V	
	CANESORB Cistern 26	Bone char Cistern 22	CANESORB Cistern 13	Bone char Cistern 8, 21	CANESORB Cistern 19	Bone char Cistern 29, 26	CANESORB Cistern 8	Bone char Cistern 17	CANESORB Cistern 10	Bone char Cistern 32, 22
Colour removal, %	84	80	90	85	86	86	87	80	91	87
Ash removal, %	23	32	16	25	30	38	19	32	19	17

[1] Service times on CANESORB carbon cisterns were 75 hours or 1.5 times the service time of representative service bone char cisterns (50 hr).

(c) *De-ashing.* The de-ashing performances of the CS/BC mixture were poorer than those of straight service char in the treatment of C.W.S.L., clarified remelt liquor, and the yellow sugar liquors (Table I). For C.W.S.L., ash removal by the mixture was 16-30% over an adsorption service time of approximately 75 hours. This was considered acceptable for existing refinery needs.

(d) *pH.* When processing C.W.S.L., the average effluent pH values from the CS/BC cisterns over 50-100% longer adsorption service times were very similar to those of the effluents from service char.

(e) *Pre-wetting techniques.* These techniques (i.e., wet-filling and dry-filling) used for service char could be successfully applied to Canesorb carbon/bone char mixtures.

(f) *Taste and odour.* These characteristics, a critical quality control property for yellow sugar were judged by Atlantic Sugar refinery personnel to be very similar for Canesorb carbon/bone char mixture and service char-treated effluents.

(g) *Other physical properties.* Mass flow properties of bulk Canesorb carbon/bone char mixtures during the adsorbent handling operations were judged to be essentially equivalent to those of service bone char.

(h) *Sweetening-off.* The times for sweetening-off to 1.0-1.5 °Brix were very similar for bone char and the mixture.

(i) *General system characteristics.* The enhanced decolorization ability of CS/BC mixtures should provide better overall process control during the adsorptive cycles especially for cases where process upsets result in higher influent colour levels.

The plant trial demonstrated that the existing char house equipment and operational practices could be applied to the new system. Consequently, the full-plant scale implementation of the process was recommended to the refinery management at Atlantic sugar.

Full-plant scale implementation of the process

Plant implementation was achieved in early 1980. The initial Canesorb carbon fill was conducted in late January/early February and was accomplished over seven operating days and during one complete turn-around of the quantity of service char stock needed for the preparation of the requisite cistern volumes of working adsorbent inventory.

After emptying several char cisterns and bagging-off the excess service char from the existing inventory within the char house, virgin Canesorb carbon was blended continuously and at a controlled addition rate with service char from the kiln. During this time the Herreshoff kiln was operated at a reduced reactivation rate of approximately 13,000 pounds of char per hour to maintain a 5-hour cistern fill time. The mechanism for the blending of the carbon with the service char during the initial-fill operation is illustrated in Figure 5.

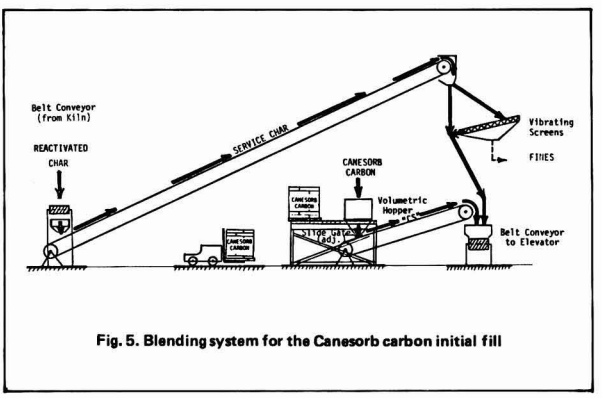


Fig. 5. Blending system for the Canesorb carbon initial fill

As soon as each working cistern was filled with the new adsorbent mixture and settled with white sugar liquor, the cistern was placed directly on-stream for the processing of clarified washed sugar liquor. Hence, the initial-fill and start-up operations were accomplished with no interruption to refinery operations. The process conditions and service times during the initial adsorption cycle for the CS/BC system were maintained similar to those used with the existing char stock in order to minimize disruptions in operation. *(To be continued)*

ICUMSA 18th Session, 1982

On p. 355 of our December 1982 issue, Recommendation 5 was inadvertently omitted from Subject 1A (Method and subject specification). After Recommendation 4, the following should have been inserted:

"5. Analysis of starch hydrolysis products should, as far as possible, be an integral part of the work carried out within the scope of existing ICUMSA Subjects. Co-ordination of analytical work in this field should again be the responsibility of Subject 29".

SUGAR CANE AGRONOMY

Yield response of three sugar cane varieties to controlled water tables. C. E. Carter. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 51-54. — Investigations on the effect of water table 2 and 4 ft below the soil surface on cane and sugar yields of three varieties showed no significant differences in results for each variety between the two water levels. In the plots of higher water table, root growth was restricted to the upper 2 ft, whereas in the other plots the roots grew deeper. In the three years of the experiments, annual rainfall exceeded the estimated cane water requirement, and was above the 55 inches classed as normal for the Baton Rouge area of Louisiana.

The effect of fertilizer potassium on quality of juice and yield from stubble cane of early maturing varieties. L. E. Golden. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 55-57. — Data were obtained at ten sites during 1972-75 to determine the effect of fertilizer K on ratoon yield and juice quality in the case of five early maturing varieties. The soils selected for the tests were those on which increases in yield are normally associated with K application. Results showed that the application of 80 lb.acre^{-1} K_2O gave an increase in sugar yield of 8.4% by comparison with the control at harvest. The total increase due to K application was generally constant throughout October and November, but the portion of increase attributable to improvement in juice quality as opposed to increased cane yield was greater early in the harvest season rather than later.

Soil physical properties and sugar cane root and shoot growth on Louisiana banks after conversion from cambered beds field layout in Trinidad, WI. L. A. Simpson and F. A. Gumbs. *Trop. Agric.*, 1982, **59**, 38-42. — In the Caribbean, sugar cane has traditionally been grown on cambered beds, which slope on both sides of a centre line to drains. With the introduction of mechanical harvesting, this system had to be converted to the Louisiana bank system of drainage in which the field is graded in one direction or in two directions at right-angles to each other. A study is reported in which soil porosity, penetration resistance, bulk density, differences in texture of the profile and chemical status were investigated in a converted field. The depth of rooting of cane stools and the height of the cane stalks were also measured at the end of the wet season and in the middle of the dry season, when the cane was 6.5 and 9 months old, respectively. Results indicated that moisture content, bulk density and penetration resistance, as measured at the lower end of the silty clay soil field, were significantly higher than before conversion, while soil porosity (particularly non-capillary porosity) was significantly higher at the top end of the field (of 0.133% gradient). These factors seemed to have contributed to a much greater rooting depth and stalk height at the higher end of the field in the wet season, and to increased stalk height in the dry season (the increase in rooting depth was not maintained). It is recommended that when similar fields having limited depths of topsoil are converted, parts of the field should not be denuded of topsoil, while drainage at the lower end should be improved.

Methods of application of glyphosate, N-(phosphonomethyl)-glycine, to eliminate sugar cane ratoons *(Saccharum* **spp.).** J. C. Rolim. *Brasil Açuc.*, 1981, **98**, 126-131 *(Portuguese).* — Treatment by three rates of application of Round-up to ratoon cane, using direct spraying through different nozzles and varying their position on the application bar, was compared with the conventional technique of overall spraying. Use of direct spraying with two Teejet 110.04 nozzles over the cane row, or two Raindrop D_2-25 nozzles in a lateral position, gave as good results as the conventional method, regardless of the dosage rate, and thus permitted a saving in the amount applied.

Effect of micronutrients in the production and quality of sugar cane in the states of Rio de Janeiro, Espírito Santo and Minas Gerais (Mata zone). Preliminary study. D. F. de Azeredo and J. Bolsanello. *Brasil Açuc.*, 1981, **98**, 163-171 *(Portuguese).* — Trials were conducted to determine the effect of B, Cu, Mn, Mo and Zn applied to soil and leaves, with and without lime, on a single variety but in three states. Cane yield was affected in only one experiment by the application of Mn with lime and Mo without. The micronutrients had no effect, with or without lime, on cane quality, apart from a depression of juice Brix in one experiment by Mo, applied without lime.

Complementation of mineral fertilization of sugar cane *(Saccharum* **spp.) with castor bean cake and Oliver filter cake.** M. A. F. Sorace, A. A. Casagrande and Z. B. Nakasato. *Brasil Açuc.*, 1981, **98**, 285-302 *(Portuguese).* The effects were examined of using castor bean cake and Oliver filter cake as supplements to a basal N-P-K fertilizer on two soil types, the quantities being up to 1240 and 1860 kg.ha^{-1}, respectively. The leaf and stalk characteristics and cane yield and sugar content were measured but no significant effect was observed, apart from that of Oliver filter cake on the juice phosphate content. Further trials with greater quantities are required.

An up-date on drip irrigation. R. J. Leffingwell. *Sugar y Azúcar*, 1981, **76**, (12), 32-33. — In a discussion on drip irrigation, it is stated that an estimated 57,000 ha of Hawaiian cane land will be provided with it by 1985, whereas the system has not been widely used in other cane-growing countries. Reference is made to experiments conducted in Australia and to the differences between conditions in Hawaii and Australia. Advantages and disadvantages of drip irrigation are also discussed.

Effects of vegetable regulators on the initial growth of sugar cane. P. R. C. Castro, A. Sanguino and C. G. B. Demétrio. *Brasil Açuc.*, 1981, **98**, 363-367 *(Portuguese).* One-eye setts of Na 56-79 cane were soaked for 5 hours in solutions of a number of growth regulators and the effects observed. Bibberelic acid at 100 ppm reduced % germination while it was increased by 0.2% Atonik. The onset of bud sprouting and inital growth were not affected by Chlormequat and Diaminozide. Agrostemmin reduced the height of cane plants as recorded 31 days after planting. Ergostim promoted the greatest height increase as recorded 65 days after planting; smaller increases resulted from application of Agrostemmin, indolyl acetic acid, 2-chloroethyl phosphonic acid, Atonik and Citex.

CANE PESTS AND DISEASES

Wilt disease in Co 1148 in the Punjab and assessment of losses caused by it. K. S. Waraitch. *Indian Sugar,* 1981, **31,** 339-341. – The incidence of wilt disease and weight loss associated with it in samples of Co 1148 cane in different factory zones of the Punjab are listed. By far the greatest incidence was 40% (resulting in a weight loss of 18%), whereas the next highest incidence was 5% (2.5% weight loss). *Fusarium moniliforme* var. *subglutinans* was found in all the isolates, but not *Cephalosporium sacchari; Acremonium* sp. was found very occasionally.

Using fungicides on mechanically harvested sugar cane seedpieces to increase yields. B. R. Eiland and J. L. Dean. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 16-19. – Tests were conducted on treatment of short (24.3 ± 5.4 cm) and long (42.2 ± 10.1 cm) setts from two varieties with Captafol or Guazatine fungicide to establish the effect of treatment and sett length on shoot emergence, final stalk population and yield. Results showed that the long setts produced more shoots, while Captafol increased the number of shoots further, and hence plant population and final yield. Guazatine gave no increase over the results without treatment. The best results were given by spraying the long setts in the furrow with Captafol at a rate of 971 ml/km (by comparison with 1941 ml/km). The yields compared favourably with those reported previously for setts planted at twice the rate studied. Further research is needed to determine the optimum levels of Captafol application.

Factors affecting the occurrence and distribution of Florida water rats in sugar cane fields. D. E. Steffen, N. R. Holler, L. W. Lefebvre and P. F. Scanlon. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 27-32. – The population and distribution of *Neofiber alleni,* one of several species of rodent known to damage cane grown in southern Florida, were determined after the 1975-76 harvest. The pest was found in 40% of fields belonging to the United States Sugar Corporation and in 80% of fields owned by Gulf + Western Food Products Inc., but appeared to be restricted to areas of high soil organic content, probably because such soils help to maintain burrow and tunnel stability. Mechanical harvesting reduced the numbers by comparison with manual harvesting, evidently because of the higher amount of trash left by the manual operation. The numbers increased with subsequent ratoon crops, so that there were fewest in 1st ratoon fields. None were found in plant cane fields, probably because of field preparation operations. Control methods are suggested by the findings.

Screening for sugar cane smut resistance in Florida – third report. D. G. Holder and J. L. Dean. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 37-39. – The smut reaction of 895 varieties or clones was tested by artificial inoculation of setts which were then planted in the field. The varieties were rated 5 months after planting, ratooned, and rated again after 5 months. Of 38 commercial varieties in Florida, 26 were rated as resistant or intermediate; 12 varieties grown in Louisiana were also found to be resistant. Of the total of 895, 62% were resistant or intermediate.

