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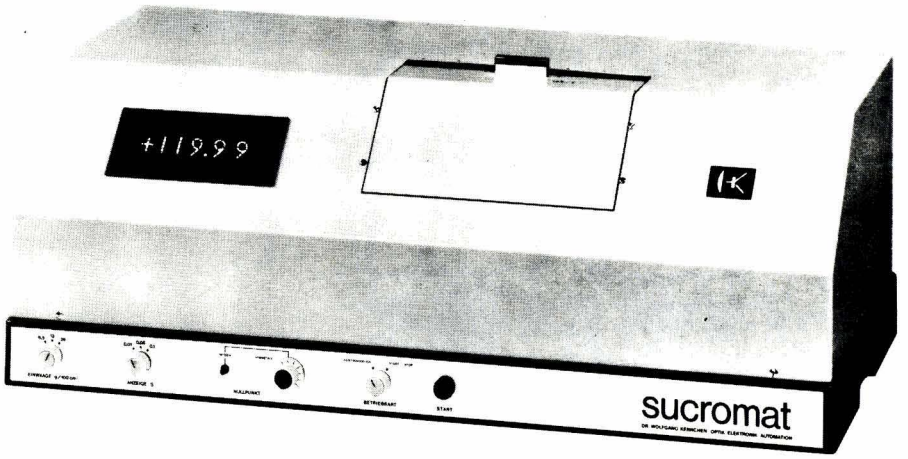

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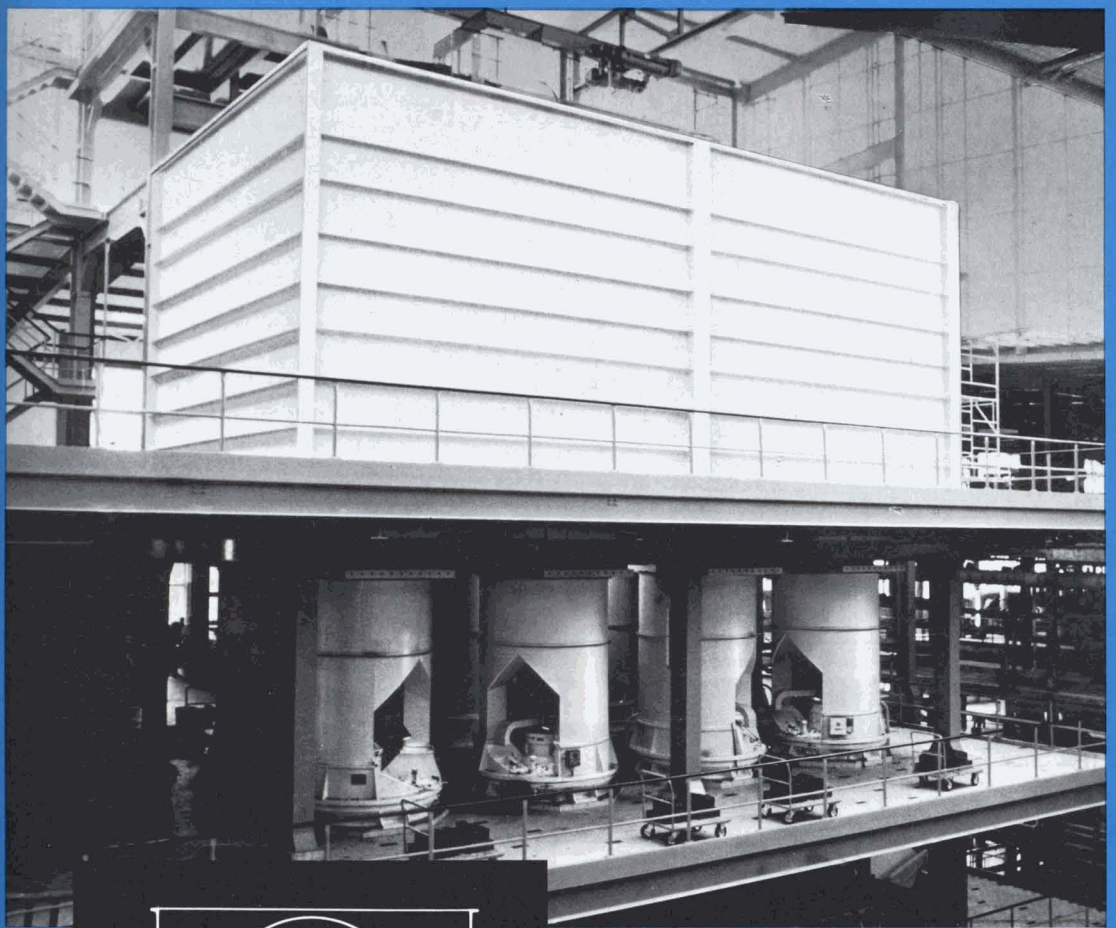

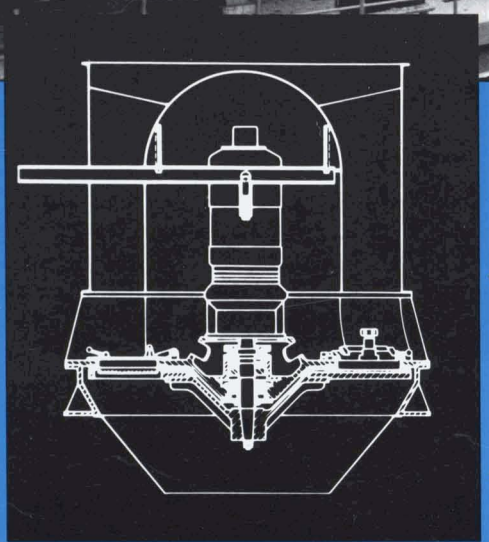

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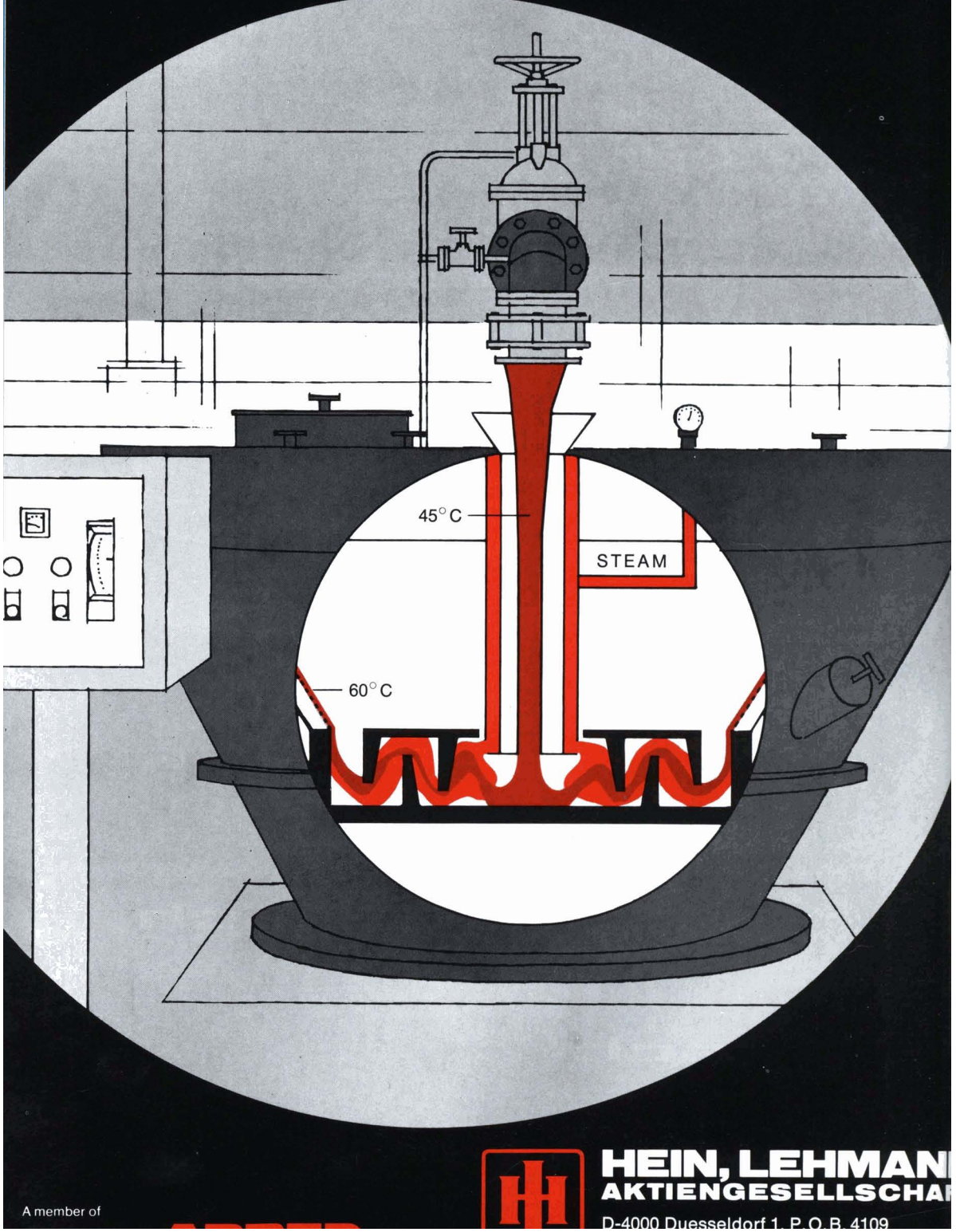

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NOTES AND COMMENTS

World sugar prices

The London Daily Price for raw sugar started the month of January at £163 per tonne and eased to £157 by January 6. With holidays in most countries during the previous two weeks and little market activity, prices had tended to drift lower and there was also a fear that political tension might hinder the delivery of sugar contracted for the USSR. Year-end observations had also emphasized the bearish supply-demand position. Frost in Florida and severe cold weather and floods in Europe strengthened the market and the LDP rose to £167 by January 14 but thereafter it eased again, aided by a reduction of £1.00 per tonne in the nominal Caribbean/UK freight rate. After remaining steady at £162 from January 18 to 22, it was strongly influenced by rumours and then official confirmation of a very poor Soviet crop, whereupon the price rose to £176 per tonne on January 26, only falling to £172 on the last trading day of the month, January 29.

During January, white sugar prices followed the variations in those for raw sugar, the LDP(W) starting the month at £169.50 and ending it at £177, with a minimum of £163 and a maximum of £182 in between. The premium varied between £5 and £11 per tonne but most days was steady at between £6 and £8.

Soviet sugar crop failure[1]

Reports had been circulating towards the end of 1981 and in early 1982 involving the shipment of considerable tonnages of EEC sugar to the USSR. Vessels in several ports were understood to be chartered to load sugar for the Soviet Union so, when the news broke that once again there had been a very poor beet crop in that country, it did not have quite the impact that it might have done had the market been completely unprepared.

The beet harvest in the autumn of 1981 is reported in the press to have been no more than 60.6 million tonnes, the lowest figure since 1963, as against 79.6 million tonnes harvested in the previous year. Clearly, assessments of sugar production will have to be severely marked down but it will be some time before a close indication of actual production can be reached. It seems probable, in view of the much reduced crop, that some pressure will have been exerted to encourage maximum deliveries to the sugar factories, bearing in mind the need also to provide cattle with beet for fodder. Furthermore, the shorter crop should ensure that the average sugar content of the roots will not be reduced to the extent which has sometimes happened when they have been kept too long in clamps.

Western Australia sugar industry plans[2]

The state government of Western Australia has announced that it will go ahead with plans to develop a new sugar industry in the Ord River region. Government officials said that the state is seeking proposals from prospective developers which will establish cane growing and one mill in the area producing 150,000 to 200,000 tonnes of raw sugar a year by the end of 1987.

The Ord River region lies in the north-west of Australia, inland from the Bonaparte Gulf and within easy reach of the port of Wyndham which can take vessels of up to 20,000 tonnes.

But the move to develop this new sugar-growing area has not been welcomed by other cane growers in Queensland, Australia's main sugar area. The Queensland growers fear that the establishment of a "rival" industry in Western Australia will hurt the viability of Australia's overall sugar industry. Several industry groups have said that any expansion of Australian output should be based on Queensland where there is sufficient land, existing infrastructure and expertise.

The EEC and the ACP sugar suppliers

At the EEC's last annual price fixing, domestic beet producers were given an 8.5% increase in prices, whereas the ACP countries were only offered 7.5%. The ACP producers were dissatisfied with this increase and the price dispute has only recently been settled[3].

It has been agreed that the price would be increased by 8.5% over that for sugar shipped in 1980/81, i.e. the same increase that had been granted to beet growers and processors. For some time finalization of the matter had been held up as the British Government wanted raw cane sugar storage levies to be suspended for a period of five years to compensate refiners for the higher price to be paid for raws, while the other EEC members were hitherto prepared only to suspend the levies for one year. In what is clearly a compromise it has now been agreed to suspend them for three years.

US sugar usage, 1981[4]

Total US domestic deliveries for 1981 are estimated at 9,737,000 short tons, raw value, a drop of 412,000 tons or 4.1% below the 1980 level of 10,149,000 tons. Cane refiners accounted for virtually all of this decrease, with deliveries lower by 402,000 tons or 5.8% (6,575,000 *vs.* 6,977,000 tons). Beet sugar shipments were down by only 20,000 tons, to 3,144,000 tons.

The dramatic decline in sucrose usage during 1981 was due primarily to displacement by high fructose corn syrup, growth of which is estimated at about 15% over 1980. In addition there are signs that total nutritive sweetener offtake may have softened slightly in 1981. The relative strength of beet over cane sugar deliveries is probably due to the good outturn of the domestic beet crop in 1980 and an even better crop in 1981, now estimated at about 3,350,000 tons.

Despite the decline in cane refiners' domestic deliveries, the total refined cane sugar output was up for 1981 as the result of expanded export business. Although official statistics on exports are not yet available for the calendar year, it is anticipated that the total will be more than one million tons against 1980's 688,690 tons.