Viability of sugar cane smut spores in a Florida organic soil at three moisture levels. H. J. Andreis. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 44-46. – Spores of *Ustilago scitaminea* were stored in a desiccator for 3 months and then mixed with soil of 16.5%, 60.9% or 129.9% moisture content *(sic)* and spore counts made at intervals. Germination fell rapidly from the original 79% with the higher moisture content, few spores being found after one week at 129.9% moisture, after eight weeks at 60.9% moisture and after one year at 16.5% moisture. Hence, flooding a field or exposing the spores to moist soil by ploughing would be one method of greatly reducing the number of viable spores; under normal climatic conditions in Florida, viable spores should not continually accumulate in organic soils.

The effect of smut on the USDA sugar cane breeding program at Canal Point. J. D. Miller. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 66-67. – Smut has caused a 50% loss of plants in the breeding program over a 5-year period, so that the number screened in all selection stages before the elimination of smut-susceptible clones has to be doubled in order to maintain the current level of selection for other characters. This necessitates some increased work in handling large populations in the various stages, so that there is need for development of techniques that would permit screening for the disease in seedlings. In the meantime, the parental varieties being used in the crossing program must be replaced with varieties known to be smut-resistant.

Economic thresholds for sugar cane borer populations in Florida. J. Alvarez and G. Kidder. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 104 *(abstract only).* – The sugar cane borer, *Diatraea saccharalis* (F.), is one of the most destructive insects attacking sugar cane in continental USA, and treating the plants with insecticides has been recommended for its control. A 5% level of infestation has been set in Louisiana and Florida as the point at which treatment becomes necessary; however, a fixed limit cannot cover all possible situations. This study applies and expands a previously advanced definition of the economic threshold, which is found to be dependent on time, yield and prices. Economic thresholds are calculated for the Florida situation using three levels of yield, three prices of sugar per pound and three times in the season. Results show the economic threshold values decreasing as yields and sugar prices increase, but increasing as the season advances. They range from a low 2.7% early in the season for a 45-tonne field when the price of sugar is US $0.15 per lb to a high 13.4% late in the season for a 20-tonne field when the sugar price is $0.12 per lb. Results also indicate the importance of considering all factors involved when computing economic thresholds, since they usually result in reduced insecticide treatments.

Use of aerated steam for control of some diseases of sugar cane in Louisiana. R. J. Steib. *Proc. Amer. Soc. Sugar Cane Tech.,* 1979, 106 *(abstract only).* – Initial studies to determine if aerated steam (AS) thermotherapy would be effective for control of sugar cane diseases in Louisiana were undertaken in 1974. Control of ratoon stunting disease (RSD) was found to be possible by

treating seed cane with all adhering trash for a period of 4 hours at 53°C. Using a larger oven than that used in Louisiana (2.25 tonnes), RSD was controlled by treatment at 54°C for 4 hours under tropical conditions. As did not reduce germination of seed cane, as did other heat treatments used to control RSD. Treatments made in 1976 to control cane mosaic, which is caused by a virus, included 56°C for 2.5 hours and 57°C for 2.0 hours. A high degree of control was obtained; however the germination of varieties sensitive to AS was reduced to a low level. The uncontrolled volume of steam entering the oven resulted in a very rapid rise in the treatment temperature desired within 20-30 minutes. Apparently, the hot steam scalded the tender buds on the 4- to 5-month-old seed cane used for planting in Louisiana. In order to reduce damage by the hot steam, a number of factors needed to be stabilized. Tests were made to establish the following parameters: the steam pressure and volume of steam entering the oven for different temperature-time combinations for given volumes of cane; the effect of the ambient temperature of the cane mass on the rate of temperature rise in the oven at different steam pressures and inlet volumes; and the effect of different methods of loading the oven on temperature distribution and on the rate of temperature rise in the cane mass throughout the oven. Tests made in 1977 using 56°C for 3 hours with reduced volumes of inlet AS were found to delay the temperature rise in the oven by 1.25-1.50 hours. The steam pressure was maintained between 25 and 45 psi for these tests, as in treatments carried out in the previous year. The reduced inlet volume, which prevented the rapid temperature rise, resulted in excellent germination for all varieties treated at 56°C for 3 hours; RSD was effectively controlled. Even though the seed cane temperature was 56°C during the last 1.5-1.75 hours of the treatment, mosaic was not effectively controlled. For all 15 tests carried out in the following year (1978), the steam pressure was maintained at 10 or 15 psi and the volume of steam entering the oven regulated using four or six holes of 0.1625 inch diameter made in the steam inlet pipe. The treatments included 4.0, 4.5 and 5.0 hours at 56°C. These tests resulted in acceptable germination for only the most heat-resistant varieties. Average mosaic control for the 4.0 and 4.5-hour treatments at 56°C was 66.7%. The desired in-cane temperature was reached after 2.0-2.5 hours in the 4-hour treatment period. Results of the tests carried out during 1978 and 1979 indicate that it may be possible to control cane mosaic in only the most heat-resistant varieties with only one AS treatment, if most parameters known to affect the results obtained are controlled. It was also concluded that it may be possible to control mosaic in the more heat-sensitive varieties using a slightly higher steam pressure and slightly greater inlet volume, along with a shorter treatment period.

Weighted average percentage of sugar cane stools infected with mosaic in São Paulo state. S. S. Mello. *Brasil Açuc.*, 1981, **98**, 118-120 *(Portuguese).* — A survey of infection in 25 districts in the state was made and the results classified by variety. Of the 19 varieties concerned, 14 are classified as resistant, 3 as intermediate and 2 as susceptible.

Bacterial flora in sugar cane with and without inoculation of *Xanthomonas albilineans.* R. M. Valdebenito and H. Tokeshi. *Brasil Açuc.*, 1981, **98**, 187-191 *(Portuguese).* — Single-bud cuttings of NA 56-79 cane were subjected to long hot water treatment and planted in sterilized soil under greenhouse conditions with and without inoculation with *X. albilineans.* After two months the bacterial populations were examined and found to be equivalent to 340,000 and 26,300,000 colonies per cm^3 of tissue, respectively, in healthy and inoculated plants. It was also found that there were differences in the species present, *Erwinia herbicola* being dominant among bacteria present in inoculated cane. This suggests the probable implication of *E. herbicola* in the etiology of leaf scald.

Hot water treatment. Anon. *S. African Sugar J.*, 1981, **65**, 463. — The marked reduction in the number of cane samples infected with ratoon stunting disease that have been sent to the SASA Experiment Station for diagnosis is attributed to greater use of hot water treatment and more careful selection of seed cane from non-nursery sources. However, for various reasons much untreated cane is still being planted. Advice is given on hot water treatment, and the seed cane system used in Swaziland is described.

Hot-water treatment and sugar cane health. G. T. A. Benda. *Sugarcane Pathologists' Newsletter,* 1981, (27), 1-2. Hot-water treatment of seed cane is discussed, covering: (1) curative treatment, which has been effective in eliminating ten systemic diseases but is limited to heat-tolerant cane (although tolerance can be induced or increased by techniques that harden the cane and so make it adaptable to treatment conditions, e.g. heat treatments on successive days that have imparted sufficient tolerance to permit control of mosaic by heat dosages that would kill unadapted cane); (2) protective treatment for the control of insect pests and fungi, and (3) preventive treatment which may be of short duration, e.g. 20 minutes at 52°C, coupled with fungicide application. Killing of buds by the fungus responsible for pineapple disease is prevented by heat-induced rapid and uniform germination of the cane. The importance of hot-water treatment in cane which, because it is a monoculture, is prone to attack by an accumulation of systemic diseases, is emphasized.

The effect of hot-water treatment on sugar cane germination. G. I. B. Ongoma. *Sugarcane Pathologists' Newsletter,* 1981, (27), 3-6. — The effect of hot-water treatment (for control of smut and ratoon stunting disease) on the germination of three-budded setts of two commercial and five unreleased varieties was determined. Treatment consisted of 2½ hours' exposure to 50°C. Tabulated results show that one of the commercial varieties, Co 331, and one of the unreleased varieties, EAK 69-47, reacted negatively to treatment in terms of % germination and tillering capacity. The reaction of Co 331 was particularly marked. Differences in growth vigour between the untreated controls and both positively and negatively reacting varieties diminished with time, so that the overall difference was one-leaf growth. EAK 70-153 was the most responsive to treatment, which increased its germination by 35% compared with a 15% reduction for Co 331 relative to the controls.

Outbreak of yellow spot disease on sugar cane. Anon. *Sugarcane Pathologists' Newsletter,* 1981, (27), 45. An outbreak of yellow spot (caused by *Mycovelosiella koepkei* syn. *Cercospora koepkei)* in Trinidad is reported. The chief variety infected is B 41227, which has had a good record of resistance to leaf scald, smut and rust and is grown on a very high percentage of the area under cane.

CANE BREEDING AND VARIETIES

Yield components in the F_1 and back-cross generations of *Saccharum spontaneum* (US 56-15-8) with commercial hybrids. R. D. Breaux. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 104 *(abstract only).* — A study was conducted to measure the effect on quantitative yield components when *S. spontaneum* is crossed and back-crossed to commercial hybrids. The mean yield of tonnes of cane per ha was very high in the F_1 generation but dropped drastically with back-crossing. The mean yield of sugar (kg/tonne of cane) was very low in the F_1 generation and increased significantly with back-crossing. The mean yield of sugar per ha was lowest in the F_1 and BC_1 generations, significantly lower than the commercial control cross. The data indicate that US 56-15-8 could reach a commmercial level for yield with two to three back-crosses to commercial hybrids.

Breeding behaviour of stubbling ability in sugar cane — preliminary observations. J. W. Dunckelman and M. T. Henderson. *Proc. Amer. Soc. Sugar Cane Tech.*, 1979, 104 *(abstract only).* — A study was conducted to determine the breeding behaviour of ratooning ability in sugar cane from the plant cane crop up to and including 2nd ratoons; 210 clones, chosen at random from the progeny of a cross of CP 65-357 x L 65-69, comprised the experimental units, each being planted to a 10-ft clonal plot. Five replicates of each parental clone were incorporated in the experiment as controls. The characteristics studied as indicators of ratooning ability were: stalk population, stalk weight, stalk length, stalk diameter and plot yield, calculated as the product of clonal population x average clonal stalk weight. Sucrose content was also determined by polarimetry and Brix analysis. The sample size used was 20 stalks per clonal plot. This paper is a preliminary investigation of the plant cane and 1st ratoon crops. The mean characteristics for the experimental clones within separate years were as follows. Plant cane: population, 53.9 stalks/plot; stalk weight, 0.923 kg; stalk length, 2.02 m; stalk diameter, 22.7 mm; yield, 49.35 kg/plot. First ratoon: population, 60.1 stalks/plot; stalk weight, 0.851 kg; stalk length, 2.28 m; stalk diameter, 21.5 mm; yield, 50.65 kg/plot.

Variation in fibre components of sugar cane. D. I. T. Walker. *Sugar y Azúcar*, 1981, **76,** (11), 52-53. — In association with use of the Tilby cane separation unit, studies have been made of the fibre content of commercial varieties, clones of *Saccharum robustum* and *S. spontaneum* hybrids, with the aim of finding a range of canes having an exceptionally high dry matter (Brix + fibre) content combined with vigorous field growth that could be utilized for sugar production or for use as energy source (including utilization as a fuel). B 76599 was found to have a much higher fibre content and a higher Brix than B 62163, which is grown on some 60% of the total cane area in Barbados; it is therefore considered of value as a dual-purpose cane, and tests are to be carried out to see if it can be harvested mechanically. The *S. robustum* clones have an exceptionally high fibre content and are of value as fuel, while the *S. spontaneum* hybrids have a fibre content intermediate between the average for the commercial varieties and B 76599.

Tillering of sugar cane, as affected by genotype and plant growth regulators. J. Wong-Chong and F. A. Martin. *Sugar y Azúcar*, 1981, **76,** (11), 56-57. — In greenhouse studies of the effects of three growth regulators on the tillering of plants from three varieties, the chemicals were applied 10 days after germination of the single-bud cuttings, and the plants then exposed to natural daylight in one set of experiments, and shaded in another set; temperature and relative humidity were the same in both sets. Under optimum (natural daylight) conditions, none of the growth regulators increased the number of early tillers (those formed 6 weeks after treatment) in CP 70-321 or N:Co 310, whereas Ethephon and Mefluidide caused a statistically significant increase in the number of tillers in the case of CP 65-357 (but not Daminozide). Ethephon caused shorter and thinner stems in all three varieties by comparison with the control. Under sub-optimum conditions, non-significant results were recorded for CP 70-321 and CP 65-357, while Ethephon caused a significant increase in the number of tillers with N:Co 310 (but not the other two regulators). Again, Ethephon adversely affected growth of the plants, which were shorter than the controls. All treatments gave stalks that were as thin as or thinner than the control. The results of the tests indicate the tillering is a function of genotype and that conditions under which the cane is grown are important (tillering being limited under adverse conditions). It remains to be seen whether the positive results obtained could be translated into an increase in yield under field conditions.