EEC beet and sugar price proposals

The EEC Commission has released details of its farm price recommendations for 1982/83; increases of 9% have been proposed for beet roots and white sugar and an increase of 10% for raws[5]. It has also been suggested that there should be some adjustment in the exchange rates applicable for agricultural commodities (the "green currencies") which would result in the returns to farmers in West Germany, Holland and the UK being less than and in Italy more than the 9%.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1982, (1581), 13-14.
[2] *Public Ledger's Commodity Week*, December 26, 1981.
[3] C. Czarnikow Ltd., *Sugar Review*, 1982, (1581), 13.
[4] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 59-60
[5] C. Czarnikow Ltd., *Sugar Review*, 1982, (1581), 13.

These recommendations will now have to be considered by the Farm Ministers. In the past there has sometimes been a tendency for the Ministers to increase the recommended prices and, indeed, that might well happen this year, but the immediate prospect would appear for decisions on farm prices to be held up until problems related to the Community budget have been solved. Nevertheless the Commission's proposals indicate that it has lost the will to attempt to solve the problem of over-production of agricultural commodities in the Community.

World sugar production estimate, 1981/82

At the beginning of January F. O. Licht GmbH issued their second estimates of world sugar production for 1981/82[1] and these are reproduced elsewhere in this issue. Yet again, Licht have raised their forecast for production in the EEC and this is now set at 2,771,000 tonnes more than in the 1980/81 campaign, an increase of 21.3%. The crop in the USSR was set 650,000 tonnes higher than the poor 1980/81 level of 7.15 million tonnes, but towards the end of the month it was stated that the 1981 beet crop had reached only 60.6 million tonnes against 79.6 million tonnes in the previous one so that Licht's estimate is likely to be at least one million tonnes too high.

Cuba is another area of uncertainty and interpretation of unclear statements but Licht have indicated a slight increase over the 1980/81 figure, itself showing a considerable recovery from the previous rust-affected crop, while acknowledging that a later upward revision might be necessary. The Brazilian crop is set at 8.45 million tonnes, below authorized production because of very dry weather in the North and North-East of the country.

Uncertainty arises in regard to the Indian crop because of the variance between government statements and those of industry sources. The forecast 7 million tonnes nevertheless represents an increase of 25% over 1980/81 and may well have to be raised if official estimates prove accurate. The total world crop, at nearly 96.8 million tonnes, is 1.7 million tonnes above Licht's first estimate of October 1981 and no less than 9.6 million tonnes or 11% above the 1980/81 production figure.

EEC sugar stockpile

At the end of September 1981 the EEC Commission announced plans to withold a total of two million tonnes of 1982/83-crop sugar from the market as a measure in support of the efforts by the International Sugar Organization to restore price levels in the world market to the ISA range. A secondary object was to reduce criticism by other sugar producers of the damage caused to their traditional sales by subsidized marketing of EEC sugar. Some 700,000 tonnes of A- and B-quota sugar were to be stored by the Commission and it was expected that the sugar producers themselves would put into store some 1,300,000 tonnes of C-quota or unsubsidized sugar.

There was some initial scepticism as to whether this 2,000,000 tonnes stock would materialize but statements were made by various national sugar producers associations in the Community indicating the amounts that they were prepared to withold from the market. As the last day approached for notification of commitment – January 31 – reports appeared that the amount to be stored would be only 1,100,000 tonnes; the German sugar manufacturers were reducing the amount they had previously intended to store and that other producers were not willing to commit themselves. This may have been the result of sales to the USSR following the poor Soviet crop.

In the event, notifications on January 31 totalled only 992,000 tonnes of C-quota sugar, implying that the Commission will have to hold back slightly more than a million tonnes if the original total is to be retained. This would be a costly matter and will involve reduction of weekly export authorizations. The question is whether the Commission will still continue with its plan; according to the *Public Ledger's Commodity Week*[2], "A number of traders believe that Brussels will still aim to bring the total stockpile up to 2 million tonnes. Having made great political capital out of the venture as evidence of its commitment to the need to control world supply and demand, the EEC can ill afford to be seen backtracking on its previous promises".

Iraq sugar industry[3]

The sugar industry in Iraq started in 1958 with the establishment of a plant in the north of the country at Mosul with an initial capacity of 3000 tonnes of beet per day. A cane project was set up in the early 1960's in the south of Iraq at Amarah and a second beet sugar plant was established in the late 1970's at Suleimaniya. The combined capacity of these plants for processing domestic crops is 73,000 tonnes per year while they also refine imported raws to produce 235,000 tonnes of refined sugar, i.e. a total annual output of 308,000 tonnes.

The Hindiyan sugar factory under construction is designed to serve the Musayeb region which has been under evaluation since the early 1970's as a beet growing area and was at one time considered suitable for production of 50,000 tonnes of sugar a year. Completion of the Hindiyan factory was originally intended for 1981 but has been delayed, perhaps by the war with Iran. Its advent will, however, bring local sugar output capacity to more than 100,000 tonnes per year, although this is only half-way to the now outdated government target for 1980 which looked to a comparable 1985 total of 700,000 tonnes per year.

Much of Iraqi agriculture is small-scale and relies on traditional equipment and methods. Both the activities of large landowners and land reform agencies set up to broaden the ownership base have hindered the development of new techniques and rises in productivity. The area under cultivation has been inadequate and productivity low. As a result the Mosul and Amarah factories have operated at only a fraction of their capacity and in 1980/81 domestic sugar production was only 25,000 tonnes of beet sugar and 15,000 tonnes of cane sugar.

Iraq thus has to rely heavily on imports, although it is able to refine most of its requirements. For 1980/81 imports totalled 330,000 tonnes but for the three previous years they averaged 440,000 tonnes; the cutback can be attributed entirely to the difficulties posed by the hostilities. Stocks have been drastically reduced, from 159,000 to 74,000 tonnes between September 1, 1980 and August 31, 1981.

Annual per caput consumption has increased markedly to a level of 40 kg. This is due in part to rises in disposable incomes but the heavy subsidies given to sugar have encouraged smuggling to neighbouring countries and this may have inflated apparent consumption.

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[1] *International Sugar Rpt.*, 1982, **114**, 21-28.
[2] February 6, 1982.
[3] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 38-39.

Studies on scale insect infestation

By N. TRIPATHI and G. S. SHUKLA*
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University of Gorakhpur, Gorakhpur, India 273001)

Introduction

The two species of sugar cane scale insect, namely *Melanaspis glomerata* (Green) and *Aulacaspis tegalensis* (Zehnt.), have been studied in some detail. Of the two, only *M. glomerata* is native to and occurs in India.

There are conflicting views on the possibility of dispersal of scale insects through planting of infested setts. In Java, van Deventer[1] asserted that *A. tegalensis* could not survive burial, but van der Goot[2] found living insects on setts 3½ months after planting, and after 5 months they were present below the soil surface on almost all plants developing from infested setts. In Mauritius, Moutia[3] stated that no stage of *A. tegalensis* is able to live more than 10-12 days on buried setts; however, Williams[4] obtained results similar to those of van der Goot.

Moutia[3] also observed that, with *A. tegalensis*, the wetter the soil, the sooner the scales died. Williams[4] stated that persistence of *A. tegalensis* on infested setts after planting was prolonged. Some were found after six months and insects eventually appeared on the stems of shoots in circumstances that left little doubt that they were derived from those on the setts. He also stated that soil structure and moisture probably influence the survival on setts but that there was surprising tolerance of the adversities of burial and a remarkable ability to live on setts in an advanced stage of decay.

Avasthy[5] believed that carryover of *M. glomerata* (Green) occurred through the use of infested setts. However, no systematic work on these lines in respect of *M. glomerata* seems to have been done so far and the present study was undertaken with a view to confirm this belief or otherwise.

Materials and methods

Setts, heavily infested with sugar cane scale insects, were planted in large earthen pots containing a mixture of soil, sand and manure which had been heated at 50°C for approximately one hour. The setts were irrigated from time to time with water which was filtered through muslin cloth. Three replicates were planted in March 1980 and three more in October 1980. All six replicates were individually covered with muslin cloth and placed in the greenhouse.

Observations were made 5½ months after planting, by which time between 12 and 17 internodes had formed.

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The whole experimental plants were separated by placing the earthen pots in a water tank. All the roots were carefully shaved with a sharp blade and the plants closely examined, using a 10X lens, to detect the presence of scale insect stages, if any. In no case was any infestion by the pest observed.

Discussion

There is a long time gap between the emergence of scale insect crawlers from the old colonies present on infested sugar cane setts and the formation of internodes in the mother plant coming from the primary buds. Evidently, such a gap in the life cycle of the pest does not permit the carryover of the population from the axileary buds of the mother shoots. It is clear that infestation by *M. glomerata* does not normally take place through the use of infested seed material. In our observation, scales can survive a maximum of 30 days when buried in light soil but the survival rate declines markedly with wetting of the soil.

Conclusions

The infestation of sugar cane by the scale insect *M. glomerata* is not due to the use of infested setts but to other causes, such as the spread of crawlers from other sources to new standing crops in scale insect-free areas. Water shoots that are generally left by cultivators after harvesting may be responsible for the carryover of *M. glomerata* in the field. Not only water shoots but also stubbles that have been left in the field after harvesting may be carriers of scale insect populations, and can serve as sources of crawlers which can infest the new cane, serving to bridge the gap from one crop season to the next.

It is because of this that ratoon fields suffer badly each year, by comparison with plant cane, and it may be concluded that the infestation is of a secondary nature, rather than a primary nature were infested setts to be the source of the pest. It is considered that water shoots should not be left to stand for the next harvest and that canes should be cut low to leave as little stubble as possible, while at the same time ratooning should be discouraged. The cultural operations deserve special mention in the ratoon management of the sugar cane crop.

Acknowledgement

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1 *Archief Suiker-Ind. Ned.-Indien*, 1911, **19**, 89-98.
2 *Rev. Appl. Ent. (A)*, 1914, **3**, 317-320.
3 *Bull. Ent. Res.*, 1944, **35**, 69-77.
4 *ibid.*, 1970, **60**, 61-95.
5 *Coop. Sugar*, 1978, **10**, (2), 53-54.

Summary

Pot experiments showed that scale insects *(M. glomerata)* on cane setts did not survive a period of 5½ months by which time the setts had developed to canes with 12-17 internodes. It is concluded that infestation arises from other sources which may include water shoots and stubble from harvested cane. This would also explain the higher incidence of the pest in ratoon crops compared with plant crops.

Etudes sur l'infestation par les cochenilles

Des expériences en pots ont révélé que les cochenilles *(M. glomerata)* sur les plançons de canne ne survivaient pas une période de 5½ mois, laps de temps au bout duquel les plançons s'étaient développés jusqu'à former des cannes à 12-17 internoeuds. On en déduit que l'infestation provient d'autres sources, que peuvent comprendre des gourmands et des chaumes de canne récoltée. Ceci expliquerait également la plus grande incidence de cette peste dans les cultures de repousses, comparées aux cultures plantées.

Untersuchungen über die Schildläuse-Plage

Topf-Versuche zeigten, dass Schildläuse *(M. glomerata)* auf Rohrsetzlingen einen Zeitraum von 5½ Monaten nicht überlebten, die Zeit in der die Setzlinge sich zu Rohr mit 12-17 Internodien entwickelten. Man schliesst daraus, dass die Verpestung aus anderen Quellen kommt, die vielleicht Wasser Schösse und Stoppein von geerntetem Rohr sein können. Dies würde auch das stärkere Auftreten der Plage in Ratoonernten gegenüber Pflanzrohrernten erklären.

Estudios sobre infestación con insectos escamosos

Experimentos con caña en tiestos demuestraron que insectos escamosos *(M. glomerata)* sobre trozos de caña no sobrevivieron un período de 5½ meses, cuando se habían desarrollado cañas de 12-17 entrenudos. Los autores concluyen que infestación proviene de otras fuentes que pueden incluir brotes y el rastrojo residual de la cosecha. Esto puede explicar la incidencia más alta de la plaga en retoños que en caña de plantilla.

Gas-liquid chromatographic determination of fructose, glucose and sucrose in cane sugar products*

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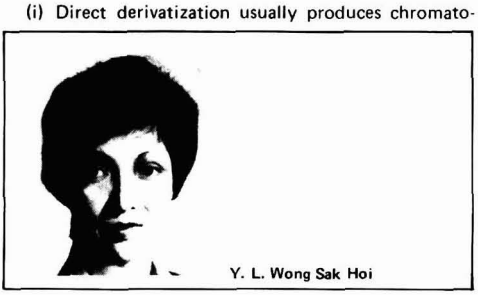
Introduction

Since the classical work of Sweeley *et al.*[1] on gas-liquid chromatographic separation of trimethylsilyl derivatives of sugars, there have been surprisingly few attempts at separation of carbohydrates in sugar cane products. Up to now, most of the work has been focused on determination of sucrose in molasses[2,3]. There are even fewer publications on separation of sugars in cane juice. It is only recently that attempts have been made to determine simultaneously fructose, glucose and sucrose in cane molasses[4]. This is probably due to the fact that:

(i) Direct derivatization usually produces chromatograms having over-lapping peaks of α-D-glucose and β-fructose which are useless for quantitative purposes and all samples must be assumed to have been mutarotated to the same extent. Although the asymmetric anomeric centre can be destroyed by reducing the sugars to their corresponding alditols, or by converting them to oximes, acetals and thioacetals, Sweeley *et al.* reported that these derivative peaks are less well resolved than their parent sugar peaks.



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(ii) The large amount of water associated with sugar cane products, especially cane juice, can render the trimethylsilyl derivatives unstable if it is not removed prior to silylation. Among the techniques used for water removal are: drying under reduced pressure[5], oven drying below 60°C[6], vacuum drying[7] and dehydrating

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

[1] *J. Amer. Chem. Soc.*, 1963, **85**, 2497-2507.
[2] Karr & Norman: *Paper presented to the 16th Gen. Meeting, Amer. Soc. Sugar Beet Tech.*, 1970.
[3] Schäffler: *Proc. 50th Ann. Congr. S. African Sugar Tech. Assoc.*, 1976, 220-223.
[4] Schäffler & Loker: *Proc. 15th Congr. ISSCT,* 1974, 1380-1387.
[5] Vidauretta & Fournier: *Anal. Chim. Acta,* 1970, **52**, 507-518.
[6] Devillers, Cornet & Detavernier: *Ind. Alim. Agric.*, 1974, **91**, 833-839.
[7] Irvine: *Sugar Bull.*, 1972, **50**, (8), 10-12.

by the use of calcium hydride[8]. These are all time-consuming if not impracticable.

To avoid tedious sample-drying procedures, Brobst & Lott[9] employed a large excess of silylating reagent and were successful in directly derivatizing corn syrup samples. It has been postulated that trimethylsilylating reagents react with water; therefore an excess of reagent must be present to dehydrate aqueous solutions of sugars before the remaining reagent can proceed to silylate the sample material.

Brittain *et al.*[10] found that, with N-trimethylsilyl-imidazole as the silylating agent, the reaction speed was instantaneous and all sugars appeared to be completely derivatized as soon as dissolved, and it proved to be efficient in specific-OH silylations.

The method developed by Pierce Chemical Co.[11] for sugars in food products based on the principle of initial conversion of the sugars to the oximes, and then to their silyl ethers by N-trimethylsilylimidazole, was tried on a cane molasses sample using nitrogen carrier gas. Results showed that there were numerous small peaks near the peaks of interest, which suggested probably incomplete silylation. Reproducibility of the method was not very good: five replicates of a cane molasses sample showed a sucrose content varying from 22.4% to 33.4%, fructose content from 7.19% to 9.69% and glucose content from 4.89% to 5.74%. The method was consequently modified for sugar cane products.

MATERIALS AND METHODS

Reagents and material

All reagents were of Analar grade: pyridine, hydroxylamine hydrochloride, trehalose dilhydrate, meso-inositol, fructose dried in a dish over concentrated sulphuric acid in a desiccator until the weight was constant (at least 2 days), glucose and sucrose dried in an oven at 105°C for three hours, and N-trimethylsilylimidazole.

Method

A larger sample size was employed to reduce sample heterogeneity. A small aliquot of oxime derivative solution was used for silylation to reduce the amount of expensive N-trimethylsilylimidazole reagent required. The proportion of the silylating reagent to the oxime solution was also raised to ensure the presence of a larger excess of the reagent. As the amounts of fructose, glucose and sucrose present in cane juice and molasses were such that their peak areas were quite different, the use of only one internal standard seems to be inadequate and may be the cause for lack of precision. Consequently, two internal standards were used: meso-inositol for fructose and glucose, and trehalose dihydrate for sucrose, and their amounts adjusted so that their peak area ratios were as near unity as possible[8].

Procedure for cane juice analysis

Preparation of internal standard solution. – 0.25 g hydroxylamine hydrochloride, 0.0400 g trehalose dihydrate and 0.0020 g of meso-inositol were required per 10.0 ml pyridine. Stirring with a PTFE coated magnet and heating to 60°C was necessary for the sparingly soluble meso-inositol[12]. This standard solution can be bulked and stored in an air-tight container at 4°C.

Sample preparation. – Cane juice was filtered through a fluted Whatman No. 1 filter paper aided with dry, acid-washed kieselguhr. After discarding the first 25 ml, 0.3 ml of the filtrate was pipetted and weighed accurately into a wideneck 40 ml bottle fitted with a screw cap lined with "Parafilm". The cap was secured tightly after introduction of 10.0 ml pyridine internal standard solution and a small PTFE coated magnet. The bottle was then placed in a thermostatic bath at 70°C for 5 minutes, then taken out and the solution stirred magnetically. Alternate heating and stirring was continued for about 30 minutes. After cooling, 50 µl of the solution was transferred by means of a Hamilton 250 µl syringe to a 7 ml screwcap septum vial supplied by Pierce Chemical Company, and 150 µl trimethylsilylimidazole added by means of a second Hamilton 250 µl syringe. The mixture was shaken for 30 seconds and allowed to stand for 30 minutes before analysis by GLC or storage at 4°C until required for GLC analysis.

Determination of the detector response factor (K). – Fructose (15-20 mg), glucose (15-20 mg) and sucrose (450 mg) were dissolved in 100 ml pyridine internal standard solution. Ten separate 50 µl aliquots of the solution were taken for silylation.

Procedure for molasses analysis

Preparation of internal standard solution. – A bulk solution containing 0.25 g hydroxylamine hydrochloride, 0.0400 g trehalose dihydrate and 0.0100 g meso-inositol per 10.0 ml pyridine was prepared.

Sample preparation. – 150 mg molasses was weighed out and dissolved in 10.0 ml pyridine internal standard solution exactly as for juice.

Detector response factor (K). – Fructose (10-12 mg), glucose (10-12 mg) and sucrose (40 mg) were dissolved in 10.0 ml pyridine internal standard solution as described.

Gas chromatography

The collector electrode of the detector was cleaned daily with a pipe cleaner to avoid silica build-up, which could render the detector insensitive.

A Perkin-Elmer F 17 gas chromatograph equipped with dual columns and dual flame ionization detectors was used. The columns were 1 metre x 4.6 mm i.d. coiled stainless steel columns packed with 3% OV-17 coated on 80/100 mesh acid-washed, dimethyldichlorosilane-treated Chromosorb W (HP), and they were preconditioned at 275°C. The injection port was set at 275°C, temperature program was from 150°C to 240°C with an initial temperature hold for 4 minutes, heating rate of 3°C/min and final temperature hold for zero minute. Flow rate of oxygen-free nitrogen carrier gas was 50 ml.min^{-1}, hydrogen gas 21 psi, 45 ml.min^{-1} and compressed air 22 psi, 450 ml.min^{-1}. 1.0 µl of sample was injected using a 10µl Hamilton syringe. Under these

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[8] Mahoney & Lucas: *I.S.J.*, 1971, **73**, 291-294.

[9] *Cereal Chem.*, 1966, **43**, 35-43.

[10] Brittain, Sullivan & Schewe: "Silylation in the presence of water – the development of a commercial reagent for silylating aqueous solutions of hydroxy and polyhydroxy compounds". In "Recent advances in gas chromatography", Ed. Domsky & Perry (Dekker, New York), 1971, pp.223-229.

[11] Pierce Chemical Co. handbook and general catalogue, 1979-80. pp. 182-184.

[12] *Analyst*, 1967, **92**, 714716.

analytical conditions, the instrument time for each analysis was 35 minutes.

Fructose, glucose and meso-inositol peaks eluted on a tailing solvent peak. A tangential curve was drawn using a flexible curve and their peak heights were measured as accurately as possible to within ± 0.1 mm.

The weight of fructose or glucose in the sample was calculated from the equation:

$$g\ \%\ g\ \text{fructose or glucose} = \frac{\text{peak height of fructose or glucose} \times \text{weight of inositol} \times 100}{\text{peak height of inositol} \times K \text{ for fructose or glucose} \times \text{wt. of sample}}$$

where K is the relative detector response factor and was calculated from the equation:

$$K \text{ for fructose or glucose} = \frac{\text{peak height of fructose or glucose} \times \text{weight of inositol}}{\text{peak height of inositol} \times \text{weight of fructose or glucose}}$$

The weight of sucrose in the sample was calculated in the same way.

Recovery trials

Recovery trials were effected on a molasses sample by first determining accurately its fructose, glucose and sucrose contents, then adding simultaneously about one-third of their original concentrations to the same molasses sample. Three such recovery tests were carried out and three silylations were performed on each solution. Results are shown in Table I.

Typical chromatograms are shown in Fig. 1.

Recovery trials were also carried out on a juice sample, but the amount of fructose and glucose added had to be larger than one-third their original concentrations because of the difficulty encountered in weighing out such small quantities of substances. Again, three recovery tests were carried out and three silylations were performed on each solution. Results are shown in Table II.

Precision test

To assess the precision of the method, three juice and five molasses samples were analysed ten times by the GLC method for fructose, glucose and sucrose, by the Lane & Eynon method[13] for reducing sugars and by Jackson and Gillis No. IV double polarization method for sucrose, using the US Customs Laboratory prescription for inversion[14]. It must be pointed out that this experiment was carried out early during the intercrop season; the three juice samples analysed were therefore from immature canes. Results are given in Table III, where averages of ten replicates are presented.

Statistical analysis of results presented in Table III is shown in Table IV.

Discussion

The accuracy of the described method is very good as evidenced by the recovery trials in Tables I and II. The precision of the method, however, is not as good as the chemical methods. This is probably because the base line of the chromatogram is not flat. The solvent tailing can probably be reduced by employing another solvent and stationary phase. Better precision can be expected from the method if an electronic integrator is available to eliminate the uncertainty of projecting the tailing baseline of the chromatograms, and peak areas measured instead of peak heights.

It has been found that when the fructose:glucose ratio exceeds one, as often found in cane molasses, it is best to adjust the quantity of meso-inositol used so that its peak area is between those of the monosaccharides. Also, in order to achieve optimum precision, the amount of sugars present in solution for detector response factor determination must be as near as possible to that present in the sample.

In the precision test it was found that the fructose:glucose ratio in the five molasses samples analysed varied from 1.17 to 2.01 and, in the three juice samples, from 0.80 to 0.83. In the former case, if sucrose determinations were to be carried out by the single polarization method, the results would be underestimated. All fructose-plus-glucose values obtained by the GLC method were lower than the reducing sugar values obtained by the Lane & Eynon method. The mean difference between the two methods was about 2.6% for molasses, as opposed to 2.7% found by Schäffler & Loker[4], and 0.42% for juice.

The Jackson and Gillis method gives sucrose values which are higher than those from the GLC technique. Statistical analysis showed that the difference in sucrose

Table I. Recovery trials for fructose, glucose and sucrose in a molasses sample

Recovery test	*Constituents*		*mg added*	*mg recovered*	*% recovery*
	Fructose	1	4.77	4.77	100.0
		2		4.70	98.4
		3		4.65	97.5
I	Glucose	1	2.39	2.35	98.3
		2		2.34	97.9
		3		2.28	95.4
	Sucrose	1	14.65	14.23	97.1
		2		14.29	97.5
		3		14.76	100.8
	Fructose	1	4.14	4.19	101.2
		2		4.22	101.9
II	Glucose	1	2.41	2.38	98.8
		2		2.46	102.1
	Sucrose	1	14.94	14.87	99.5
		2		14.81	99.1
	Fructose	1	4.52	4.43	98.0
		2		4.41	97.6
		3		4.56	100.9
III	Glucose	1	2.60	2.65	101.9
		2		2.58	99.2
		3		2.59	99.6
	Sucrose	1	14.62	14.20	97.1
		2		14.26	97.5
		3		14.76	101.0

1, 2 and 3 are silylation replicates
From the results, the mean fructose recovery = 99.4% ± 0.6%
" " glucose " = 99.2% ± 0.7%
" " sucrose " = 98.7% ± 0.5%

[13] Meade-Chen: "Cane sugar handbook", 10th Edn. (Wiley, New York), 1977, p. 559.
[14] *ibid.*, pp. 547-548.

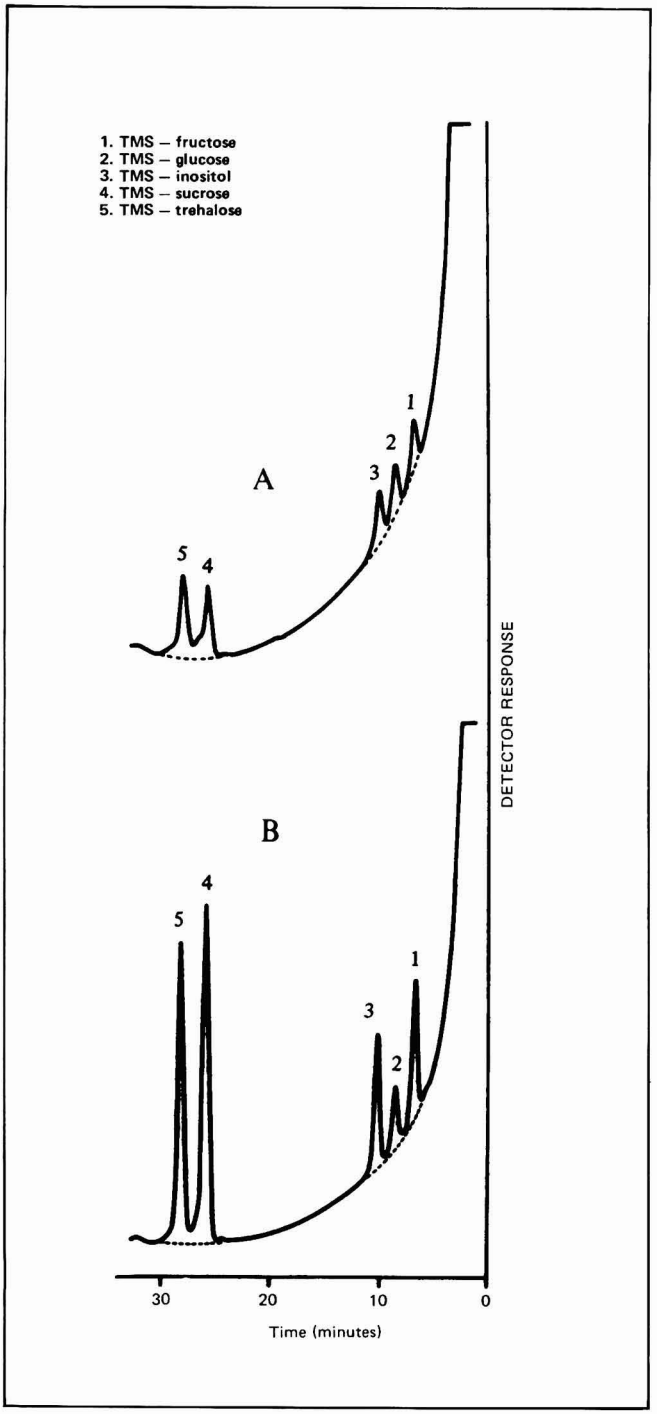

Fig. 1. Temperature-programmed gas-liquid chromatogram of TMS-derivatives of (A) cane juice (B) cane molasses with inositol and trehalose dihydrate added as internal standards

values given by these two methods is significant at 95% confidence level, the mean difference between the two methods being 0.09% for juices and 1.2% for molasses. If this factor is accurately established, a correction can be applied to the existing routine chemical method to give the true sucrose values without having to resort to the GLC method routinely.