Cane breeding in Réunion. Anon. *Ann. Rpt. Inst. Rech. Agron. Trop.* (Réunion), 1980, 23-29 *(French).* — Details are given of cane propagation *in vitro,* using both cuttings and tissue culture, and brief mention is made of preliminary field studies to determine the adaptability of crosses to environmental conditions. The occurrence of specific diseases and the varieties affected were investigated; details are given of these and of screening tests to determine the reactions of given varieties to leaf scald and gummosis. Both leaf and stalk inoculation techniques have been used and are described, together with their advantages and disadvantages.

Comparative anatomical study of leaves of sugar cane varieties *(Saccharum* spp.) submitted to water deficit treatments. G. M. Corso, O. Brinholi, S. R. Machado and V. Factori. *Brasil Açuc.*, 1981, **98,** 146-152 *(Portuguese).* — Cane plants of six varieties, of known different response to drought, were subjected to water stress to different degrees and sections made of their leaves to determine physiological differences. The most susceptible varieties showed intense wilting of the parenchymatous tissues and deformed fibrovascular bundles whereas changes in the structure of the resistant varieties were much smaller. Data obtained indicate that proline is present in greater amounts in the resistant varieties and is concerned in the normalization of cellular osmosis.

Variety review — Jamaica 1980. K. M. Baker. *Tech. Bull.* (GEPLACEA), 1981, (20), 5 pp. — An account is given of major commercial varieties and outstanding unreleased varieties in Jamaica, with mention of screening for smut and rust, the two important diseases affecting the industry.

CANE SUGAR MANUFACTURE

Efficient operation of heating and boiling equipment. S. K. Ghosh. *Sharkara,* 1977, **16,** (2), 3-13. – Factors in the operation of juice heaters, evaporators and vacuum pans are discussed, including: heat surface requirements of juice heaters and the effects of steam pressure and difference between steam and juice temperature; tube material for juice heaters, and juice velocity, heat transfer and pressure drop in them as well as size of steam feed ports and venting of incondensables. Short-circuiting of juice and entrainment in evaporators and pans and their prevention are examined, as well as venting of incondensables, scale formation, circulation velocity, the need for high vacuum, steam pressure requirements, temperature drop and its effect on throughput, optimum number of evaporator effects, vapour cell operation and the benefits of vapour bleeding for the steam economy, and various means of condensate extraction.

Panama. Anon. *Sugar y Azúcar,* 1981, **76,** (11), 38, 40. An outline is presented of the Panama cane sugar industry.

Costa Rica. Anon. *Sugar y Azúcar,* 1981, **76,** (11), 40, 42. – A short survey is presented of cane agriculture and processing in Costa Rica.

El Salvador. Anon. *Sugar y Azúcar,* 1981, **76,** (11), 42. In a short description of the sugar industry in El Salvador, it is stated that some 20% of the cane grown is still processed as a cottage industry to yield panela, although the installation of a refinery has encouraged a preference for refined sugar in urban communities.

The cumulative benefits of surface treatment of mill rolls. N. Maier. *Sugar y Azúcar,* 1981, **76,** (11), 60-61, 64-65. – In experiments conducted in a number of Brazilian factories, surface treatment of cane mill rollers using an Azúcar 80 welding electrode eliminated the requirement for chevrons, leading to increased contact with the bagasse and a reduction in its moisture content and pol. The additional revenue resulting from this is calculated. Since the deposits from the electrode are globular, the gripping points on the feed roller teeth were able to pass 20% more bagasse through the rollers without increased slippage. Removal of Messchaert grooves proved inadvisable because of a resultant 2% increase in bagasse moisture. Some disadvantages of the Azúcar 80 electrode are mentioned, including increased wear on trashplates and scrapers, lack of success in the use of spring-loaded scrapers (which must be far more rigid), and the possibility of easy breakage of trashplate teeth (where these are made of cast iron) by foreign bodies as a result of increased brittleness caused by carbon pickup from the welding, although cast steel trashplates have been found to last longer than previously. If the electrode is not correctly placed on the face adjacent to the bead, there is risk of erosion, so that slippage would increase and hence losses rise significantly.

Boiler water treatment. P. A. Koopman. *Sukari* (Zaire), 1981, **1,** (1), 25-28 *(French).* – Causes of scaling and corrosion are explained and methods of boiler feedwater softening and degassing described.

Novel technical solution to optimization of the energy context of a cane sugar complex. G. Dormal. *Sucr. Belge,* 1981, **100,** 371-380 *(French).* – Details are given of the power generation plant installed at Xuenoula sugar factory (in the Ivory Coast) to provide electricity for both the factory and for the cane irrigation system operated as part of the sugar complex. The major constraint is the fluctuation in power demand by the irrigation scheme, which should not interfere with the steam requirements of the factory. The basic plant is a 4000 kVA/3000 kW back-pressure turbo-alternator, a 7850 kVA/6280 kW bleeder-type turbo-alternator and an expansion and desuperheater valve in parallel for a maximum steam flow of 60 tonnes.hr^{-1}. Advantages of the scheme are explained.

An improvement of thermal efficiency in the Taiwan cane sugar industry. S. L. Sang and Y. C. Yen. *Taiwan Sugar,* 1981, **28,** 152-157. – As part of a program initiated in 1955 to modernize the heat schemes used in Taiwan sugar factories and thus increase energy conservation, low-pressure boilers, steam engines and power plant were replaced with high-pressure boilers and turbines of lower steam rate and higher exhaust steam pressure than the engines. The exhaust steam requirement was reduced by making use of vapour bled from the 1st, 2nd and 3rd evaporator effects to heat juice and massecuites in the vacuum pans. Details are given of the development of the program, which has permitted a reduction from 20.5 to 16.0 tonnes of bagasse consumed per 100 tonnes of cane, corresponding to a surplus increase from 350,000 to 800,000 tonnes of bagasse per year for the entire Taiwan sugar industry. Details are given of the program and its results.

Combustion efficiency and bagasse dirt. C. R. Chang. *Taiwan Sugar,* 1981, **28,** 167-169. – Details are given of the reconstruction of step-grate furnaces to Ward-type furnaces in Taiwan sugar factories so as to increase the combustion efficiency, which is normally only about 60% but becomes even lower when the bagasse dirt content is high.

Energy in a cane sugar complex: an original technical solution for its most efficient use. G. Dormal. *Sugar J.,* 1981, **44,** (6), 5-8. – See abstract above.

The process of sugar extraction by diffusion in the cane agro-industry. C. Parazzi and S. E. Ferrari. *Brasil Açuc.,* 1981, **98,** 172-186 *(Portuguese).* – A bibliographic study of the subject is reported with 24 references to the literature and a summary of the characteristics of some makes of diffuser and performances achieved.

Practical dimensioning of a cane sugar factory. O. P. Carvalheira. *Brasil Açuc.,* 1981, **98,** 192-197 *(Portuguese).* A list is given of areas in the sugar factory which can have a limiting effect on capacity and, for each, a number of important dimensions which are required for factory design to a given capacity.

Economical utilization of steam for saving bagasse. D. S. Lande and A. R. Patil. *Maharashtra Sugar,* 1981, **7,** (2), 31, 33, 35-37. – Means by which steam consump-

tion can be reduced in the individual processes and by certain measures, such as maintenance of continuous milling and lagging of pipework, are described.

Laboratory study on the insulation of the Fe-Cu couple. J. Bango. *CubaAzúcar,* 1981, (July/Sept.), 24-28 *(Spanish).* — With copper tubes installed in steel tube-plates in sugar factory evaporators, galvanic corrosion occurs, and studies are reported on insulation of the joints to prevent this. These showed that use of a layer of epoxy resin between the tubes and plate served not only as an adhesive but also as an insulator, preventing corrosion and offering prospects for industrial use. The mechanical resistance of the joint will depend on the resin characteristics, on the nature of the catalyst and on the proportions by weight of the components.

Considerations on the replacement of copper tubes in sugar factory evaporators. R. Caro, J. Bango and R. Quintero. *CubaAzúcar,* 1981, (July/Sept.), 36-39 *(Spanish).* — Replacement of copper tubes in an evaporator becomes necessary when local corrosion occurs or general corrosion reduces the original weight of the tube by 40%, and when destruction of the expanded ends occurs. Studies were made on the loss by corrosion of tubes under the action of juice, steam, boiling 3% HCl as used for cleaning, and on the mechanical resistance of 5 cm diameter tubes under working conditions more drastic than usual. The results showed that loss by corrosion is uniform along the tube, that copper tubes are sufficiently resistant to corrosion, but that it is necessary to improve the quality of the metal used for tube plates or to use corrosion inhibitors during acid cleaning. Since new tubes are not of uniform thickness, it is considered that the criterion for replacement of 40% weight loss is incorrect and losses of 1.11 and 0.82 $lb.ft^{-1}$ should be substituted for tubes of original diameter 5 and 3.8 cm, respectively, with the copper thickness standardized at an original 0.9 mm.

Assessment of final molasses coolers. L. M. S. A. Jullienne and S. Munsamy. *S. African Sugar J.,* 1981, **65,** 578-579. See *I.S.J.,* 1982, **84,** 303.

Boiling techniques for the evaluation of surfactants. J. C. P. Chen, J. S. Rauh and B. A. Smith. *Sugar J.,* 1981, **44,** (7), 9-13. — Details are given of a 1-ft diameter vacuum pan used in tests to determine the effects of surfactants on low-grade boiling. The Ziegler & Associates supersaturation and consistency monitors installed in the pan are described by means of diagrams. Results of boiling a magma made up of 75°Bx *B*-molasses and an equal weight of seed sugar are reported, showing that use of a surfactant reduced boiling time, increased solids recovery and improved sugar quality in terms of grain size and uniformity, colour and ash content. Performance of the pan was satisfactory.

The AMS Sucro juice double purification system trials at Lopez Sugar Corporation. C. M. Madrazo and R. C. Olvido. *Sugar News* (Philippines), 1981, **57,** 250-252, 254, 256, 258, 260-261. — Double purification involves pre-clarification, using the flotation process, followed by conventional settling in the main clarifier. The chief object is to remove those impurities (bagacillo, waxes, gums and fatty acids) that would otherwise remain in the clarified juice and adversely affect boiling and crystallization. A diagram is presented of the flotation clarifier used in trials, in which an AMS Sucro unit was used as main clarifier[1]. Although the results obtained were not spectacular, the process gave significant overall benefits despite poor juice quality.

Reverse osmosis and mechanical vapour recompression as potential energy-saving alternatives in cane sugar processing. A. A. Teixeira. *Tech. Bull.* (GEPLACEA), 1981, (18), 24 pp. — The possibility of replacing multiple-effect evaporation with reverse osmosis (RO) or mechanical vapour recompression (MVR) is examined. It is concluded that RO is not a practical method because of the inadequate upper concentration limit of the treated juice (a constraint imposed by the maximum operating pressure of 600 psi to which RO systems are restricted), because of loss of flux with increasing concentration and because of the narrow range of operating temperatures typical of commercial membranes. On the other hand, MVR uses much less energy than conventional evaporation and could replace the entire evaporator in concentrating juice from 15° to 65°Bx.

Testing, evaluation and payment systems. J. R. Hudson. *Tech. Bull.* (GEPLACEA), 1981, (18), 7 pp. — Cane analysis, evaluation and payment are discussed in general terms, with particular attention focused on the question of increasing sophistication in analytical procedures and equipment (which could raise the costs beyond a level where there is any benefit to producers), the changing emphasis on the value of cane components in the light of tendencies to regard cane as more than just a raw material for sugar production, and the possible adverse effect of too rigid a payment system where it is beyond the grower's ability to influence quality.

Labour-intensive technologies in sugar production: an economic evaluation. D. J. C. Forsyth. *Tech. Bull.* (GEPLACEA), 1981, (18), 2 pp. — Reference is made to a study which showed that, for various reasons stated, labour-intensive sugar production as a cottage industry does not and will not constitute a serious alternative to conventional, capital-intensive sugar manufacture.