Conclusion

The GLC method outlined in this paper for the simultaneous determination of fructose, glucose and sucrose is suitable for cane sugar products. The silylation procedure gives stable derivatives in the presence of water. With the possibility of storing the reagent and the derivatized sample, the analysis can be conveniently geared to the load demands. The analytical method is rapid, accurate and adequately precise and yields much more information than the chemical methods.

Summary

A gas-liquid chromatographic method for the simultaneous determination of fructose, glucose and sucrose in cane juice and cane molasses is described. The sugars are converted to their oximes before being trimethylsilylated, with the result that glucose is presented as a single peak on the chromatogram; equilibrium attainment of the sample solution is therefore unnecessary. Comparisons were made with the Lane & Eynon method for reducing sugars and the Jackson & Gillis No. IV double-polarization method for sucrose determination. Accuracy and precision of the method were assessed and found to be good.

La détermination du fructose, du glucose et du saccharose dans les produits du sucre de canne par chromatographie gaz-liquide

Une méthode par chromatographie gaz-liquide pour la détermination du fructose, du glucose et du saccharose dans le jus et dans la mélasse de cannes est décrite. Les sucres sont convertis en leurs oxymes avant d'être triméthylsilylés, ce qui a pour résultat que le glucose se

Table II. Recovery trials for fructose, glucose and sucrose in a juice sample

Recovery test	*Constituents*		*mg added*	*mg recovered*	*% recovery*
	Fructose	1	4.63	4.53	97.8
		2		4.60	99.4
		3		4.62	99.8
I	Glucose	1	4.88	4.86	99.6
		2		4.65	95.3
		3		4.88	100.0
	Sucrose	1	5.62	5.58	99.3
		2		5.63	100.2
		3		5.65	100.5
	Fructose	1	4.57	4.63	101.3
		2		4.46	97.6
		3		4.57	100.0
II	Glucose	1	5.04	5.07	100.6
		2		4.91	97.4
		3		5.11	101.4
	Sucrose	1	5.87	5.90	100.5
		2		5.83	99.3
		3		5.87	100.0
	Fructose	1	2.48	2.43	98.0
		2		2.51	101.2
		3		2.47	99.6
III	Glucose	1	3.48	3.44	98.9
		2		3.45	99.1
		3		3.28	94.3
	Sucrose	1	2.89	2.95	102.1
		2		2.91	100.7
		3		2.92	101.0

1, 2 and 3 are silylation replicates
From the results, the mean fructose recovery = 99.4% ± 0.5%
„ „ glucose „ = 98.5% ± 0.8%
„ „ sucrose „ = 100.4% ± 0.3%

présente comme un simple pic sur le chromatogramme; il n'est dès lors pas nécessaire que la solution d'échantillon atteigne l'équilibre. Des comparaisons furent faites avec la méthode Lane & Eynon pour sucres réducteurs et avec la méthode de double polarisation Jackson & Gilles N° IV pour la détermination du saccharose. L'exactitude et la précision de la méthode ont été évaluées et trouvées bonnes.

Gas - flüssig - chromatographische Bestimmung von Fructose, Glucose und Saccharose in Rohrzuckererzeugnissen

Eine gas-flüssig-chromatographische Methode für gleichzeitige Bestimmung von Fructose, Glucose und Saccharose in Rohrsaft und Rohrmelasse wird beschrieben. Die Zucker werden in ihre Oxime umgewandelt, bevor sie trimethylisiert werden mit dem Ergebnis, daß die Glucose als einzelner Peak auf dem Chromatogramm dargestellt wird; die Gleichgewichtseinstellung in der Probelösung ist daher nicht erforderlich. Vergleiche mit der Lane & Eynon-Methode für reduzierende Zucker und mit der Doppelpolarisationsmethode von Jackson & Gillis Nr. IV zur Saccharosebestimmung wurden gemacht. Richtigkeit und Genauigkeit der Methode wurden bestimmt und für gut befunden.

Determinación de fructosa, glucosa y sacarosa por medio de cromatografía gaseoso-liquida

Se describe un metodo de CGL para la determinación simultánea del contenido de fructosa, glucosa y sacarosa en jugo de caña y en miel final. Los azucares son convertidos a sus correspondientes oximas antes de ser trimetilsililados con el resultado de que la glucosa presente un solo pico en la cromatograma; por lo tanto resulta inecesario esperar que la solución de la muestra llegue a su punto de equilibrio. Se hizo la comparación de los resultados con los obtenidos por el metodo de Lane y Eynon para los azucares reductores y el N° IV de Jackson y Gillis con doble polarización para la sacarosa. Se encontró que la precisón de los analisises era buena.

Table III. Comparison of sugar contents in juice and molasses samples by two different methods

		GLC				*Lane & Eynon*	*Jackson & Gillis*
		% Fructose	*% Glucose*	*% Fructose + glucose*	*% Sucrose*	*% Reducing sugars*	*% Sucrose*
Juice	1	1.30	1.62	2.92	5.94	3.38	6.00
	2	1.31	1.62	2.93	5.90	3.29	5.96
	3	1.38	1.66	3.04	4.94	3.49	5.08
Molasses	1	10.17	7.61	17.78	28.16	19.56	29.33
	2	10.10	5.90	16.00	28.93	18.66	30.76
	3	10.76	9.18	19.94	29.36	22.48	30.55
	4	7.28	3.60	10.88	28.75	13.91	29.50
	5	8.99	4.48	13.47	28.60	16.28	29.80

Table IV. Statistical analysis of results shown in Table III

			GLC				*Lane & Eynon*	*Jackson & Gillis*
			Fructose	*Glucose*	*Fructose + glucose*	*Sucrose*	*Reducing sugars*	*Sucrose*
Juice	1	variance	0.00034	0.00038	0.00072	0.0016	0.00013	0.00018
		S.D.			0.027	0.039	0.12	0.013
		S.E.			0.0085	0.013	0.0036	0.0042
Juice	2	variance	0.00039	0.0014	0.0018	0.00066	0.00018	0.000089
		S.D.			0.043	0.026	0.013	0.0094
		S.E.			0.014	0.0082	0.0042	0.0030
Juice	3	variance	0.00017	0.00029	0.00046	0.0064	0.00029	0.00011
		S.D.			0.021	0.080	0.017	0.011
		S.E.			0.0067	0.025	0.0054	0.0033
Molasses	1	variance	0.015	0.0089	0.024	0.044	0.0049	0.0027
		S.D.			0.15	0.21	0.070	0.052
		S.E.			0.049	0.067	0.022	0.016
Molasses	2	variance	0.010	0.018	0.034	0.044	0.0063	0.0036
		S.D.			0.19	0.21	0.079	0.060
		S.E.			0.059	0.067	0.025	0.019
Molasses	3	variance	0.014	0.0063	0.020	0.018	0.0062	0.0021
		S.D.			0.014	0.13	0.079	0.046
		S.E.			0.045	0.042	0.025	0.015
Molasses	4	variance	0.0053	0.0053	0.011	0.041	0.0025	0.00028
		S.D.			0.10	0.20	0.050	0.017
		S.E.			0.033	0.064	0.016	0.0053
Molasses	5	variance	0.011	0.0057	0.017	0.060	0.0073	0.0012
		S.D.			0.13	0.24	0.085	0.034
		S.E.			0.040	0.077	0.027	0.011

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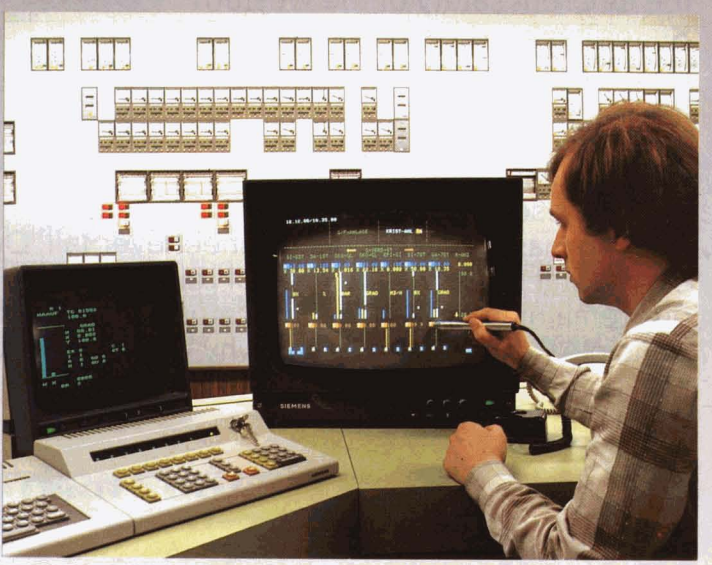

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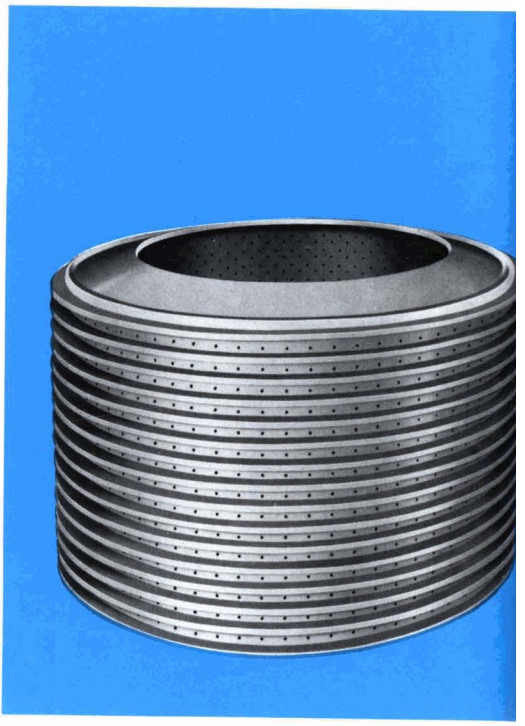

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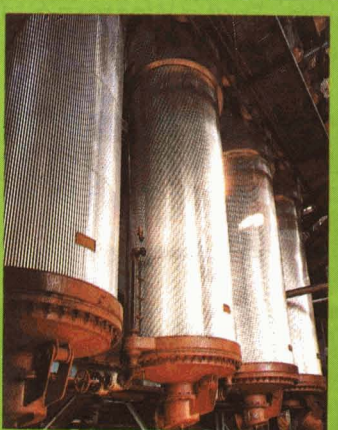

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Vinasse pollution elimination and energy recovery

By G. P. SPRUYTENBURG
(Hollandse Constructie Groep B.V., Leiden, Holland)

In Bangkok, Thailand, an effluent treatment plant for sugar cane vinasse went into operation in July 1981; it is owned by the Bangyikhan distillery and is the first installation of its kind in the world.

Pollution problem

It is a well-known fact that distilleries discharge particularly strong effluents. A distillery like the Bangyikhan distillery, with a capacity of 90,000 litres of alcohol per day, will have to dispose of about 1000 m^3 per day of effluent with a biological oxygen demand of around 40,000 mg per litre. This is the equivalent of the domestic sewage load of a town of more than 150,000 inhabitants. The effluent vinasse with this high oxygen demand, if dumped into a river, deprives all the bacterial, animal and plant life of its oxygen. Typically black, anaerobic lifeless smelly water results. For that reason the Government of Thailand had required closure of the distillery, if the vinasse pollution problem could not be solved.

In the United States of America and in European countries with stringent pollution restrictions, water is evaporated from the effluent until it has a concentration of about 60% solids. In this form the vinasse is a useful animal feed, containing proteins and carbohydrates. Such concentrated vinasse, blended with other nutrients and fibres, provides a balanced diet for cattle, pigs, poultry and fish. The revenues from the sale of this vinasse just about balance the cost of oil (at today's oil and feed prices) to evaporate the water.

Thailand, with its excellent agricultural lands, does not need to import animal feed, but does have to import expensive energy, so the economic balance of the price of animal feed against the price of oil is not favourable and a more cost-effective method of vinasse disposal is required. This has led to energy recovery by incineration of vinasse concentrate.

The incineration plant at the Bangyikhan distillery was designed, engineered and supplied by Tate & Lyle Ltd., who were the main contractor for this project, Vogelbusch, who supplied the evaporation system, and the NEM-Boilers and Process Equipment Division of Hollandse Constructie Groep B.V. for the vinasse incineration system. Hollandse Constructie Groep B.V. has been developing a vinasse firing system since 1947 and has built some boilers fired by vinasse originating from sugar beet. The boilers for Thailand are the first to be used for vinasse from sugar cane. At the end of 1981 a second Bangyikhan plant went into operation with a capacity of 2000 m^3 per day of vinasse for a 180,000-litre alcohol distillery.

The weak effluents including the water evaporated from the strong effluents are treated in a biological treatment plant, designed and supplied by Tate & Lyle Ltd. The plant includes the means to absorb large volumes of oxygen into the effluent, causing aerobic bacteria and other life to develop rapidly. The sludge is settled and dried, and may be compared to a well-made compost for gardening. Both Bangyikhan distilleries discharge cleaner water into the Chao Phya River than the water they take in.

G. P. Spruytenburg

Evaporation and incineration

The vinasse is collected and evaporated in a stainless steel evaporator (specially designed for the purpose by Vogelbusch) to a concentration of 60% solids. The concentrated vinasse is then atomized into the swirl combustion chamber of the NEM vinasse-fired boiler. Here the vinasse is burnt and the heat used to generate steam. A concentration of 60% solids is necessary for maintaining combustion; the lower calorific value is around 7600 kJ/kg. The combination of atomizing equipment and burning chamber is a special design of HCG.