Filtrate clarification employing flotation techniques. O. A. Khan. *Sugar News* (Philippines), 1981, **57,** 300-303. — Details are given of the Talo flotation technique as applied to filtrate from rotary vacuum filters after addition of phosphoric acid (5 ppm on cane), neutralization with milk-of-lime and addition of 1-1.5 ppm Taloflote to promote flotation.

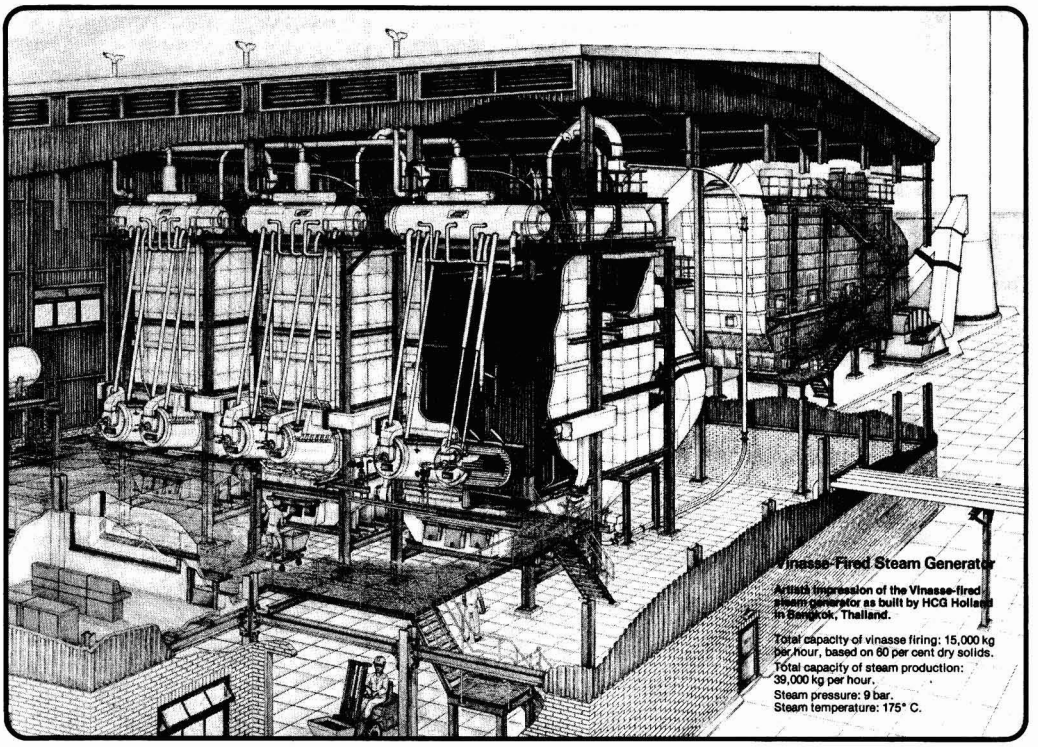
Problems associated with dextran, the major microbial cause of sucrose loss, and their remedies. S. Bose and L. Singh. *Indian Sugar,* 1981, **31,** 603-608. — The literature on the origin and constitution of dextran, problems caused by it in juice analysis and processing, and methods of determining and eliminating it is surveyed.

Automation of cane payment systems. M. F. Nolting. *Bol. Técn.* (GEPLACEA), 1981, (19), 6 pp *(Spanish).* See *I.S.J.,* 1982, **84,** 212.

Two-boiling system. A. P. Lopez *Tech. Bull.* (GEPLACEA), 1981, (20) 4 pp. — The two-boiling system is compared with the double seed system and found to be better in terms of molasses exhaustion, pan capacity and steam consumption, while producing *A*-sugar of the same purity (98.8) from a syrup of 85 purity.

[1] Madrazo & Marcelino: *I.S.J.,* 1981, **83,** 99-101.

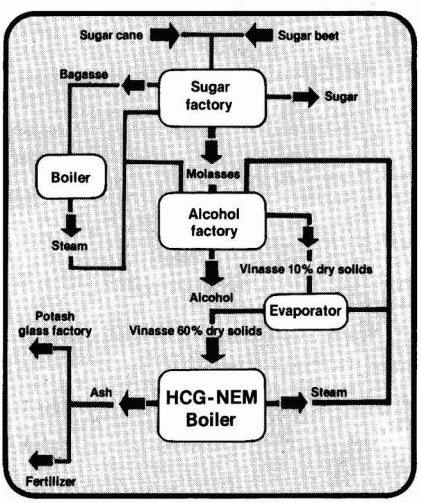
EFFLUENT TREATMENT and ENERGY SAVING through NEM VINASSE BOILER



Vinasse-Fired Steam Generator

Artist's impression of the Vinasse-fired steam generator as built by HCG Holland in Bangkok, Thailand.

Total capacity of vinasse firing: 15,000 kg per hour, based on 60 per cent dry solids.
Total capacity of steam production: 39,000 kg per hour.
Steam pressure: 9 bar.
Steam temperature: 175° C.



- During the production of power alcohol as well as industrial alcohol, vinasse is obtained as by-product. By evaporation to 60% solids concentration this vinasse becomes suitable as fuel for the HCG combustion boiler for generating process steam.
- By using vinasse as fuel, the alcohol factory can achieve savings of approximately 50% in fuel consumption.
- HCG has been involved in the development of vinasse-fired boilers for many years. Three boilers have been built while six more are under construction.

hcg hollandse constructie groep bv
nem-boilers and process equipment division
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BEET SUGAR MANUFACTURE

Modification of a scheme for lime kiln-gas sections at sugar factories. K. N. Savchuk. *Sakhar. Prom.,* 1981, (12), 32-38 *(Russsian).* — A modified scheme for lime kiln operation, milk-of-lime preparation and purification, and CO_2 distribution is described which, in tests during two campaigns, has permitted a reduction in lime and fuel consumption, an increase in milk-of-lime activity and cuts in labour requirements and power usage (e.g. for gas feed and ventilation).

Comparative evaluation of the operational properties of tubes for heat exchange vessels in the sugar industry. V. A. Yavor and M. V. Dvornichenko. *Sakhar. Prom.,* 1981, (12), 38-41 *(Russian).* — The corrosion resistance was determined of seamless steel tubes, welded steel tubes, brass tubes and welded chrome steel tubes immersed in a variety of factory juices and liquors as well as condensate and 3% HCl. Results, given in the form of anode polarization curves at 90°C, are discussed.

The use of ion exchange columns for remelt liquor decolorization. S. Gielzynski. *Gaz. Cukr.,* 1981, **89,** 100-103 *(Polish).* — The use of anion exchange treatment of remelt liquor based on Wofatit ES resin is described, and details are given of optimum operating conditions, of column design and installation (as at Lublin sugar factory) and of automatic control of liquor flow.

Treatment of sugar factory waste water by mechanical aeration. E. Mlotkowski and M. Manczak. *Gaz. Cukr.,* 1981, **89,** 106-108 *(Polish).* — The use of two aerators at Jawor sugar factory reduced the BOD_5, COD and oxygen consumption by approx. 96, 95 and 98%, respectively, at a power consumption of 0.49 kWh per m^3 (0.36 kWh per kg of reduced BOD_5) over a 11-week period. The initial BOD_5 was 1821 g O_2/m^3.

Type series of plant for SO_2 generation. Z. Kalata. *Gaz. Cukr.,* 1981, **89,** 109-110 *(Polish).* — A description is given of a sulphur burner design which is intended for use in beet or cane sugar factories processing between 1000 and 15,000 tonnes per day.

Remelt liquor decolorization by lime carbosaccharates. S. Wysocki and J. Marczynksi. *Gaz. Cukr.,* 1981, **89,** 130 *(Polish).* — Tests are reported on remelt liquor defecation with lime saccharate that had been gassed with CO_2 to give a mean alkalinity of 0.015 g CaO/100 cm^3; the complex was added at the rate of 20% on quantity of remelt, giving an average decolorization of 60% on an initial colour content of 40°St.

Development of a method for sucrose recovery from molasses by means of ion exclusion. W. Fornalek, T. Szulc, A. Jarosz and M. Ligowska. *Gaz. Cukr.,* 1981, **89,** 131 *(Polish).* — Ion exclusion using Lewatit TSW 40 strongly acid cation exchanger in Na^+ form was used to recover sugar from molasses of an initial 52°Bx in pilot-scale experiments. At a flow rate of 4.5 $m^3.hr^{-1}$ recovery was about 75%.

Development of a technology for recovery and utilization of beet tails and fragments. H. Dabrowski. *Gaz. Cukr.,* 1981, **89,** 132-133 *(Polish).* — Mention is made of the possibility of using beet tails and pieces as a fodder component, for alcohol manufacture or simply extracting sugar from them.

Designing multiple-effect evaporators in sugar factories using the HP-41C programmable calculator. P. Traganitis. *Sucr. Belge,* 1981, **100,** 385-400. — Details are given of a Hewlett-Packard HP-41C calculator program for the design of multiple-effect evaporators and for calculation of the heat balances of existing evaporators on a trial-and-error basis.

An extension to the three-boiling system. K. W. R. Schoenrock. *Sugar J.,* 1981, **44,** (6), 13-18. — See *I.S.J.,* 1982, **84,** 345.

A sugar factory power house connected to the public supply grid. W. Goepen. *Zuckerind.,* 1982, **107,** 19-22 *(German).* — Since energy costs are a sizeable proportion of the overall costs of sugar production, it is important to reduce the amount consumed and make best use of that power that is consumed. However, since the quantity of electricity produced from process steam is governed by steam throughput, reduced to a level corresponding to the overall efficiency of the turbo-set, it follows that a drop in steam consumption will result in a fall in power production. It is shown, by means of diagrams, how it is possible to use the public supply system to cover such shortfalls, either occasionally or on a continuing basis. Advantages of a system in which the powerhouse and public grid are interlinked are discussed; one of the major disadvantages of the fully independent powerhouse is the risk of overloading of the turbo-set and the considerable capital that must be used to cover peak loads.

Energy reduction by cossette liming. J. M. Randall, W. Camirand and E. M. Zaragosa. *Zuckerind.,* 1982, **107,** 38-46 *(English, German).* — The experiments on liming of cossettes as a means of improving pulp pressing[1] are further discussed by expanding on the energy saving aspects.

Sugar storage in silos. V. Louvred elements for ventilation of storage bins and silos. L. Budicek, O. Mikus and J. Smid. *Listy Cukr.,* 1981, **97,** 278-282 *(Czech).* Procedures for the designing of louvres are examined, and the optimum geometry of louvred systems for bulk sugar storage is discussed on the basis of investigations of sugar under dynamic and static conditions.

The Perner 12 R beet slicer. M. Dreser, L. Budicek and V. Prokopova. *Listy Cukr.,* 1981, **97,** 282-287 *(Czech).* Details are given of the title beet slicer, which operates at 85 rpm and contains 16 Goller knife frames, as well as a rotating brush system for knife cleaning. The daily capacity is 1250 tonnes of beet.

Beet damage and its implications for processing. G. Vaccari, C. A. Accorsi and G. Mantovani. *Ind. Sacc. Ital.,* 1981, **74,** 153-155, 158-161 *(Italian).* — The adverse effects of damage during harvesting and handling in the

[1] Camirand *et al.: I.S.J.,* 1982, **84,** 374.

beet yard on beet storage and processing are discussed, and tests are reported in which the resistance to impact, cutting and bruising as a result of falling was determined for 10 beet varieties; their storage properties were also investigated. Results showed distinct differences in varietal vulnerability. The findings are compared with results obtained by other authors and reported in the literature.

Determination of the amount of recycle to preliming and of the lime consumption in raw juice purification. K. P. Zakharov, R. G. Zhizhina, N. I. Zharinov and V. V. Rakhmanyuk. *Sakhar. Prom.,* 1982, (1), 21-23 *(Russian).* — Formulae are presented for calculation of the quantity of 1st carbonatation juice or mud suspension to be recycled to preliming and of the amount of lime to be added on the basis of the $CaCO_3$ balance in preliming and the total amount of CaO in 1st carbonatation. Worked examples are given.

Chemical treatment of regeneration effluents formed during deliming of 2nd carbonatation juice. V. A. Pronina and A. B. Khanin. *Sakhar. Prom.,* 1982, (1), 26-29 *(Russian).* — Ion exchange effluent, containing $CaCl_2$ and NaCl, was treated with sodium carbonate to give a mixture of calcium carbonate and NaCl, which was then filtered and the NaCl returned to the brine tank for future regeneration of the Na^+-form cation exchange resin. Details are given of tests conducted at Krivets factory in 1979-80.

Calculation of the diameter of pipelines and height of lift of a milk-of-lime mixer. A. L. Antonovich. *Sakhar. Prom.,* 1982, (1), 30-31 *(Russian).* — Equations are presented for calculation of the diameter of pipelines to carry milk-of-lime and of the height of the lime mixer relative to the liming vessel when the process station is reconstructed.

A pneumatic system for automation of batch vacuum pans. B. A. Eremenko, A. F. Kravchuk and T. V. Lenets. *Sakhar. Prom.,* 1982, (1), 38-43 *(Russian).* — Programming of a vacuum pan based on boiling point elevation as control parameter is described, and formulae are given for calculation of the supersaturation coefficients for incorporation in the program.

Sugar storage in silos. VI. Analysis of causes of sugar caking in Prumstav silos. L. Budicek and O. Mikus. *Listy Cukr.,* 1982, **98,** 2-7 *(Czech).* — Examination of samples of white sugar taken from a Czechoslovakian-designed silo after 77 days' storage showed that caking was caused by excessive moisture resulting from failure to pre-condition the sugar before storage. The need to restrict the relative humidity in a silo to a pre-set level and to ensure as even a temperature throughout the silo as possible, with a maximum difference between two points of 7°C, is stressed.

Rate of absorption of carbon dioxide under conditions of 1st and 2nd continuous carbonatation. IV. Catalytic and inhibitive activity of sucrose and invert sugar. E. Sarka. *Listy Cukr.,* 1982, **98,** 10-13 *(Czech).* — Investigations showed that at low concentrations (up to 0.03 mole.litre^{-1}) sucrose had a medium-to-strong catalytic effect on CO_2 hydration; in the concentration range 0.03-0.4 mole.litre^{-1} it acted as hydration inhibitor at 30°C or 40°C and as weak-to-moderate catalyst at 60°C or 70°C, whereas at concentrations above 0.4 mole.litre^{-1} it acted as weak-to-moderate inhibitor. Invert sugar had little effect on CO_2 hydration.

Effect of sugar factory juice clarification with sucro-carbonate complex on the mud granulometry. J. Grabka. *Listy Cukr.,* 1982, **98,** 13-15 *(Czech).* — Examination of the particle size of mud formed by addition of milk-of-lime or sucro-carbonate in liming showed that milk-of-lime treatment gave smaller particles, with 71% of the mud falling the range of 0-5 μm, while only 23% occurred in this range when sucro-carbonate was used as liming agent.

Fine separator for flume and wash waters, raw juice and diffusion water. M. Tvrz. *Listy Cukr.,* 1982, **98,** 16-19 *(Czech).* — A description is given of a rotary screen separator with screened appendages fixed to the drum circumference at regular intervals. Water or juice is fed into the side of the housing accommodating the separator, so that the bottom half of the drum is immersed in it. The discharge port is diametrically opposite the feed port, so that the level of the liquid is maintained constant. The solids picked up by the peripheral blades are washed off by spray from internal jets and are discharged by screw conveyor. Performance data are given for juice treatment using wire screen of two different perforations.

Supersaturation control in massecuite boiling. V. I. Tuzhilkin, S. M. Petrov and A. R. Sapronov. *Izv. Vuzov, Pishch. Tekh.,* 1981, (4), 100-103 *(Russian).* — Weaknesses in boiling control systems based on the relationship between supersaturation and absolute values of given parameters (including boiling point elevation) are discussed, and the use of the ratio between BPE of a massecuite and that of a saturated solution of the same composition relative to water as a control function is described. The validity of this ratio for precise control of refinery and beet sugar factory massecuite boiling is indicated.

Water treatment at Genappe sugar factory. A. Bausier. *Sucr. Belge,* 1982, **101,** 3-18 *(French).* — Details are given of the water treatment station installed at Genappe (in Belgium), where there are strict controls on the quality of discharge into the local river. The station comprises a bacterial filter for excess condensate, two anaerobic fermentation tanks for treatment of overflow from settling tanks, and a plate-type settler for overflow from the bacterial filter and fermentation tanks. Preliminary results are discussed, and a program is proposed which would permit the BOD_5 of the effluent to be maintained at no more than 20 g/tonne of beets during a campaign and 10 g/tonne in February-April. The energy balance is given for the anaerobic treatment.

Use of synthetic polyelectrolytes in the food industry. T. Florea, M. Leonte and M. Bulancea. *Bul. Univ. Galati, Fasc. VI,* 1980, **3,** 23-32; through *S.I.A.,* 1982, **44,** Abs.'82-074. — Acrylamide copolymers with acrylic acid and maleic acid were prepared; their structures were investigated and their suitability as flocculants tested. Tabulated data show that, in laboratory purification of diffusion juice, addition of 2, 4 or 6 ppm of one of these polymers improved the sedimentation rate and clarity. In factory tests, effects were similar although less marked. Flocculants of high M.W. and 25-45% degree of hydrolysis gave the best results. Their mechanism of action is discussed. They were also beneficial in the treatment of flume-wash water.

LABORATORY STUDIES

Improved column efficiency in chromatographic analysis of sugars in cation exchange resins by use of water-triethylamine eluents. L. A. T. Verhaar and B. F. M. Kuster. *J. Chromatogr.*, 1981, **210**, (2), 279-290; through *Anal. Abs.*, 1981, **41**, Abs. 6C15. – Separation of sugars and sugar alcohols on a column (25 cm x 4.6 mm) of Aminex A-5 resin (Ca^{++} form) is improved by elution with aqueous triethylamine (1 mM) at 0.5 $ml.min^{-1}$. The amine additive reduces peak width by catalysis of the mutarotation of reducing sugars but has no effect on retention time. Elution is effected at 45°C, and a differential refractometer is used for detection; the column can be used for approx. 1000 analyses before regeneration. The method has been applied to several sugar mixtures; e.g. glucose, mannose and fructose can be completely resolved in approx. 6 min, and a mixture of these plus mannitol and glucitol is separated in 9 min.

Determination of residues of Pyrazon (Chloridazon) and its metabolites in sugar beet. F. Kuhlmann. *Z. Lebensm.-Unters. Forsch.*, 1981, **173**, (1), 35-39; through *Anal. Abs.*, 1982, **42**, Abs. 1G16. – The sample of beet, leaves or whole plant is homogenized with acetone, first in a Waring Blendor, then in an Ultra-Turrax apparatus and finally in an ultrasonic bath. The homogenate is centrifuged, Chloridazon is extracted from the supernatant liquid into $CHCl_3$, and its metabolites [the N^5-glucoside and 5-amino-4-chloropyridazin-3-(2H)-one] are separated from the aqueous phase and purified by column chromatography on alumina. The compounds are separately determined by GLC, e.g. on a 12.5-m capillary column coated with SP-2100 and operated isothermally for 1 min at 100°C, then temperature-programmed to 240°C at 25°C per min with a N-P detector. The limit of detection is 0.02 ppm for each compound and the recovery is 85-90%.

Conditions for producing fructose syrup from sucrose. J. Mihailovic, L. Petrov and S. Petrov. *Ind. Secera*, 1979, **33**, (1-2, Supp.), 69-72; through *S.I.A.*, 1981, **43**, Abs. 81-1719. – Fructose syrup was prepared from sucrose under laboratory conditions; sucrose was inverted by ion exchange, and the resulting syrup was limed to precipitate Ca fructosate. The dependence of fructose recovery on CaO dose, temperature and reaction time was investigated. Optima appeared to be: 20% solution treated with 40-50% CaO on dry solids at 5°C or below and aged at least 5 min.

Determination of reducing sugars with nitro derivative of anthraquinone. R. Soloniewicz and M. Teodorczyk. *Chem. Analityczna*, 1978, **23**, (4), 645-652; through *S.I.A.*, 1981, **43**, Abs. 81-1735. – Reducing sugars were determined spectrophotometrically by means of 1, 5-dihydroxy - 4,8 - dinitroanthraquinone - 2,6 - disulphonic acid (I), which on reduction in alkaline solution has an absorption maximum at 620 nm. The rate of reduction depends on temperature and NaOH concentration. The following procedure is recommended: to a sample containing 0.3-0.9 mg sugar, add 1 ml 0.005M solution of I, 1 ml 1.7M potassium-sodium tartrate and 1 ml 1.5M NaOH, and dilute to 10 ml. Colour is developed at 70°C, over 60 min for glucose, fructose, galactose, xylose, mannose and sorbose, 65 min for ribose and 70 min for lyxose and maltose; alternatively it is developed at 100°C over 7 min (5 min for ribose). The absorbance is measured at 650 nm. For each sugar, coefficients in the linear equation relating absorbance to concentration are shown.

Determination of betaine in sugar and wine by liquid chromatography. J. Vialle, M. Kolosky and J. L. Rocca. *J. Chromatogr.*, 1981, **204**, (16), 429-435; through *S.I.A.*, 1981, **43**, Abs. 81-1750. – The determination of betaine by HPLC presents some difficulties owing to the quaternary ammonium moiety. The use of polar stationary phases (silica gel and amine-bonded silica gel) was investigated. Betaine could be determined on columns containing either material, with acetonitrile:water as eluent; pretreatment of the sample was necessary. The method was used to determine betaine in three samples of commercial beet sugar; contents found were 30-37 ppm.

The kinetics of nucleation in supersaturated solutions. V. Maurandi. *Ind. Sacc. Ital.*, 1981, **74**, 141-146 *(Italian)*. See *I.S.J.*, 1982, **84**, 348.

Modifications in the sucrose crystal habit. The appearance of the less common faces during the crystallization process. G. Vaccari, C. A. Accorsi and G. Mantovani. *Ind. Sacc. Ital.*, 1981, **74**, 147-152 *(Italian)*. – Photomicrographs and diagrams are presented of single sucrose crystals formed in the presence of various individual sugars and non-sugars and in the absence of impurities but under varying conditions of growth. The modifications of crystal habit resulting from the variations in growth conditions are discussed, using the Goldschmidt number (defining the frequency with which any of the simple facet forms undergoes change with modifications in the growth conditions) and the Vavrinecz "growth number". Both experimental results and data from the literature are examined. It is stressed that one single parameter is probably not responsible for a given habit modification; for conclusive evidence, knowledge of the entire crystal structure is essential.

Direct analysis of sugar cane by the hydraulic press method. A. C. Sturion and J. P. Stupiello. *Brasil Açuc.*, 1981, **89**, 303-309 *(Portuguese)*. – A study was made to establish a correlation, under Brazilian conditions, between the weight of press bagasse and the fibre % cane in order to facilitate calculation of the fibre and thence the recoverable sugar. Data were used from 180 tests in which 500 g of prepared cane of fibre content between 9.5 and 16.5% was subjected to 245 $kg.cm^{-2}$ pressure for 1 minute. Fibre content was calculated using five different equations and the most appropriate found to be $F = 0.0877\ R_1$, where R_1 is the weight of press bagasse in grams; this gave the nearest values to that obtained from the Tanimoto procedure[1].

Determination of reducing matter in routine analyses of sugar beet. B. Ticha, Z. Folbergerova and M. Friml. *Listy Cukr.*, 1981, **97**, 271-277 *(Czech)*. – Details are given of a greatly simplified version of an automatic

[1] *Hawaiian Planters' Record*, 1964, **57**, (2), 133-150.

analyser, used in medicine for blood sugar determination, that was applied to reducing matter determination; the colorimetric method is based on use of 1.4 cm^3 of a reagent prepared by mixing 100 cm^3 of isopropyl alcohol with 10 cm^3 of aqueous NaOH solution (0.1 $mole.dm^{-3}$) and 10 cm^3 of 1% triphenyltetrazolium chloride solution. The reagent is reacted with 0.4 cm^3 of clarified beet brei extract. Results obtained were exactly the same as values given by the Ofner method.

Potentiometric determination of chloride in sugar products. H. Manso J., R. Cuervo F. and A. Rodríguez A. *CubaAzúcar,* 1981, (July/Sept.), 30-35 *(Spanish).* Analysis of chloride in process materials is extensively used for studies on retention times, losses, etc. and the work described examines the use of potentiometry for chloride measurement with a silver plate as indicator electrode, a calomel electrode as reference, and a 2M ammonium nitrate salt bridge, titration with 0.01N silver nitrate being used as the norm. The tests showed that the potentiometric method was accurate and precise and was not affected by reducing sugars up to 30%. For extension of the method to automatic analysis, the potential would have to be determined for each type of process material.