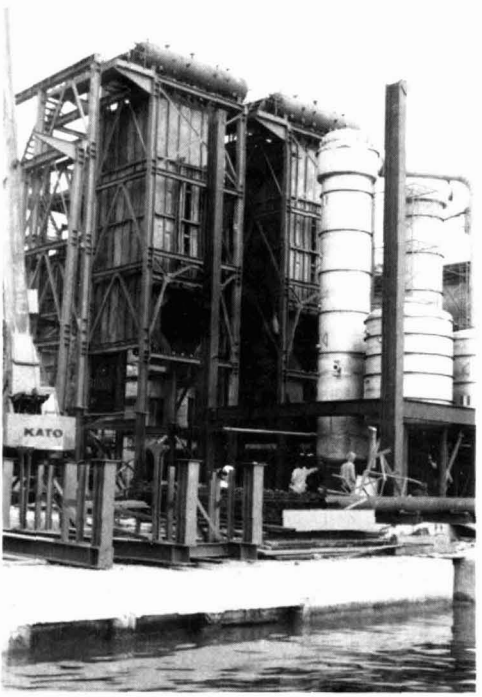

Fig. 1. Vinasse boilers and evaporation plant at Bangyikhan distillery during erection

The hot gases from the furnace go to the convection section, which is equipped with a special cleaning system. After passing the boiler, the gases are fed to an electrostatic precipitator, where more than 99% of the ash is recovered.

Energy recovery

For the 90,000-litre alcohol distillery a plant has been installed with a maximum firing capacity of 9 tonnes.hr^{-1}

of vinasse, based on 60% D.S. The vinasse is handled in three incineration units, each having a maximum capacity of 3 tonnes.hr^{-1}. From each tonne of concentrated vinasse 2.8 tonnes of saturated steam at 16 bar can be produced.

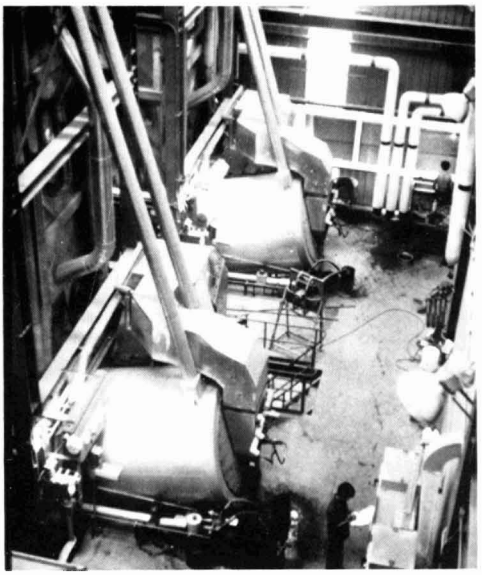

Fig. 2. Two of the three vinasse-fired furnaces

The evaporator system concentrating the vinasse from 10% to 60% dry solids requires a steam supply of 0.16 tonnes per tonne evaporated water. To obtain one tonne of concentrated vinasse, 5.5 tonnes of water must be evaporated; this means a consumption of 0.9 tonnes of steam per tonne of concentrated vinasse. So the net steam quantity available for the process in the distillery is 2.8 – 0.9 = 1.9 tonnes for each tonne of burnt concentrated vinasse. By burning the vinasse of this 90,000 litre alcohol distillery, there is an energy saving of 40%. Calculated at a steam price of US$ 20 / tonne (based on today's fuel oil prices), the fuel saving for this distillery, based on 300 days, exceeds US$ 2,000,000 a year.

Ash recovery

An extra advantage of the vinasse incineration is the possible application of ash recovery. The quantity of ash is different for each type of vinasse. It is between 10 and sometimes, for sugar beet, 25%. In Thailand the quantity of ash recovered from the vinasse is 15%. The ash contains useful potassium salts, such as K_2SO_4, KCl and K_2CO_3, as well as other components such as CaO, MgO, etc. As produced, the ash can be used as a fertilizer. Approximately 75% of the ash is soluble in water.

The ash can be treated for use as a raw material for the fabrication of glass or alum. The quantities obtained are rather large; for the 90,000 litres distillery the quantity of ash is approximately 25 tonnes per day. A simple refining process yields a quantity of potassium salts of approximately 13 tonnes. At US$ 100/tonne of unrefined ash a revenue of US$ 750,000 a year is possible.

In Thailand the most important component of the ash is potassium sulphate. Eighty % of the potassium salts are soluble in water. The ash from an installation built by Hollandse Constructie Groep B.V. for Czechoslovakia (which has now been burning sugar beet vinasse for more than ten years) contains potassium carbonate (K_2CO_3) as its most important component.

Pay-back period on investment

For a distillery with a capacity of 90,000 litres of alcohol a day like Bangyikhan, the total possible saving on fuel and revenue on ash is over US$ 2,750,000 a year.

The pay-back period for the evaporator and incinerator system is approx. 2½ years. Of course, this calculation is based on the local situation and there are differences in each country and for each situation. Beside the recovery of energy and ash, the most significant thing for the Government of Thailand is that the pollution problem is eliminated and a short pay-back time on the capital investment is achieved.

Summary

A plant is described in which vinasse from a Thailand alcohol distillery is concentrated to 60% dry solids and burnt in the furnace of a boiler. The steam generated is sufficient to concentrate the original vinasse, as well as to meet partially the needs of the distillery itself. By this means, a considerable saving is made by the reduced need for fuel oil, while the ash from the vinasse can be used as fertilizer, and the problem of environmental pollution thus solved.

Elimination de la pollution occasionnée par la vinasse et la récupération d'énergie

On décrit une installation dans laquelle la vinasse provenant d'une distillerie d'alcool thaïlandaise est concentrée jusqu'à 60% de matières sèches et brûlée dans le foyer d'une chaudière. La vapeur générée est suffisante pour évaporer la vinasse originelle aussi que remplir en partie les besoins de la distillerie elle-même. Ainsi on réalise une grosse économie, car la quantité de fuel oil est réduite considérablement, pendant que la cendre à partir de la vinasse peut être employée comme engrais, et ainsi le problème de la pollution de l'environnement est résolu.

Beseitigung der von der Vinasse verursachten Verschmutzung und die Energiegewinnung

Es wird eine Anlage beschrieben, die für die Eindickung auf 60% Trockensubstanz der Vinasse einer Alkohol-Brennerei Thailands und ihr Verbrennung im Ofen eines Dampkessels dient. Die Menge des hergestellten Dampfes genügt, die ursprüngliche Vinasse einzudicken und auch einem Teil des Bedarfs der Brennerei selbst zu entsprechen. Dadurch erzielt man eine erhebliche Ersparnis, da die benötigte Brennölmenge bedeutend erniedrigt wird, während die Asche aus der Vinasse als Düngemittel verwendet werden kann und das Problem der Umweltverschmutzung dabei gelöst.

Eliminación de contaminación por vinaza y recuperación de energía

Se describe una planta en que vinaza de una distilería de alcohol en Tailandia es concentrado a 60% contenido de sólidos y quemado en el horno de una calera. El vapor obtenido es bastante para evaporar la vinaza original y para cubrir una parte de las necesidades de la distilería también. De este modo, un ahorro notable es posible porque la necesidad de petróleo es considerablemente reducida, mientras que la ceniza de la vinaza puede usarse como fertilizante, y la problema de contaminación del ambiente se supera.

SUGAR CANE AGRONOMY

Advance prediction models and infiltration in sugar cane irrigation. W. Silva, A. Vásquez, E. Paz-Vergara and A. Hoekstra. *Sugar News* (Philippines), 1980, **56**, 90-93. See *I.S.J.*, 1981, **83**, 208.

The effect of various herbicidal treatments on *Digitaria horizontalis* growing in plant cane. G. McIntyre, J. Pitchen, C. Barbe and M. Yerriah. *Sugar News* (Philippines), 1980, **56**, 94-96. – See *I.S.J.*, 1981, **83**, 173.

Some aspects of Mon 8000 as a sugar cane ripener to replace Polaris. H. W. Hilton, R. V. Osgood and A. Maretzki. *Sugar News* (Philippines), 1980, **56**, 176-180, 200 A. – See *I.S.J.*, 1981, **83**, 206.

Field trials with chemical ripeners. D. G. Dakshindas and P. D. Kashid. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1980, (1), A.51-A.62. – Large-scale trials are reported in which Polaris, Cycocel and sodium metasilicate had no positive or consistent effect on the cane sucrose content, although it is suggested that the method used to evaluate ripener effect may need modifying.

Quantity-potential (Q/P) and quantity-intensity (Q/I) isotherms of soil potassium in some sugar cane growing soils. G. Hunsigi and S. C. Srivastava. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1980, (1), A.63-A.72. – The title isotherms were established as measures of K supply to cane in five soils of different mineral composition, K status and response to K application. The results are discussed.

Role of hormones, Azotobacter and chemicals on germination and seeding behaviour of sugar cane. A. V. Bendigeri, D. G. Hapase and S. S. Patil. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1980, (1), A.115-A.120. – Split-plot replicated trials were conducted on treatment of scooped eye buds and single setts with various chemicals and Azotobacter culture before planting. Germination, which was low because the seed material was taken from 14-month-old cane, was not significantly affected by any of the treatments. Seed material taken from the top of the cane germinated better than that from the middle section, while the bottom section gave the poorest material. There was no essential difference between the two forms of seed material as regards germination.

A review of evapotranspiration studies in irrigated sugar cane in Hawaii. C. A. Jones. *Hawaiian Planters' Record*, 1980, **59**, 195-214. – Studies carried out in Hawaii showed that Class A Pan (CAP) evaporation gives an adequate estimate of potential evapotranspiration (PET) of cane only when long-term (monthly) averages of relative water use are applied, so that it is of value in estimating furrow and sprinkler irrigation requirements, wheras the PET may be as much as 15% lower than CAP evaporation in the case of drip irrigation. Analysis of three irrigation experiments conducted in the 1950's and 1960's indicates that relative cane yield (ratio of actual to maximum possible yield) is a positive linear function of relative water use (effective water use/CAP evaporation); this finding contrasts with that of other investigators who concluded that the relationship is curvilinear.

Companion cropping with autumn-planted sugar cane – a critical review. VI. Intercropping of sugar beet with autumn-planted sugar cane. K. S. Rathi and R. A. Singh. *Indian Sugar Crops J.*, 1980, **7**, 48-52. – Beet intercropping with cane has been tested by a number of authors at different sites since 1969. The results obtained are reviewed and show that, generally, intercropping of beet with spring-planted cane is not to be recommended, whereas beet + autumn-planted cane is economically beneficial.

Yield of sugar cane as influenced by weather variables. R. L. Yadav. *Indian Sugar Crops. J.*, 1980, **7**, 53-55. Investigations of the effects of climatic factors on cane yield, at the farm of the Indian Institute of Sugarcane Research in Lucknow, showed that a 1°C rise in mean temperature in the range 30-33°C during the growing period increased yield by 13 tonnes.ha^{-1}, a 1 hr increase in the hours of sunshine during the entire growing period raised it by 6.28 kg.ha^{-1}, rainfall reduced it by 17.2 kg.ha^{-1} per mm, while a rise in relative humidity beyond approx. 77% caused a marked fall in yield. Regression values are tabulated for each factor during each month from April to December, inclusive.

Land use planning for sugar cane. G. G. Platford and L. P. Nel. *S. African Sugar J.*, 1980, **64**, 533, 537, 542-543, 545. – See *I. S. J.*, 1981, **83**, 367.

Influence of irrigation with filter wash water on the response of sugar cane to nitrogen fertilization. H. Tello A. and S. Valdivia V. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1979, **7**, 74-85 *(Spanish)*. Trials carried out with cane grown on soil irrigated with filter cake wash water showed no response to any of the six levels of N fertilizer applied, owing to the nutrients in the water and to the fact that the soil was rich in available N.

Influence of salinity on the production of sugar cane and on the physico-chemical characteristics of the soil. J. Barreto R. and S. Valdivia V. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1979, **7**, 87-102 *(Spanish)*. – Cane was grown in soils of conductivity between 5.5 and 20.2 mmno.cm^{-1} (equivalent to a salt content of 0.28-2.92%). The effects were classified in six grades. In young calcareous soil with highly saline ground water, cane could develop in a good condition even with as much as 0.5% salts or 6.5 mmho.cm^{-1} conductivity. However, increase to 0.6% salt content (7.6 mmho.cm^{-1}) reduced the yield by 15%, while a 50% reduction occurred at 0.85% salts (11.2 mmho.cm^{-1}).

Experiments in spray irrigation in the Peruvian sugar industry. E. Paz-Vergara P. and W. Silva B. *Bol. Técn. Divn. Técn. Inst. Central Invest. Azuc.* (Peru), 1978, **7**, (3/4), 85-104 *(Spanish)*. – Between 1950 and 1972, trials were carried out with sprinkler irrigation in Peru, and the findings published as internal reports. The

present article is a review of these findings; while it is not a complete bibliography, it does confirm the sugar industry's interest in the technique as a method of efficient utilization of water resources.

Micro-element nutrition of sugar cane. I. Effect of micro-elements on growth and yield. J. E. Bowen. *Trop. Agric.* (Trinidad), 1981, **58**, 13-21. – Correlations between micro-nutrient concentrations in elongating leaf sheaths and cane growth and sugar accumulation were studied in commercial cane. The data were analysed statistically by multiple regression, yielding equations for estimation of cane yield and sugar yield per ha. When only micro-nutrient levels were used to calculate the regression equations, the resulting coefficients of determination (R^2) were low, whereas inclusion of plant age at sampling and at harvest, sheath moisture content and radiant energy ($J.cm^{-2}.day^{-1}$) significantly improved both the R^2 values and the yield estimates. The only essential micro-nutrients to affect both yield parameters were Ca and S; tissue levels of SiO_2 also influenced these parameters, but this compound is apparently a non-essential nutrient.