Use of the IRIS tests of molasses exhaustion. P. Devillers, R. Detavernier and J. Roger. *Sucr. Franç.,* 1982, **123,** 47-56 *(French).* – In tests reported earlier[1] the viscosity of the mother liquor was used instead of the non-sugars: water ratio as a criterion of exhaustion. However, it has been found that the method is liable to error because of the use of "apparent" parameters, viz. refractometric Brix and pol. Subsequent tests were conducted on use of the same method of molasses exhaustion determination, but using "true" parameters, viz. dry solids as determined by oven drying at 105°C and sucrose as found by enzymatic means[2]. The procedure used in the method, based on the preliminary findings, is described and results for three molasses (selected from a large number) are discussed. From these, relations have been derived between saturated molasses viscosity, temperature, the sugar:water ratio and non-sugars:water ratio; knowledge of two of these factors permits calculation of the other two. The ratio of sugar to non-sugars is preferred to purity, since it gives a direct value of the molasses sugar; curves of the sugar:non-sugars ratio *vs.* log viscosity or *vs.* temperature give a better understanding of the effect of the two parameters on the ratio. It is concluded that, for optimum molasses separation in the centrifugals, it is better to use a temperature of 40°C and as high a mother liquor viscosity as is practical.

The structure of sucrose molecules. I. N. Kaganov. *Sakhar. Prom.,* 1982, (1), 23-24 *(Russian).* – While the Haworth formulae describing the molecular structures of sugars are well known, they are only approximations, being based on the assumption that the six atoms in the pyranose ring and the five atoms in the furanose ring lie in one single plane. On the other hand, the structural formulae of Reeves come closer to reality. Analogy between the structures of pyranose and cyclohexane have been adequately substantiated; the "armchair" form of the molecular structure of cyclohexane (the most common modification) is described, and it is shown how substitution of an O atom for the C-6 atom in the pyranose ring produces the sucrose molecule. A spatial model of the sucrose molecule is also presented, and the important role played by the three classes of H bonds (those within the pyranose and furanose rings, taken separately, those between the two rings, and those connecting sucrose molecules within the crystal) is indicated.

Determination of total and non-protein nitrogen in beet sugar factory products. L. P. Reva, R. I. Sukhomlin and E. A. Grivtseva. *Sakhar. Prom.,* 1982, (1), 25-26 *(Russian).* – Details are given of a modification of the Kjeldahl method for determination of both total and non-albumin N in which (1) the ammonia is not driven off, but a hypochlorite-iodometric means is used for ammonium titration, (2) the sodium salt of EDTA is used to eliminate the adverse effect of Cu^{++} ions on the titration by forming a copper complex, and (3) sodium hypobromite is replaced with calcium hypochlorite, which is more stable in storage and more readily available. Full details are given of the modified method and of results obtained with it on filtered beet brei extract and molasses; the mean value for these products at a number of factories agreed exactly with that obtained by the original method.

A new method for determining phosphates in boiler water. M. Solvcova. *Listy Cukr.,* 1982, **98,** 7-9 *(Czech).* Details are given of a method based on reaction between phosphoric acid and molybdic acid to form phosphomolybdic acid which, in an acid medium, is reduced to molybdenum oxide; the intensity of the blue colour of the oxide, measured at 630 nm, is a direct measure of the P_2O_5 concentration. Reagents used are conc. sulphuric acid, sodium molybdate and a solution made up of hydroquinone and sodium sulphite. Full details are given of the procedure, and some results are reported, showing a mean recovery of 99.9%, very good reproducibility and satisfactory reagent stability.

Refractometry of aqueous solutions of sucrose. S. T. Krylov. *Izv. Vuzov, Pishch. Tekh.,* 1981, (4), 107-110 *(Russian).* – Application of a series of differential equations to calculation of the refractive index of sucrose solutions beyond the visible light range is shown, by comparison with values obtained using the well-known dispersion formula and substitution of refractometer values, to be valid.

Estimation of the degree of exhaustion of molasses. E. Grut. *Sugar J.,* 1982, **44,** (8), 15-17. – See *I.S.J.,* 1963, **65,** 88.

Rapid determination of the invert sugar content in sugar factory products. K. Vukov. *Cukoripar,* 1981, **35,** 28-33 *(Hungarian).* – Details are given of a rapid method suitable for routine determination of invert sugar which is based on addition of 3,5-dinitrosalicylic acid, NaOH and potassium sodium tartrate to the test solution and photometric measurement at 530 nm. For rapid determination of fructose and glucose specifically, an enzymatic method is suitable. The test solution is first clarified with potassium ferrocyanide and zinc sulphate and the glucose then subjected to phosphorylation with glucose-6-phosphate dehydrogenase, which is one component of an enzyme mixture (Boehringer 139106) that also contains NADP magnesium sulphate and phosphoglucose isomerase as well as triethanolamine buffering agent. Photometric measurement is then carried out at 340 nm if the total fructose + glucose content in the initial solution is below 50 μg, or at 365 nm if it is between 50 and 100 μg.

[1] Devillers *et al.: I.S.J.,* 1979, **81,** 26.
[2] Idem: *ibid.,* 1976, **78,** 91.

BY-PRODUCTS

Peru: bagasse paper. P. A. Koopman. *Sukari* (Zaire), 1981, **1**, (1), 30-31 *(French).* – The Peruvian sugar industry is briefly surveyed, with emphasis on bagasse paper manufacture, and the possibility of producing bagasse paper at Kiliba sugar factory in Zaire is examined.

Need to develop cane wax production by the world sugar industry. P. J. M. Rao. *Maharashtra Sugar,* 1981 **7**, (1), 77, 79, 81-84, 85-93, 95. – See *I.S.J.,* 1981, **83**, 251.

Production of biogas by anaerobic digestion of vinasse. M. P. de Campos and D. V. F. Gonçalves. *Brasil Açuc.,* 1981, **98**, 47-53, 103-117 *(Portuguese).* – A two-year cooperative study was made by Cooperativa Fluminense dos Produtores de Açúcar e Alcool and Eletrobrás on the anaerobic fermentation of vinasse to yield methane for use as a fuel and an easily disposable fertilizer. The paper describes the history of such fermentation and the microbiology concerned, and the experiments carried out at the Jacques Richer central distillery. The pH should be in the range 6.6-7.6, preferably 7.0 7.2, and if it fell resulted in a higher production of organic acids instead of methane. Fermentation by thermophilic micro-organisms at 60°C presented no problems but temperature control needed to be closer than the 33-35°C required for mesophilic fermentation. The size of the fermenter was appropriate to the load; if the latter was reduced this had a harmful effect on the microbial flora. The retention time proved important and 10 days found to be best. Other factors studied included total alkalinity, solids (which should not exceed 12%), COD and BOD. The product gas is a mixture of methane and CO_2 and its calorific value depends on the content of the former. An industrial unit of 400 m^3 capacity was built and is described and illustrated, as are trials which showed the suitability of the gas obtained for firing of boilers without modification and of diesel engines with reduction of the air intake.

Bagasse as a potential source of raw material with special reference to the availability of bagasse in Maharashtra. Anon. *Maharashtra Sugar,* 1981, **7**, (2), 9-15. – The amount of bagasse that could be surplus to requirement as fuel in a sugar factory of 2400 tcd capacity is calculated, and the possible annual total quantity of surplus bagasse in Maharashtra estimated to be sufficient to permit production of 100,000 tonnes of paper.

Modern depithing methods for bagasse and its effect on paper-making properties. Anon. *Maharashtra Sugar,* 1981, **7**, (2), 17-21, 23, 25, 27-30. – Descriptions are given of dry depithing, wet depithing and a combination of these two methods as well as of the equipment used and means of pith disposal. Pulping and depithing studies conducted at Parkhe Research Institute are reported; results showed that screened yield rose as the pith content fell, while the percentage of rejected material, Kappa number and chemicals consumption decreased.

Sugar beet pressed pulp silage – its feed value and possible use in pig feed. G. Burgstaller. *Die Zuckerrübe,* 1981, **31**, 40, 42 *(German).* – Feeding trials are reported in which little difference was found between the results for pigs fed on a non-beet pulp energy ration and those fed on a daily energy ration of 2.2 kg pressed pulp silage. Addition of 20% molasses increased consumption of the ration. For pigs weighing at least 45 kg, replacement of the energy ration with pulp silage is recommended.

Prospects for use of unconventional biocides in the disinfection of ethanolic fermentation. M. E. M. Furletti, M. C. F. L. de Oliveira and D. F. de Angelis. *Brasil Açuc.,* 1981, **98**, 219-223 *(Portuguese).* – The use of two disinfectants, one a 30% formulation of 2-(thiocyanomethylthio) benzothiazole and the other a formulation of 25% 2-hydroxy-ethyl 2,3-dibromopropionate and 5% 2-(thiocyanomethylthio) benzothiazole, was compared with the use of crystalline penicillin V acid. The first two were used in gross concentrations of 40 ppm and the last as 0.5 mg (containing 840 units) per litre. Neither of the two disinfectants affected the biological fermentation process and so have a potential for use as disinfectants in alcohol fermentation which is to be studied further.

Physico-chemical treatment of vinasse: flocculation, sedimentation and filtration. E. Nicolaiewsky. *Brasil Açuc.,* 1981, **98**, 253-260 *(Portuguese).* – Experiments have been made on removal of solids from vinasse of different origins in order to render it suitable for treatment by reverse osmosis before disposal. Vinasse from mainly juice fermentation could be satisfactorily flocculated by liming to pH 11.5, but vinasse from molasses required the addition of polyelectrolytes or other aids. Vinasse from manioc required considerable amounts of chemicals. Filtration of vinasse required a considerable filter surface area and was expensive owing to the large amount of filter aid required, although the COD reduction was of the order of 30-40%. Utilization of the separated solids as a soil additive, for recirculation, etc., requires study.

The DCI (submerged cell diffusion) process: a diffuser for the national alcohol program. C. Procknor. *Brasil Açuc.,* 1981, **98**, 261-275 *(Portuguese).* – The advantages of the use of diffusers for autonomous distilleries is discussed, with a brief theoretical summary of the process of juice extraction by diffusion. The results obtained in a pilot installation erected to determine percolation rates are presented, as well as the conditions necessary to obtain the maximum efficiency at each stage of the diffuser. The data from the pilot plant will serve as a basis for a project of developing a diffuser specifically for autonomous distilleries, which is described with a discussion of its advantages.

Sugar beet pulp drying control. H. P. Gildersleeve. *Sucr. Belge,* 1982, **101**, 19-27. – The pulp dryer load control system developed and patented by Holly Sugar Corp. is described. Control is based on the relationship between drum pulp load and the differential pressure between the furnace and the drum discharge chamber; as the differential pressure decreases, the induced draft to the drum automatically increases. Results obtained with the system are reported, and advantages indicated as reduced fuel costs, increased capacity, greater uniformity in dried

pulp moisture content and reduction in particulate emission. Investment costs are low and installation requires only minor changes to existing equipment. A method of proportioning the variable flow of pulp to two or more dryers at the same factory is also described. Its use at four factories permits each dryer to operate at almost identical values of operational parameters.

Beet — a renewable raw material for production of ethanol and chemical feedstock. M. Dambroth. *Zuckerind.*, 1982, **107**, 125-130 *(German)*. — Various aspects of alcohol manufacture from beet are discussed. Under West German conditions, there would be insufficient area available for enough beets to satisfy all the fuel requirements, so that a "gasohol" mixture would have to be the aim. Considerable improvement in the technology of alcohol manufacture would be needed, and special beet varieties bred that were suitable for alcohol production. The product would have to be competitive on an open market, without fiscal protection. The question of chemicals production based on ethanol is also discussed.

Ethanol fermentation of blackstrap molasses and sugar cane syrup by *Zymomonas* (preliminary experiments). M. R. de Melo Cruz and W. Borzani. *Rev. Brasil. Tecnol.*, 1980, **11**, (2), 51-57; through *S.I.A.*, 1982, **44**, Abs. 82-209. — Ethanol production by *Zymomonas* and by *Saccharomyces cerevisiae* was measured in fermentation experiments using cane molasses and cane syrup as raw materials. Fermentation yields were 19-39% higher with *S. cerevisiae* than with *Zymomonas*. The relatively high residual sugar contents after fermentation with *Zymomonas* indicate that sugar was not the limiting substrate in these tests. The method used to prepare the inoculum seemed to have a considerable effect on ethanol production by *Zymomonas*.

Generation of electricity in alcohol distilleries. N. Fraidenraich. *Rev. Brasil. Tecnol.*, 1980, **11**, (4), 257-278; through *S.I.A.*, 1982, **44**, Abs. 82-199. — Taking into account the high potential for electricity generation in alcohol distilleries, using bagasse as a fuel, a co-generation scheme is analysed as a function of the pressure of the boiler, in the range 15-120 atm. Multi-stage, high-efficiency turbines of the back-pressure and condenser types are considered. For both schemes, the energy produced per tonne of cane processed in the alcohol plant is evaluated. Calculations show that significant amounts of electricity can be obtained. The relation between the additional investments required and the energy produced in one year is evaluated in the case of a distillery of 120,000 litres/day capacity.

Manipulation of fermentation in sugar cane silages and its feeding value for lambs. II. Sodium monensin addition to the supplement and physical and alkaline (NaOH) treatments of the sugar cane on the animal performance. M. L. Cuaron and A. S. Shimada. *Cuban J. Agric. Sci.*, 1981, **15**, 181-190. — Two experiments were carried out: (1) to compare fresh cane silage of 28% dry matter, to which 4% NaOH (on dry matter) had been added, with fresh cane silage of 30% dry matter, sun-dried (withered) cane (of 38% dry matter) and cane burnt at harvest (of 28% dry matter), and (2) to determine the effect of NaOH addition to the silage and of the use of sodium monensin (an antibiotic) on daily weight gains and forage consumption. Results showed that both factors increased as a result of NaOH addition, but that withered cane was better in this respect, while burnt cane was the best (both with NaOH added). Addition of Na monensin reduced voluntary consumption without affecting daily weight gain.

Need to develop cane wax production by the world sugar industry. P. J. M. Rao. *Indian Sugar*, 1981, **31**, 437-449. — See *I.S.J.*, 1981, **83**, 251.

Molasses and its derivatives. H. Swan and A. Karalazos. *Bol. Técn.* (GEPLACEA), 1981, (19), 20 pp *(Spanish)*. A survey is made of the literature (but without a bibliography) on aspects of animal feeding with partial substitution of grains with molasses or condensed molasses solubles. Observations are quoted on digestibilities, composition of rations, nitrogen compositions, etc.

Economic considerations on sugar cane by-products. H. Noa S. *CubaAzúcar*, 1981, (July/Sept.), 3-16 *(Spanish)*. — The economics of utilization of sugar cane by-products (trash, bagasse, molasses, filter cake etc.) are discussed with cost and price data applicable in Cuba. The advantages of diversification in sugar producing countries is mentioned, but comparative advantages of one product against another will depend on conditions in the individual country concerned.

Comparative studies on the effect of depithing of pulps from Brazilian and Egyptian bagasse. M. M. S. El-Morsy and R. A. M. El-Gohbasy. *Fibre Sci. Technol.*, 1979, **13**, (1), 23-27; through *S.I.A.*, 1982, **44**, Abs. 82-258. Bagasse samples were pulped by the prehydrolysis-soda process, followed by multi-stage bleaching. Without depithing, pulping was unsatisfactory and the pulp had a high ash content. Results are given of tests in which (a) 2—6% pith was removed before prehydrolysis, or (b) 2—17% was removed after prehydrolysis. For Brazilian and Egyptian bagasses, respectively, the ash contents of the pulps were minimum if pith removal was 5 and 3% in (a) and 15 and 10% in (b). Method (a) gave a better yield, higher alpha-cellulose content and higher degree of whiteness. However, all pulps were suitable for viscose.

Energy saving in the thermal drying of sugar beet pulp. W. Poersch. *Zuckerind.*, 1982, **107**, 195-204 *(German)*. Calculations are made of the quantity of heat consumed: to evaporate 1 kg of water from beet pulp; to heat the pulp and residual water; to cover heat losses in the dryer, those caused by air entrainment and from flue gas as well as in firing; and to evaporate the water of combustion. The specific flue gas quantity is also calculated, and from the overall heat consumption is derived information on the potential energy saving. The system of calculations is found to give a clearer picture than a Sankey diagram. The energy savings that could result from mixing dryer drum waste gas with the furnace gases, by utilizing boiler flue gas or by pre-heating the combustion air, are calculated. Replacement of oil with solid fuel is also discussed, as are the advantages and disadvantages of fluidized-bed coal firing instead of conventional oil or gas firing.

Experience and recommendations on the use of pressed pulp in fodder. E. Thier. *Zuckerind.*, 1982, **107**, 223-230 *(German)*. — The advantages and disadvantages of pressed pulp as cattle and pig fodder are discussed on the basis of trial results, and a number of recommendations are made.

BREVITIES

Greece beet by-products utilization[1]. — Hellenic Sugar Industry Ltd. intends to improve the utilization of its by-products. The program includes the construction of three plants for manufacture of citric acid, dry yeast and alcohol, involving a total investment of 2000 million drachmae. The citric acid plant will have an annual capacity of 6000 tonnes using molasses as raw material, while the other plants will produce 2000 tonnes of yeast and 10,000 tonnes of alcohol per year, also from molasses.

ISO sugar economy studies. — The International Sugar Organization is revising the format of the series of studies on the sugar economies of individual countries to be published as "The World Sugar Economy: Structure and Policies". The series will consist of regional volumes which will include country-by-country developments between 1961 and 1981, with statistical information provided on processing capacity, production, consumption, trade and agriculture. Expected dates of publication are: Volume 1 (Central and South America), December 1982; Volume 2 (Africa), December 1982; Volume 3 (Asia), February 1983; Volume 4 (Oceania and North America), April 1983; and Volume 5 (Europe), May 1983. Further information concerning the series, including availability and prices, will be available from the International Sugar Organization, 28 Haymarket, London SW1 4SP, England.

Sugar Industry Technologists Inc. Meade Award. — Dr. Michael Bennett, President of SIT, has informed Mr. W. F. Barton of Atlantic Sugar Ltd. and Dr. W. J. Knebel of Calgon Corporation, that their joint paper[2] has won the Meade Award for the best paper presented to the 1982 SIT Technical Sessions in Atlanta. The authors will be presented with the award plaque at the SIT meeting in New York in May 1983.

South African Sugar Technologists Association 1983 Congress. The 1983 Congress of the S.A.S.T.A. will be held during June 6-10, with opening sessions at the Royal Hotel in Durban, factory sessions at the Experiment Station and agricultural sessions at Huletts Country Club. As before, an attempt will be made to include a symposium and a panel discussion in the Congress proceedings. Authors wishing to present a paper at the Congress should provide a record of their name(s), provisional title and abstract of the paper immediately and the full text by March 18, to the Hon. Technical Secretary, S.A.S.T.A., c/o SASA Experiment Station, Mount Edgecombe, South Africa 4300. Instructions for the guidance of authors are printed at the back of previous proceedings or are available from the Secretary.

New Pakistan sugar factory. — On December 1, the Vice Chief of the Pakistan Army Staff laid the foundation stone of a new sugar factory which is the country's 36th and will go into trial production during the next campaign. The factory, known as Shah Burhan Sugar Mills, is being built by the Army Welfare Trust at an estimated cost of Rs. 300 million (£14,290,000). It is located at Badin, about 150 miles from Karachi, will have an initial designed capacity of 2000 t.c.d. and will produce about 22,000 tonnes of sugar, tel quel, per annum. It is to be supplied by the state-owned Heavy Mechanical Complex Ltd., of Taxila. The installed cane crushing capacity of Pakistan is now 860,024 t.c.d. and the government plans to add 10 more sugar factories to raise this to 1,091,000 tonnes. Current white sugar production is 1,300,000 tonnes and will rise to about 1,650,000 tonnes when the expansion is complete.

New RT diffuser contract. — Raffinerie Tirlemontoise S.A. has placed an order with Abay S.A. (formerly ABR Engineering) for construction of the latest design of RT diffuser for installation at the Longchamps factory. The new diffuser has been designed for high thermal efficiency, and uses "low temperature" heat normally lost. The nominal daily capacity of the plant is 5000 tonnes and it is 46.77 metres long, with a 5.6 m drum diameter and 6 m diameter of the built-on heat exchanger. The contract is worth about 120 million Belgian francs and the plant is to be commissioned in August 1983.

Unofficial post-ISSCT Congress tour. — The official post-Congress tour to be held after the 18th ISSCT Congress will be in Mexico but, owing to its proximity to Havana, the location of the Congress, the City of Miami, Florida, in conjunction with the Inter-American Sugar Cane Seminars, has extended an invitation to delegates to visit Miami and the Florida cane area during February 28 to March 4, 1983. The program will consist of several tours to Florida sugar factories, where visitors will have the opportunity to see the different field and factory operations. A Ladies Program has also been prepared, as well as a visit to Disneyworld and the recently inaugurated Epcot Center (City of the Future). The total cost of the program, including de luxe hotel accommodation for four nights, Ladies Program, meals, all the tours and the Disneyworld/Epcot Center trip, is $295 per person, double occupancy, or $395 per person, single occupancy. Further information may be obtained from Mr. A. Latour, Inter-American Sugar Cane Seminars, Inter-American Building, 3690 N.W. 62nd Street, Miami, FL 33147, USA (Telephone: 305-633-0351; Telex: 51-9490 Vancart Mia).

Süddeutsche Zucker-AG 1981/82 report. — The year was characterized by a record harvest which resulted from a combination of the planned increase in the beet area from 103,000 to 116,000 ha and an unusually high crop yield of 61.6 tonnes/ha against 50 tonnes/ha in 1980/81. The beet quantity processed rose by about 40%, from 5.2 to 7.2 million tonnes and, although the sugar content was lower, at 16.02% vs. 16.68%, sugar production reached 994,000 tonnes against 744,000 tonnes in the previous campaign. In order to handle the large crop an advance program was put into practice and the daily slice rose from 62,100 to 65,600 tonnes. During the year, Aktien-Zuckerfabrik "Wetterau", at Friedburg, was acquired. The associate company Zuckerfabrik Franken GmbH processed a total of 2.9 million tonnes of beet in its factories at Ochsenfurt, Wabern, Warburg and Zeil to produce 408,000 tonnes; in 1980/81 it sliced 2.2 million tonnes to produce 308,000 tonnes. A reduction of 9% in the beet area is expected for 1982/83.

Belize sugar industry[3]. — The Belize Sugar Board has reported a production of approximately 106,000 long tons from the crop which ended on July 31. This exceeds the 1981 production of 98,000 tons by more than 8% but total revenue will be lower at only $31 million, against $44 million in 1981, owing to lower sugar prices. Despite the low prices, however, a feasibility study is being completed by consultants to Belize Sugar Industries Ltd. of expanding crushing capacity by around 40%. Sugar has traditionally provided more than 50% of Belize's export earnings. Close to 60,000 tons has been exported annually to the US but under the new quota system this will be reduced to 34,000 short tons. Something more than 40,000 tons are sent to the EEC but, with only 7-8000 tons required for domestic consumption, more than 20,000 tons must be sold on the world market. Output in 1982 was affected by smut but this is expected to be only a temporary reverse because of active replanting with resistant varieties. The full benefit of these will not be felt until 1985, however.

Corrigendum. — In a report on Syrian sugar expansion[4] we said that two sugar factories built by ABR Engineering at Meskenah and Raqqa would be in operation in the 1982 campaign. We are now advised that these factories have been in operation since 1978 and that they processed 380,000 tonnes of beet in 1982, their fourth campaign.

UK request for EEC quota increase[5]. — British Sugar plc and the National Farmers Union have approached the UK Minister of Agriculture with a request that the UK's B-quota should be increased. The A-quota is 1,040,000 tonnes and B-quota 10% of this, 104,000 tonnes. For other EEC countries the B-quotas are 27.5% of the A-quotas. Sugar produced in excess of the two is C- or non-quota sugar and must be sold on the world market without subsidy. The UK 1982/83 sugar production estimate is 1,350,000 tonnes.

Sri Lanka sugar project possibility[6]. — In discussions between the Sri Lanka Minister of Lands and Land Development and the visiting UK Trade Minister, the possibility was raised of UK capital investment in agricultural projects in Sri Lanka, including a sugar project to be set up with Commonwealth Development Corporation assistance.

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[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 518.
[2] See *I.S.J.*, 1983, **85**, 14.
[3] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 506-507.
[4] *I.S.J.*, 1982, **84**, 300.
[5] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 556.
[6] *Standard Chartered Review*, Oct. 1982, 22.

Brevities

Peru sugar industry crisis[1]. — Although 1981/82 sugar output was the best since 1977/78 (an estimated 740,000 tonnes against only 478,500 tonnes in 1980/81 and 537,375 tonnes in 1979/80), it still has some way to go to attain the 900,000 tonnes-plus level achieved during the most of the 1970's. To achieve this will require major changes in the structure of the sugar industry centering on the need to convert the sugar cooperatives into efficient businesses. They should benefit from the establishment of the recently announced INCOOP and from scrapping of the centralized marketing agency CECOAAP. But the 12 cooperatives face other problems; low domestic prices, debts and an acute shortage of working capital. They want the government to authorize prices on the home market that will cover their costs, averaging 325 soles/kg against an official price of 240 soles/kg. To add to its financial problems, the sugar industry fears that drought, which severely reduced production in 1977-1980, could recur in the coming season. The area most likely to be hit, and where water is in shortest supply at the moment, is La Libertad province, where the three large cooperatives Casa Grande, Cartavio and Laredo account for 45% of national output.