Effect of Polaris and gibberellic acid on growth, ^{14}C fixation and translocation, and sugar content of two sugar cane cultivars. C. R. McDavid and E. A. Babiker. *Trop. Agric.* (Trinidad), 1981, **58**, 73-79. – The effects of Polaris and gibberellic acid (GA) on 4-month-old plants of two cane varieties were investigated. Polaris at 3000 ppm inhibited stem elongation, reduced leaf fresh weight and increased both sucrose % cane and sucrose % stem, while GA at 400 ppm increased stem elongation, stem and leaf fresh weight and sucrose % stem, although it reduced sucrose % cane. The rate of ^{14}C fixation by the topmost fully expanded leaf was increased by GA and reduced by Polaris, but both chemicals increased the rate of translocation. GA increased acid invertase activity, whereas Polaris reduced it; neutral invertase activity tended to be affected in the reverse manner. The findings are consistent with the view that the ripening activity of Polaris results from a combination of growth inhibition, increased translocation and reduced acid invertase activity, while GA increases sucrose % stem by increasing the storage capacity, accompanied by greater rates of photosynthesis and translocation.

Influence of N-P-K fertilization on the technological qualities of plant cane, variety CB 41-76. J. Orlando and E. Zambello. *Brasil Açuc.*, 1980, **96**, 161-168 *(Portuguese).* – Trials carried out in four soil types in the Centre-South area of Brazil showed that only with the highest level (480 $kg.ha^{-1}$) in one soil did N have a negative influence on pol % cane, while no significant variation was produced by different levels of P and K. N fertilization did not affect reducing sugars, and only in two soils did increase in P and K fertilization raise their contents in juice. An inverse linear relationship was found between pol % cane and reducing sugars for two soil types, and between pol % cane and ash for another two.

Forms of phosphorus in the soils of the cane-growing area of Campos, Rio de Janeiro. M. S. Manhães and N. A. da Glória. *Brasil Açuc.*, 1980, **96**, 213-219 *(Portuguese).* – The modified Chang & Jackson method of phosphate fractionation[1] in soil was applied to three types of soil in the Campos region, and the results are tabulated and discussed.

NPK fertilization and the placing of fertilizer in sugar cane ratoons, variety CB 41-76. E. Zambello, H. P. Haag and J. Orlando. *Brasil Açuc.*, 1980, **96**, 220-230 *(Portuguese).* – Trials carried out in four soil types with different levels of N, P and K, applied on the surface and below the surface to ratoon cane, are described. Only in one soil type did placement below the surface produce an increase in cane and pol yield per ha. N and K produced a linear response, except for the K treatment in one soil type. P caused significant production increases in cane for three soils and also increased sugar yield per ha for two of them. Irrigation did not increase yields of the cane grown in one soil type.

The effect of herbicides on the sugar content in sugar cane. H. J. Yeh. *Taiwan Sugar,* 1980, **27**, 196-202. Application of named pre- and post-emergence herbicides to eight varieties of cane had no adverse effect on the sugar content at harvest, even though some of the varieties were injured by certain herbicides in their early growth stage. The juice Brix in all treated varieties was higher than in the untreated control.

The efficacy of Roundup for killing sugar cane. P. E. T. Turner. *S. African Sugar J.,* 1980, **64**, 583-584, 586-587, 590-591. – See *I.S.J.*, 1981, **83**, 366.

Utilization of a waste product of the sugar industry as a soil amendment for reclamation of saline-sodic soils. Y. Rai, D. Singh, K. D. N. Singh, C. R. Prasad and M. Prasad. *Indian Sugar,* 1980, **30**, 241-244. – Filter cake from a sulphitation factory was applied to a soil of pH 9.0 and 8.6 (in 1978-79 and 1979-80), a conductivity of 4.6 and 4.8 $mmho.cm^{-1}$ and Na saturation of 15.6 and 16.7%. All three treatments (150, 200 and 250 $quintals.ha^{-1}$ filter cake) reduced the soil parameters mentioned, increased available phosphate and significantly raised cane yield, the maximum yield increase being given by 200 quintals. ha^{-1} (582 by comparison with 319 $quintals.ha^{-1}$ in the control).

Advances in sugar cane fertilization in Mexico. M. Torres B. *Sugar J.*, 1980, **43**, (7), 21-24. –See *I.S.J.*, 1979, **81**, 112.

Effect of earthing-up and the action of the stubble shaver in mechanized harvesting on sugar cane yields. II. Results with first ratoons. R. Plana. *Cienc. Técn. Agric., Caña de Azúc.*, 1980, **2**, (1), 7-15 *(Spanish).* – The effects on cane yield of earthing-up to a height of 10 cm and to 20 cm were compared with no earthing-up, with and without stubble shaving. The trials followed a random block design with 6 replications; the variety used was B 4362. Measurements were made of stalk height and diameter, and the results showed that earthing-up to 10 cm improved yields; however, no further advantage resulted from earthing-up to 20 cm. Stubble shaving should be omitted when the stubble left by the mechanical harvester is lower than 8 cm.

Study of different methods of cultivation in sugar cane ratoon plantations *(Saccharum* spp. hybrids) cultivated in compacted ferralitic red soils. M. Bertolí. *Cienc. Técn. Agric., Caña de Azúc.*, 1980, **2**, (1), 17-27 *(Spanish).* Four cultivation treatments involving deep (25-30 cm)

[1] *Soil Sci.*, 1957, **84**, 133-144.

and shallow (12-15 cm) cultivation in the centre of the inter-row and on either side of the row were subjected to trials in a random block design with four replications. There was virtually no difference in the responses in terms of stalk height or population.

Comparative study of the effects of liming and the application of filter cake on the improvement of yellow ferralitic soils and the yields of sugar cane (*Saccharum* sp.). N. Medina. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (1), 29-50 *(Spanish).* – Split plot trials with four replications were used to assess the effects of filter cake (0 and 200 tonnes.ha^{-1}) and $CaCO_3$ (0, 3, 6, 9 and 12 tonnes.ha^{-1}) on an unsaturated yellow ferralitic soil and on the yield and quality of sugar cane of variety PR 980 grown in it. Soil samples were analysed at 4-month intervals, and cane leaf samples were examined at 5 months of age and at harvest. The $CaCO_3$ reduced the soil acidity, as did the filter cake, but had no effect on nutrient contents nor on cane yield, sugar yield or juice quality (plant cane and two ratoons). The filter cake increased soil fertility and nutrients and raised cane yield, but lowered juice quality; no effect on sugar yield resulted.

Study of levels of NPK with a base of filter cake in gley ferralitic concretionary soil and their effects on the cultivation of sugar cane (*Saccharum* spp. hybrids). V. M. Paneque. *Cienc. Técn. Agric., Caña de Azúc.,* 1980, **2**, (1), 65-78 *(Spanish).* – To a soil in the eastern part of Havana Province was applied 200 tonnes.ha^{-1} of filter cake and, in factorial trials, three levels each of N, P and K. Over a plant crop and two ratoons, soil and cane analyses were made and cane and sugar yields measured. There was no significant response to the fertilizers, and it is concluded that, with the use of the basal filter cake, application of chemical fertilizers is unnecessary for at least three years.

Estimation of the distribution of the sugar cane crop in the soils of São Paulo state. L. T. B. Rizzo and J. Orlando. *Brasil Açuc.,* 1980, **96**, 285-292 *(Portuguese).* – A survey has been made of the soils of the 1979 cane growing area of São Paulo with information provided by the 77 sugar factories and 9 autonomous distilleries. Of the total cane area, 57.03% was a clay latosol, 16.51% a medium textured latosol and 15.71% a red-yellow podzol. Comments are made on the changes resulting from the expansion of the cane area between 1972 and 1979.

Comparative study of the forms and doses of nitrogen fertilizers in the cultivation of sugar cane (one-year cane). O. Brinholi, J. Nakagawa, D. A. S. Marcondes and T. H. Liem. *Brasil Açuc.,* 1980, **96**, 308-312 *(Portuguese).* – Trials were made in which 30, 60 and 120 kg.ha^{-1} of N was applied to cane in the form of ammonium nitrate as surface application and as anhydrous ammonia injected into the soil. No significant response was found in the plant cane crop, while in the first and second ratoons a greater response was obtained with the lower dosages as ammonium nitrate and with the highest dosage as anhydrous ammonia, in terms of both cane and sugar yield.

Increase sugar productivity through cane harvest management. A. P. Gupta. *Maharashtra Sugar,* 1981, **6**, (3), 9, 11, 13-15. – Causes of losses were found to be failure to determine the pre-harvest maturity of the cane and schedule harvesting on its basis, post-harvest deterioration and associated processing difficulties, and post-maturity deterioration in standing cane. Consideration of these factors and adoption of remedial measures would permit increase in cane productivity.

Inclination of recovery with irrigation frequency during cane ripening under low temperature stress. O. Singh, K. Singh and R. S. Kanwar. *Maharashtra Sugar,* 1981, **6**, (3), 51-52, 54-56. – Investigations showed that c.c.s. per ha and financial return increased with increase in the frequency of irrigation of moderately frost-susceptible cane varieties over the same period of 120 days (3, 4, 6 and 12 irrigations).

Potash fertilizer use for increased yields of cane and sugar. M. J. Chaudhry. *Paper presented at 15th Ann. Conv. Pakistan Soc. Sugar Tech.,* 1978, 10 pp. – The literature on K_2O application to cane is reviewed, and recommendations given for the cane area around Dadu and Thatta factories (owned by the Sind Sugar Corporation) in Pakistan, where cane and sugar yields are low.

Practical approaches to cane development. M. J. Chaudhry and B. Mirza. *Paper presented at Seminar of Pakistan Soc. Sugar Tech.,* 1979, 11 pp. – Because of the low cane and sugar yields in Pakistan, a development program in the cane areas serving the new factories at Dadu and Thatta has been initiated, in which 7000 acres in each zone have been divided into 500-acre areas assigned to a fieldman for supervision of the work carried out by the individual growers. The organizational approach adopted and field staff training are outlined.

Rational approach to cane development. M. J. Chaudhry. *Paper presented at Seminar on Sugar Cane* (Pakistan), 1980, 9 pp. – Cane agricultural practices adopted at Dadu and Thatta factory areas are outlined, including the application of K_2O (which has increased cane and sugar yields significantly), hot water treatment for disease control, planting, etc. Because of the presence of large numbers of different weed species in the cane fields, there is need for chemical control, but herbicides are generally not available.

The Rello experiment – an extension system for yield improvement. S. A. Hussain, B. Mirza and M. J. Chaudhry. *Paper presented at Seminar of Pakistan Soc. Sugar Tech.,* 1980, 9 pp. – A two-day crash course was held for freshly recruited field staff and covered weeding, earthing-up, fertilizer application and harvesting. Each worker was assigned an area of 100-250 acres (depending on field layout) in the Thatta sugar factory project area, and kept a log of operations; each farm was visited weekly by the other growers. The experiment, named after one of the sites in the area, has proved successful in raising yields to an average equal to that of the large farmers in the area. Details are given of the experiments and results achieved.

Sugar cane and the mills: a deal in dispute. M. J. Chaudhry. *Pakistan Agric.,* 1981, (Jan.), 7-9. – The relations between cane grower and factory in Pakistan are discussed, and the position of Sind Sugar Corporation relative to other sugar manufacturers as regards its approach to the farmers and the price paid for their cane is outlined.

CANE PESTS AND DISEASES

Effect of defoliation on the production of sugar cane. N. Degaspari, N. Macedo, P. S. N. Botelho and A. C. Mendes. *Brasil Açuc.*, 1980, **96**, 93-100 *(Portuguese).* In a series of experiments to evaluate the damage caused by leaf-eating caterpillars, cane was grown in plots and two levels of defoliation obtained artificially by removing all the leaf blade from one side of the rib (i.e. 50%) and from both sides (i.e. 100%). In one experiment, the artificial damage was carried out twice to simulate the effect of a double infestation by the pest. The central row of cane from each plot was harvested and weighed, and the results showed that the loss in yield was not sufficient to justify the use of chemical control measures against the caterpillars.

Weighted average percentage of sugar cane stools infected with mosaic in the state of São Paulo. S. S. Mello. *Brasil Açuc.*, 1980, **96**, 117-119 *(Portuguese).* – A survey was made in 1979 of the extent of mosaic infection of 17 cane varieties grown in 29 municipalities in São Paulo state. Twelve of the varieties, classified as resistant, showed infection between 0 and 3.74%, while three intermediate varieties showed 6.26-11.3% infection, and two susceptible varieties showed 22.25% and 45.81%.

A note on top shoot borer attack in relation to nitrogen fertilization. A. S. Patil, D. G. Hapase and B. P. Gajare. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.1-A.4. – Trials with different ratios of ammonium sulphate and groundnut cake with and without compost and with and without basal dressing showed that the various forms of fertilization had no effect on the incidence of *Chilo infuscatellus,* a major pest of Indian cane.

Laboratory behaviour and multiplication of *Isotima javensis* Rohwer, a pupal parasite of the sugar cane top borer, *Tryporyza nivella* Fabr. A. N. Kalra, N. K. Tiwari and J. Chandra. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.13-A.20. – The mating behaviour of the title parasite, a pupal wasp, was studied as well as the fertilization capacity of the males, etc. A new chimney-pipe method of laboratory rearing is described which has increased recovery of parasite cocoons by 20-25% by comparison with previous methods. A female wasp was found to be capable of paralysing 5-34 host caterpillars in its life span, laying an average of 2.8 eggs per paralysed caterpillar. A male 2-3 days old could fertilize 3-10 females, the oviposition period ranging from 7 to 13 days.

Oxidative enzymes in mosaic virus-infected sugar cane variety Co 740. L. N. Ghorpade and G. V. Joshi. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.33-A.40. – Mosaic virus strain F was identified in Co 740 cane and found to increase the activities of polyphenol oxidases (monophenolase and *O*-diphenolase), ascorbic acid oxidase and glycolate oxidase. Oxidative enzymes have been found to play a part in the defensive reactions of infected plants. The increase in glycolate oxidase activity suggested the possible existence of photorespiration in the infected leaves.

Phytopathological problems associated with sugar cane breeding in Uttar Pradesh. G. P. Singh. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.41-A.44. – Cane seedling diseases found in U.P. were the two blights caused by *Alternaria tenuis* and *Helminthosporium halodes* and damping-off caused by *Pythium* sp. Means of control of the diseases are indicated. Mycoflora found on fuzz may cause complex seedling disorders and deterioration of the fuzz; preliminary studies revealed *Helminthosporium* sp., *Alternaria* sp., *Curvularia* sp., *Fusarium* sp. and *Aspergillus* sp.

Distribution and intensity of the internode borer of sugar cane, *Chilo sacchariphagus indicus* (K.), during different periods of plant growth. K. Ananthanarayana and M. Balasubramanian. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.81-A.88. Determination of the distribution and intensity of the title borer in crops of Co 419 and Co 449 cane showed that in 1977-78 intensity was lower in the initial period (up to 180 days after planting) than during the next 90 days, but was lowest of all in the third period up to 360 days, whereas in 1978-79 it was lowest in the initial period and thereafter was roughly constant to the end of the third period. The distribution of borer-infested canes in order of age groups is indicated.

Effect of different methods of planting on incidence of *Chilo infuscatellus* Snell. A. S. Patil, B. P. Gajare and D. G. Hapase. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.101-A.104. – Early shoot borer incidence was lowest where cane had been planted in flat beds; next lowest incidence occurred with conventional planting, followed by a system of spaced transplanting in ridges and furrows, while the intensity was highest where the cane had been transplanted in flat beds.

Incidence of internode borer *Chilo sacchariphagus indicus* (K.) in relation to its population in sugar cane. K. Ananthanarayana and M. Balasubramanian. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.121-A.126. – Internode borer incidence was found to increase progressively with the age of the crop, a trend unrelated to the larval population but a consequence of larval migration.

Scope of using wax moth larvae as laboratory hosts for breeding *Sturmiopsis inferens* Tns. H. David, S. Easwaramoorthy, V. Nandagopal and G. Santhalakshmi. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.133-A.136. – *S. inferens* is a parasite of the shoot borer, *Chilo infuscatellus;* it occurs naturally in some parts of Tamil Nadu, but is absent from coastal districts of India where the borer is endemic, so that mass rearing for release in these areas is being attempted. However, it is difficult to rear the natural host in the laboratory, so that the possibility of using alternative hosts has been considered. Results obtained with the wax moth, *Galleria mellonella,* included parasitization in the range 12.38-31.29%, high larval fecundity and larger puparia, all of which are sufficiently promising to justify further studies.

A pilot survey on the pest situation in sugar cane in Tamil Nadu and Pondicherry states. H. David and S. Sithanatham. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.137-A.145. – The incidences of various cane pests were determined in cane fields in seven districts of Tamil Nadu and one of Pondicherry. Results are tabulated. Only the internode borer, *Chilo sacchariphagus indicus,* proved a serious problem in six of the districts.

An exotic tachinid parasite, *Diatraeophaga striatalis* Tns., established on the sugar cane internode borer. S. Easwaramoorthy, N. K. Kurup, M. Shunmugasundaram and H. David. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), A.147-A.148. – In 1979, 144 gravid females of the parasite (commonly known as Javanese fly) were released in 8- to 10-month-old cane. Before release, a survey showed that the parasite was absent from the area. At the end of 1979, 17 puparia of the parasite were recovered, indicating its possible establishment, although the need for continued releases in large numbers is stressed for complete establishment in south India.

Some new and interesting observations on the biology of *Tryporyza (Scirpophaga) nivella* F. O. P. Singh, R. K. Tiwari and O. Prakash. *Indian Sugar Crops J.,* 1980, **7,** 37-41. – Investigations showed that larvae of the title pest (top borer) preferentially made a tunnel on the sun-lit side of the cane when overwintering. In most cases, the location of the exit hole, also on the sun-lit side, was positively correlated with the axillary bud and growth ring.

Factors leading to increased incidence of the sugar cane top borer in recent years in some areas of India. A. N. Kalra. *Indian Sugar Crops. J.,* 1980, **7,** 42-43. – A marked increase in the incidence of *Tryporyza nivella* in certain areas of the north Indian cane belt in recent years is attributed to: the growing of susceptible cane varieties; prolonged crushing periods (allowing the borer to complete its life-cycle and emerge as a moth which then lays eggs and so continues infestation of subsequent crops); frequent irrigation of the young cane crop during May, when the first generation of moths appears, which provides micro-climatic conditions favourable to the borer; and the increasing tendency to grow ratoon crops, on which the moths lay their eggs.

Chemical control of the sugar cane leaf hopper *(Pyrilla perpusilla)* Wlk. during summer. Y. P. Madan and R. A. Singh. *Indian Sugar Crops J.,* 1980, **7,** 45-47. BHC 10% dust at 2.5 $kg.ha^{-1}$ a.i. and Methyl Parathion 2% dust at 0.25 $kg.ha^{-1}$ a.i. reduced the numbers of adults and nymphs by up to 98.8% and 96.4%, respectively, and thus proved the most effective of ten chemicals tested; they were also among the cheapest.

Leaf scald – a new disease of sugar cane in the eastern tract of Uttar Pradesh. K. P. Verma. *Indian Sugar Crops J.,* 1980, **7,** 56-57. – Symptoms and means of control of leaf scald (caused by *Xanthomonas albilineans*), found in a number of districts of eastern U.P. in recent years, are described.

The fight against Eldana: a biocontrol unit established. Anon. *S. African Sugar J.,* 1980, **64,** 557, 560, 562. Details are given of a biological control centre set up at the Experiment Station, Mount Edgecombe, for purposes of breeding parasites of the borer, *Eldana saccharina.* Particular mention is made of the wasp, *Trichogramma australicum,* which is known to parasitize eggs of the borer under laboratory conditions and was introduced from Taiwan in 1980. A bethylid wasp found on the borer in Malawi is also being cultured.

Entomological parasite-host records from Mauritius. J. R. Williams. *Occ. Paper, Mauritius Sugar Ind. Research Inst.,* 1980, (32), 39 pp. – Two lists are given of parasites and their hosts, and of the hosts and their parasites. Those parasites introduced deliberately for biological control purposes are indicated, as is the status of parasite or host (whether primary or secondary) where hyperparasitism is known to be involved. In List I, the parasites are listed alphabetically under their different orders, each entry being numbered. In List II, the hosts are listed alphabetically under their orders, and the parasite(s) given the number(s) occurring in List I, where the full details are to be found. List II is followed by a bibliography and alphabetical indexes to parasites and to hosts. The work is a revision of records last published in 1974[1].

Control of the sugar cane scale (insect), *Melanaspis glomerata* Green, by granular insecticides. S. V. Rao, C. S. Rao and B. H. K. Rao. *Indian Sugar,* 1980, **30,** 237-239. – Replicated trials in a randomized block design were conducted with six granular insecticides (Lindane, Citrolane, Endrin, Sevidol, Disulfoton and Aldicarb), all applied at 2.5 $kg.ha^{-1}$ a.i. to 2nd ratoon cane. The granules were placed 15 cm deep in the soil near the stool and then covered with soil. Best results were given by Aldicarb, which reduced scale incidence, increased mean Brix and raised juice purity by comparison with the control, as did the other five treatments.

Leaf scald disease of sugar cane in Punjab (India) and its control. K. S. Waraitch. *Indian Sugar,* 1980, **30,** 301-304. Since it was first observed in Punjab in 1977, leaf scald (caused by *Xanthomonas albilineans)* has been found on a number of varieties, although at a fairly low incidence, except for a rate of 58% in the case of Co 7301, which has exhibited both chronic and acute phases of the disease. Trials with various treatments are reported; generally, greatest reduction in incidence was achieved with moist hot air treatment at 54°C for 4 hours, or hot air treatment at 54°C for 8 hours, but bud germination was lower than in the case of the control. Bleaching powder treatment gave highest bud germination and substantially reduced disease incidence, while antibiotic treatment gave almost the same level of bud germination but failed to give satisfactory disease control. Hot water treatment at 50°C for 2 hours had no effect.

Effect of wind on pheromone emission by females and on laboratory mating of *Chilo sacchariphagus* Boj. (Lep.: Pyralidae). D. Fournier. *Agron. Trop.,* 1980, **35,** 395-401 *(French).* – Laboratory investigations showed that a light wind (simulated by air blown at 0.3-1.0 $m.sec^{-1}$ by a fan through a conduit into the cages) favoured mating of the title borer by stimulating the females to emit pheromones more frequently than at lower or higher wind velocities, and by diluting the pheromones (which at too high a concentration have an inhibiting effect on the males).

[1] *I.S.J.,* 1976, **78,** 81.

CANE SUGAR MANUFACTURE

Improvement in graining method. K. N. Kanawade and M. N. Kotasthane. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.23-M.26. – A method of seed slurry preparation is described, in which white sugar is dissolved in water, the solution heated and then added to denatured spirit. The mixture is then stirred for 15-20 minutes to allow formation and precipitation of crystals. The slurry gave better quality low-grade massecuite and lower final molasses purity than did conventional ball mill slurry.

Separate treatment of Oliver filtrates – laboratory trials. V. B. Mudhale and S. A. Kore. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.27-M.34. – After mud problems had arisen, it was decided to see if it was practical to treat Oliver filtrate separately rather than combine it with mixed juice before treatment. Laboratory trials were conducted with milk-of-lime and phosphate, and showed that separate treatment can give clear juices. The extra equipment required and the advantages of such treatment are discussed. Further trials are to be made on a factory scale.

On bringing down the downtime. G. G. Kakade and S. L. Nehere. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.35-M.42. – Details are given of modifications to the evaporator station arrangement at the authors' factory so as to reduce the downtime needed for scale cleaning.

Practical application of statistical quality control in the sugar industry. G. Ramanathan. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.43-M.51. – Three case histories are described to which statistical quality control was applied. Use of the technique showed that higher imbition % fibre gave higher mill extraction, revealed the pan man responsible for dropping a sub-standard massecuite, and located the cause of discrepancy in juice purity determinations.

Experiments with a transient heater. S. N. Guptha. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.53-M.62. – The concept of transient heating[1] is briefly explained, and trials with a small 1-tonne capacity heat exchanger, designed to reheat low-grade massecuite, are reported. Results indicated a rise in molasses purity which was generally below 1 unit during heating from about 46-50°C to about 54-58°C.

Proposal of an arrangement for the preparation and addition of T.S.P. to raw juice. M. K. Kucheria, V. S. Desai and K. Gopelakrishnan. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.63-M.70. – A simple arrangement for dissolving triple superphosphate and adding the solution to juice is described.

Converting quadruple into quintuple for bagasse saving. Allied problems and economy. V. A. Buddhe and S. A. Kore. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.71-M.77. – The bagasse and steam saving achieved by converting a quadruple-effect into a quintuple-effect evaporator, with or without vapour cell, is calculated, and the effects of the conversion on investment, cleaning and maintenance costs indicated.

In need of normalization of performances. P. K. More. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.81-M.103. – In order to evaluate sugar factory performance, the author presents a large number of mathematical equations for calculation of balances applicable to milling, clarification, boiling, massecuite curing, boiling house efficiency, and overall performance. A number of conclusions are drawn.

Walkonti 10DC – performance data in sugar factories. K. N. Shukla, A. R. Bhide and B. R. Math. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), M.105-M.112. – Details are given of the Walkonti 10DC continuous centrifugal, and its performance in three Indian sugar factories is summarized.

Desuperheating of exhaust steam. R. T. Khurd. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), E.1-E.4. – The author discusses the advantages of steam desuperheating as a means of saving bagasse, and calculates the quantities involved for a 1250 tcd factory.

Cane fiberizing comber. T. M. Karne. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), E.25-E.34. – Modifications to a cane fiberizer are described and results given of cane preparation evaluation by three methods (sieving, determination of the Preparation Index in terms of pol, and the bulk density method). Milling results obtained before and after the modifications are also tabulated, showing a 1% (absolute) increase in reduced milling extraction, a fall in the load on the mills, a reduction in bagasse losses of 0.13%, a considerable increase in primary extraction, etc.

Rag Sai – a simple cane carrier drive. – .Raghavan, –. Ramaswamy and –. Giri. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), E.35-E.43 + diagram. – A simple automatic drive, which takes its name in the form of an acronym from the authors' names, is described. It automatically starts and stops the cane carrier when there is an overload on the relays controlling the leveller, cutter and shredder, and varies the speed according to the thickness of the cane blanket.

Maintenance of instruments – problems and solutions. J. P. Mogal. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.1-S.9. – Process instrument faults and their corrections are described. The need for proper maintenance by trained personnel is emphasized.

A note on weight measuring systems. K. K. Seth. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.11-S.12. – Brief reference is made to weighing systems used in the sugar factory, followed by an outline description of an electromagnetic flowmeter and its advantages.

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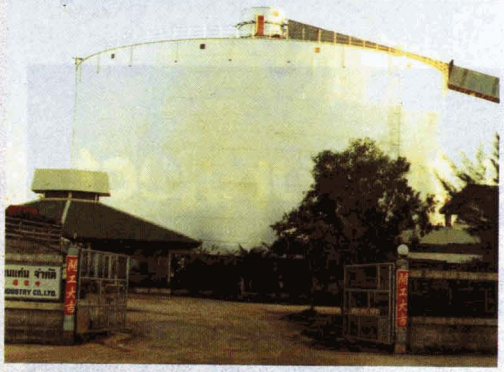
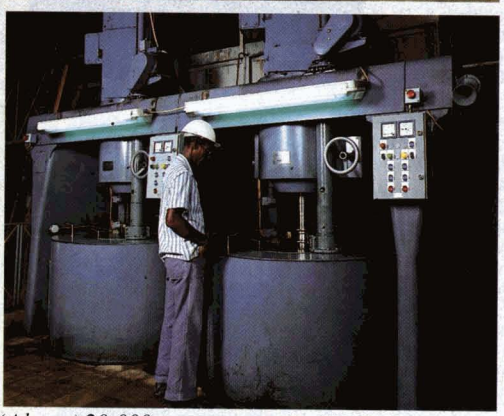
[1] Doss: *I.S.J.,* 1981, **83**, 279.