Fuel alcohol from corn in US[2]. — The Loudon, Tennessee, corn milling plant, which was originally under construction as a facility for HFCS manufacture[3], is initially to produce only fuel alcohol; HFCS manufacture could follow when HFCS prices are more favourable. Present excess capacity in the HFCS industry largely reflects the decision by two major beverage companies not to raise rates of substitution of HFCS for sugar at present.

Mexican sugar factory purchase by government to cease. — The new Mexican government has officially announced that it does not wish to buy any more private sugar factories[4]. Government acquisition during the recent López Portillo administration reduced the private sector from 50% to 23% of the Mexican industry; many of the remaining private factories are operating at a loss and can only continue through large infusions of government financial capital and certain preferential treatment. Apparently the government is becoming very sensitive to criticism that its mismanagement has turned Mexico into a sugar importer by destroying private incentive. Cane farmers in three states delayed harvesting of cane to back demands for higher prices. The National Sugar Commission offered to raise cane prices by 67% and the farmers eventually agreed[5], although they had been earlier insisting on a 100% rise. A sharp increase in the domestic sugar price from 8 to 18 cents/lb[6] was announced in November and is expected to lead to reduced consumption and imports.

Nigeria sugar imports growth[7]. — Nigeria is one of the world's largest importers of white sugar and, according to the I.S.O., imports rose from 267,416 tonnes to 709,212 tonnes between 1976 and 1980. In the same period domestic consumption of sugar rose from an estimated 250,000 tonnes to 635,000 tonnes. The explosive growth of consumption can be ascribed to rising incomes, population growth and low sugar prices. Oil revenues made the large imports possible but oil revenues in the years to come may not be as plentiful as in the past. The resultant trend towards lower consumption growth rates for sugar could only be halted if domestic production shows signs of improvement. But the production record is depressing and various new schemes are behind schedule. Sugar production in 1981/82 is estimated at 36,000 tonnes, raw value, while the government's target for 1980 was fixed at 80,000 tonnes, white value. Production costs are among the highest in the world and the new Laflaga sugar complex has run into severe difficulties.

High fructose corn syrup facility in Uruguay[8]. — Remolacheras y Azucareras del Uruguay S.A., jointly with Coca-Cola, is redesigning the equipment at its plant in Mercedes, Soriano Dept., to produce HFCS. The Coca-Cola involvement is through its subsidiaries A.E. Staley Mfg. Co. and Industria de Maiz S.A. of Argentina. The project involves an investment of $18 million and will start operating in the last quarter of 1983, to produce 10,000 tonnes of 55% HFCS (dry basis).

Puerto Rico sugar crop, 1982[9]. — The 1982 Puerto Rico sugar season began late, in the absence of a labour agreement. Two factories did not start operating until early February and three were delayed until mid-March. Five factories processed 1,580,000 short tons of cane, down from 2,040,000 tons in 1981. However, only 111,948 tons of sugar, raw value, was produced from the 1982 crop, down significantly from 150,840 tons a year earlier. Sugar recovery was disappointing, averaging only 7.1% against 7.4% in 1981 and 7.9% in 1980. The rate in 1982 partly reflects the late start in processing but, also because of the late start, the season ran later than usual and a significant amount of cane not harvested will be carried over to the 1983 harvest.

Surinam sugar factory rehabilitation[10]. — An Indian firm has been assigned to renovate an old factory in Surinam which once used to employ Indian labour, it has been officially stated. The $9,000,000 deal is the first technological contract between India and Surinam.

Brazil sugar exports ban[11]. — Brazil is to export no more sugar until the price improves and alcohol fuel is to be produced instead 1982 exports earned only half 1981's income of $1100 million and it now seems a better bet to raise the proportion of alcohol mixed with petrol for use in cars. The government has recently introduced severe import restrictions, extending to chemicals, machinery and non-ferrous metals, in an effort to bring the year to a close with a trading surplus.

Belgium sugar dust explosion[12]. —24 people were injured, four of them seriously, in October last when a sugar dust explosion occurred in the old icing sugar section of the Tirlemont refinery. The new crystallization station was damaged and a fire broke out, with resultant damage amounting to many millions of Belgian francs. Beet processing could continue in the factory despite initial fears.

Protests against Italian sugar factory closures[13]. — The governments of the Veneto and Romagna regions of Italy have called on the Industry and Agriculture Ministries in Rome to intervene in the proposed closure of the six sugar factories of Bando d'Argenta, Jolanda di Savoia, Mezzano, Ficarolo, Ceggia and Montesi. The regional governments want the Italian government to seek a higher A-quota in order to keep sugar production at least at its previous level. Sugar workers called an 8-hour strike on December 1 against the closures.

Hawaii sugar industry future[14]. — Hawaiian authorities are giving serious consideration to the possibility of a collapse of their sugar industry. It has been stated, however, that, even though the picture looks bleak, with closure of four factories under consideration, the Hawaiian industry will not close down overnight, and indications are for a phasing-out over 10-15 years. During the past 50 years, employment in the industry has steadily declined with the increase in mechanization, and labour force reductions will not help the industry out of its current plight. Unions representing sugar workers have agreed to defer half of a 10% wage rise for six months provided a retrospective lump sum adjustment is made when the sugar price increases and remains at a pre-determined level. Additionally, they have agreed an increase in rent for workers dwellings from $35 to $40; the sugar companies had sought an increase of 150% in rent for the dwellings while, for similar accommodation outside the industry, the rent would be $400. Current sugar production in Hawaii is about 1,000,000 tonnes a year.

Finland 1982 beet crop[15]. — Finland's sugar beet harvest in 1982 amounted to 756,000 tonnes, against 680,000 tonnes in 1981. Favourable weather made harvesting easier and brought higher yields per hectare.

India sugar production, 1981/82[16]. — India's sugar production in the 1981/82 season to September 30 rose to a record 8.43 million tonnes from 5.14 million tonnes the previous year, according to the Indian Sugar Mills Association. Total offtake in 1981/82 was 5,500,000 tonnes for domestic consumption and 415,000 tonnes for export, against 4,900,000 and 60,000 tonnes, respectively, the previous year. Factory stocks on September 30 were a record 3,290,000 tonnes against only 777,000 tonnes a year earlier.

Mexico sugar factory closures[17]. — Mexico has announced plans to liquidate a number of wholly-or partly-government owned companies and this will involve, among others, closure of the Agua Buena, El Cora and Santa Inés sugar factories.

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1 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 561.
2 *U.S.D.A. Sugar & Sweetener Outlook & Situation*, Sept. 1982, 14.
3 *I.S.J.*, 1981, **83**, 352.
4 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 601.
5 *ibid.*, 643-644.
6 C. Czarnikow Ltd., *Sugar Review*, 1982, (1624), 198.
7 *African Business*, Sept. 1982.
8 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 578.
9 *U.S.D.A. Sugar & Sweetener Outlook & Situation*, Sept. 1982, 12.
10 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 603.
11 *The Times*, October 7, 1982.
12 *Zuckerind.*, 1982, **107**, 1077.
13 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 616.
14 *Australian Sugar J.*, 1982, **74**, 412.
15 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 616.
16 *Reuter Sugar Newsletter*, October 25, 1982.
17 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 618.

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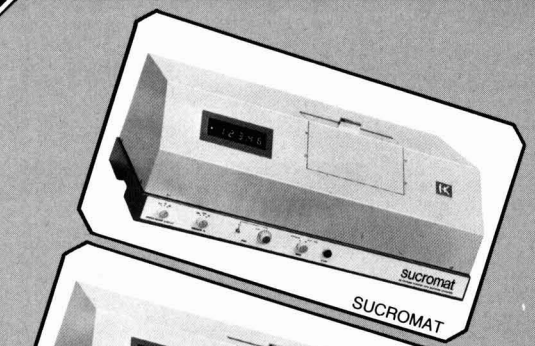

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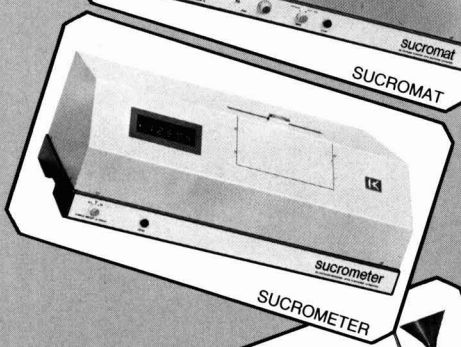

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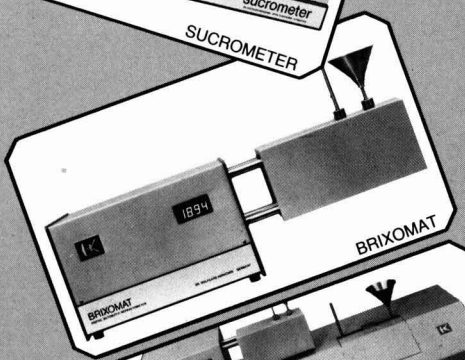

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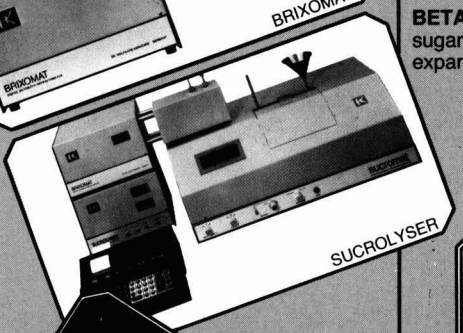

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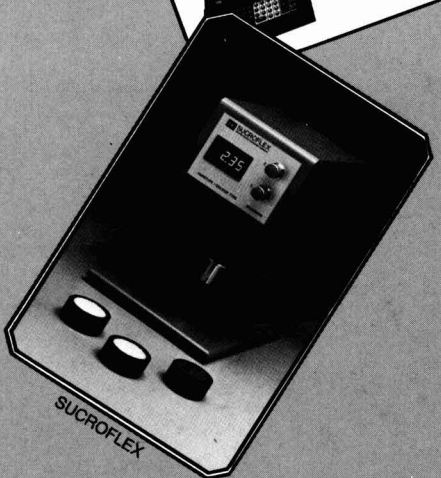

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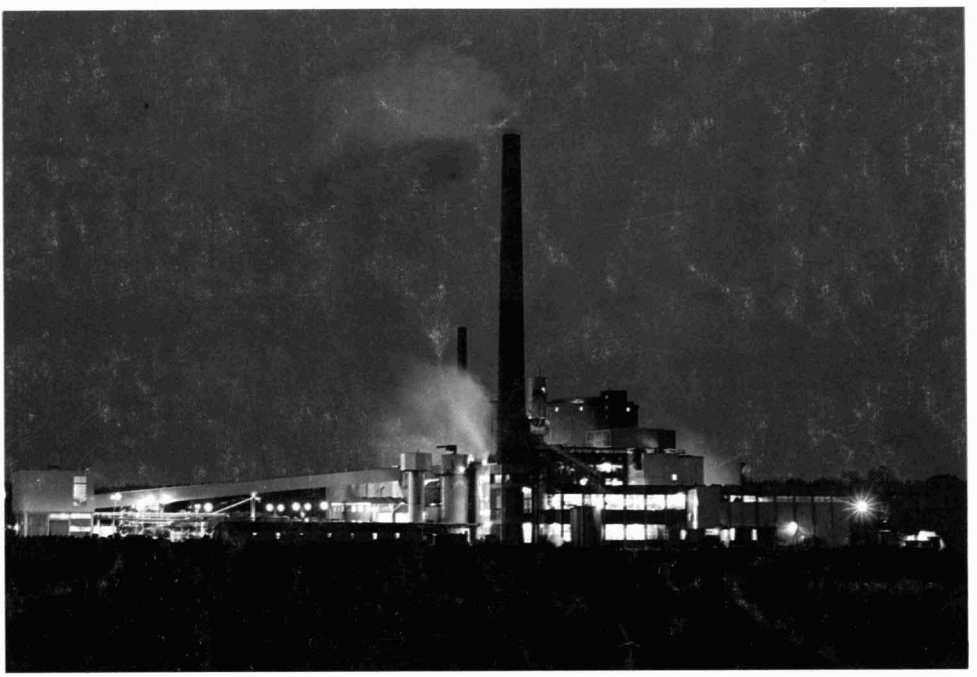

Braunschweiger Zucker AG, Wierthe Sugar Factory. Overall engineering design and supervision: IPRO

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