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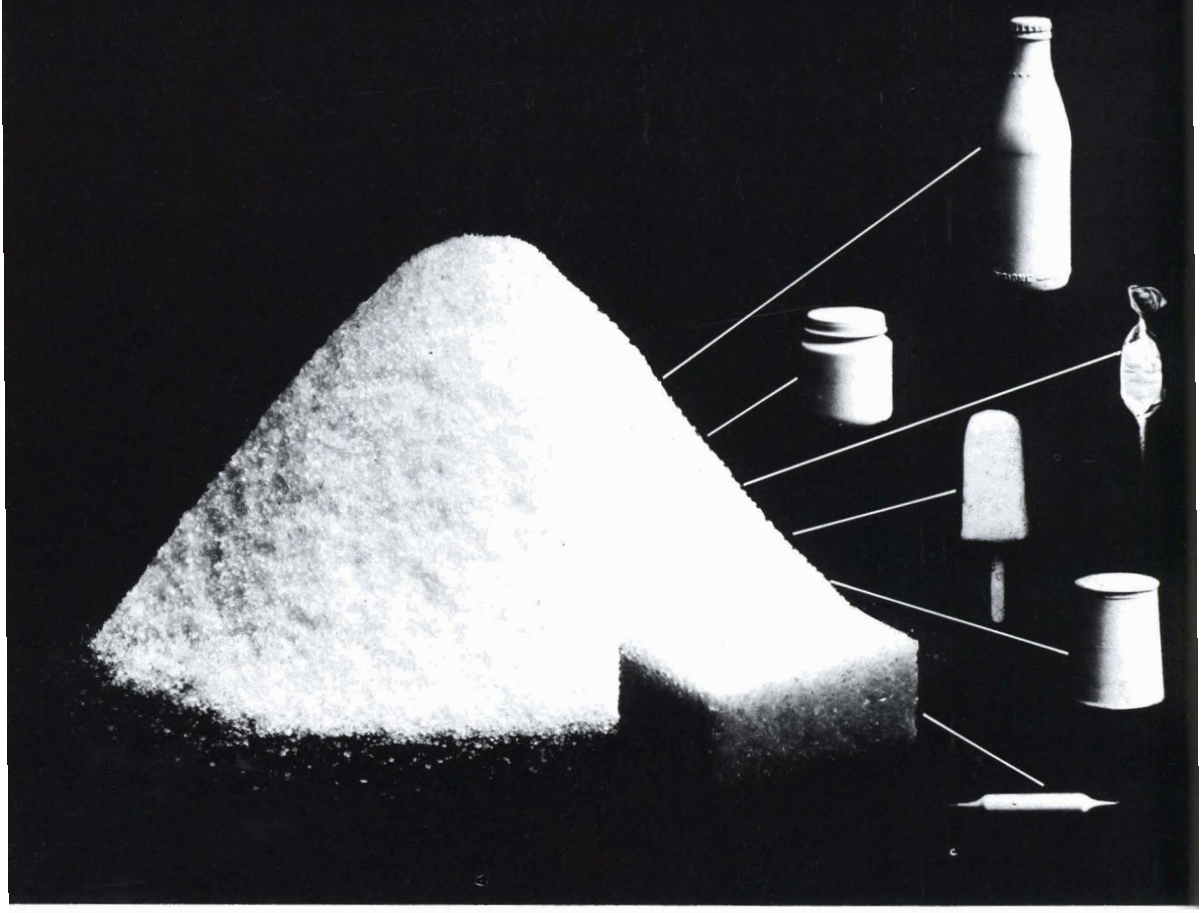

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Operation of instruments in sugar factories. A. S. Ashtekar, R. B. Borate and S. A. Banikar. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.13-S.14. – The need for proper maintenance of process instruments is stressed, and establishment of steam consumption from steam flowmeter readings at the authors' factory is described.

Instrumentation and automation in the cane sugar industry at Vuyyuru. I. S. V. P. Rao and B. K. Rao. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.15-S.28. – Instrumentation and automatic controls installed at the authors' sugar factory are described with the aid of diagrams.

Important instruments in a sugar factory. P. B. Bargaje. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.29-S.34. – A brief survey is presented of the more important instruments used in a sugar factory, and guidance is given on optimum location and use.

Automation system for a multiple-effect evaporator control without vapour draw-offs. A. J. Date. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.35-S.39. – The system described includes a liquid level control for each effect in a quadruple-effect evaporator, a means of controlling the rate of evaporation, density control, and a means of automatically adjusting the evaporation rate to coincide with changes in juice feed. The advantages such a system would bring are indicated.

Automation in sugar factories. R. K. Sirdeshmukh. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), S.41-S.44. – The possible application of automatic controls in cane handling, milling, boiler operation and in the power house is briefly discussed.

Methodology of exergy investigations in sugar factories. T. Baloh. *Zuckerind.,* 1981, **106,** 29-40 *(German).* – The establishment of a thermal balance for a cane sugar factory is explained with the aid of graphs, Sankey diagrams, schematic diagrams and a Mollier diagram, and sources of losses shown. Optimization of evaporator operation and improvement in the heat economy (to give a 46% saving in bagasse without any changes to the processing scheme) are described. Although the use of vapour compression in the evaporator station necessitates greater electricity consumption, the extra power required is less than the excess power available for supply to the public grid.

Analysis of a sugar cane transport circuit on a basis of the service distributional characteristics of each of its stations. M. Morales, E. Capuñay G. and E. Angulo A. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1979, **7,** 115-128 *(Spanish).* – An analysis was made of the loading, weighing and unloading of cane during a 12-day period at Cartavio in Peru. The overall amounts were essentially the same, and there was an equal hourly rate of supply to the factory during the night as during the day. All the stations (i.e. loading, weighing and unloading) had an installed capacity greater than that utilized. With more frequent arrivals, the statistical distribution lies about an interval rather than a point. All the stations worked efficiently. Although three cranes could handle present supplies to the factory instead of the four installed, it is the unloading station which would be the determining factor in the system and would govern the maximum capacity in the absence of any modification to the system.

Introduction of modern technology in Indian sugar factories. M. Singh. *Indian Sugar,* 1980, **30,** 229-235. Improvements that could be made in Indian sugar factory technology are discussed, including bagasse drying with the aim of reducing the amount used as fuel and thus increasing the amount available for by-product utilization, and improvement in cane mill performance, e.g. through installation of Lotus rolls[1].

Noise reduction in Queensland sugar mills. D. Macey. *Noise Control Eng.,* 1978, **10,** (2), 67-73; through *S.I.A.,* 1981, **43,** Abs. 81-48. – A detailed report on noise levels and their reduction is given, with regard to locomotives, shredders and the steam system. Locomotive cabin noise has been reduced to acceptable levels by lining the cabin with sound-absorbing material and fitting a more suitable exhaust silencer. Shredder noise has been reduced to 90 dB(A) at points where operators work continuously; radical design changes would probably be needed to reach only 85 dB(A). Suitable absorption-type silencers are shown for high- and low-pressure steam vents; noise from pressure-reducing valves is significantly decreased by a simple perforated diffuser on the down-stream side.

Optimum design of a triple-effect for the sugar industry by the method of dynamic programming. P. García G. and I. Morrell F. *Centro Azúcar,* 1980, **7,** (1), 49-63 *(Spanish).* – The design method using "dynamic programming" is presented and applied to the design of a triple-effect evaporator. Because of the amount of calculation involved, the use of a computer is necessary, but it permits calculation of the minimum area of the evaporator to meet the required duty.

Crystallization by exhaustion. A bibliographic study. I. Gallardo A., R. Alemán G. and N. Valdés P. *Centro Azúcar,* 1980, **7,** (1), 65-76 *(Spanish).* –The literature on exhaustion of molasses in crystallizers is surveyed and factors identified as having influence on exhaustion are summarized. A program of work is proposed to obtain a clearer idea of the quantitative effects of these factors.

Thermal characteristics of evaporators. II. R. Espinosa P. and M. Chaviano S. *Centro Azúcar,* 1980, **7,** (1), 77-90 *(Spanish).* – A method is described which has been used for the evaluation of a quadruple-effect evaporator. This involved not only the determination under controlled conditions of the evaporation coefficient (as specified by the Ministry of the Sugar Industry) but also the thermal efficiency coefficient, heat transfer coefficient, utilization coefficient, specific thermal resistance and operation time for each effect; definitions of each of these are provided.

Measurement of the sugar crystal in massecuites. F. Pantuso N. *Centro Azúcar,* 1980, **7,** (2), 15-28 *(Spanish).* – The crystal content of massecuites is an important parameter in the control of boiling, and is beginning to be adopted as a routine measurement in the Cuban sugar industry. A survey is presented of the types of meter used for crystal content determination, including a conductimetric device patented by the Cuban industry.

[1] Bouvet: *I.S.J.,* 1980, **82,** 23.

BEET SUGAR MANUFACTURE

Twenty years of experience and research concerning waste water control at CSM 1960-1980. R. de Vletter. *Sucr. Belge,* 1980, **99,** 439-449. – See *I.S.J.,* 1980, **82,** 344.

Carbonatation gas scrubbing with a venturi tube. N. I. Gavrina. *Sakhar. Prom.,* 1980, (12), 40-41 (Russian). A brief description is given of a gas cleaning system which includes a vertical venturi tube surmounted by a swirler in which the dust-laden gas is mixed with water, passes down the venturi tube and is fed, via a scrubber, to a wet trap.

Reconstruction of the electric drives of inclined diffusers. V. N. Pokrovskii. *Sakhar. Prom.,* 1980, (12), 41-42 *(Russian).* – The possibility of replacing the D.C. motors used as drives on Soviet-built inclined diffusers with thyristor-mounted drives, of greater reliability, is discussed.

Radiometric measurement of liquid density in the sugar industry. J. Wajs. *Gaz. Cukr.,* 1980, **88,** 154-157 *(Polish).* Details are given of a density meter which utilizes isotope caesium-137 as radiation source and has been installed in new and modernized sugar factories in a number of countries. Trials at one factory in 1979 showed that the P-3302 meter gave readings which were practically identical with refractometric values. The meter is applicable to thin and thick juices, undiluted mud and milk-of-lime.

The flow of a boiling massecuite layer with free surface in a direct-flow inclined channel. B. G. Didushko and V. G. Garyazha. *Izv. Vuzov, Pishch. Tekh.,* 1980, (5), 118-121 *(Russian).* – In an investigation of the gravity flow behaviour of massecuite during continuous boiling, it was found that the rate of flow of a layer of massecuite in an inclined channel was governed by thickness of the layer, the physical properties of the massecuite, and the angle of incline of the channel. An equation is derived for calculation of this velocity where the massecuite has no surface limitation.

The advisability of separating predefecation mud from juice before main liming. L. P. Reva, G. A. Simakhina and V. M. Logvin. *Izv. Vuzov, Pishch. Tekh.,* 1980, (5), 122-125 *(Russian).* – The effect of removing predefecation mud after preliming at 40, 60 and 85°C for 30, 10 and 5 minutes, respectively, was studied with two juices, of 86.8 and 77.2 purity, to which 100% freshly produced 1st carbonatation mud was added and then progressively brought to an optimum alkalinity of 0.08-0.09% CaO (pH 11.32-11.38). The prelimed juice was then divided into two streams which were processed up to 2nd carbonatation, one of the streams being filtered to remove the predefecation mud. Results showed that the mud formed during preliming at 40 and 60°C was sufficiently stable, under the conditions of high alkalinity and temperature during main liming, for juice purity to fall only very slightly; mud removal was justified only where hot preliming (at 85°C) was used, and gave a purity rise of 0.8-1.2 units by comparison with the results of mud retention. On the other hand, hot preliming gave 2nd carbonatation juice properties that were worse than with cooler preliming, regardless of mud removal. Albumins pass into solution from predefecation mud during main liming to a greater degree than do acid anions, but this can be minimized by preliming at the lower temperatures tested, so as to bring about formation of a more stable albumin coagulate.

The energy consumed in manufacture of sugar factory products. Z. Kuncewicz. *Gaz. Cukr.,* 1980, **88,** 169-172 *(Polish).* – The energy consumed in producing each of 45 components involved in the manufacture of white sugar, ranging from the beets themselves via fuels and chemicals to the metal components of machinery and including energy consumed in maintenance and repairs, is calculated; the energy consumed (MJ/mg) in sugar manufacture is then established on the basis of the quantity of consumable used (mg/mg). The total energy consumption per tonne of sugar and dried beet pulp is shown to be 26,505 and 19,802 MJ, respectively. The simplest and cheapest way in which to reduce energy consumption is considered to be processing of beets of higher sugar content, e.g. 17-18% as opposed to 14-15%.

Changes in the colloid content of sugar factory juices. M. Wachowicz and J. Makowski. *Gaz. Cukr.,* 1980, **88,** 179-181 *(Polish).* – Juice and molasses samples from October and December were analysed for a number of components, including total, hydrophobic and hydrophilic colloids. The quantities of both groups of colloids removed by various processes were also established. Some 50% of the raw juice colloids was removed by juice purification, while a further 20% was eliminated during evaporation and boiling, leaving 30%, or 0.143-0.178% (on beet) in molasses. The colloid content was greater in December than October samples. While 95% of the hydrophobic colloids were removed in processing, only 66% of the hydrophilic colloids were eliminated.

Decrease in sugar losses as a result of thin juice deionization in an alkaline medium. H. Zaorska, S. Zagrodzki, D. Sucharzewska and K. Lisik. *Sucr. Belge,* 1980, **99,** 463-469 *(French).* – See *I.S.J.,* 1980, **82,** 381.

Anaerobic waste water treatment at CSM sugar factories. K. C. Pette. *Sucr. Belge,* 1980, **99,** 473-479. – See *I.S.J.,* 1980, **82,** 344.

Continuous production of massecuite. I. Simulation of the process of sucrose crystallization in a continuous vacuum pan. R. Stengl and S. Kuzera. *Listy Cukr.,* 1980, **96,** 275-282 *(Czech).* – The state of the art of continuous boiling is briefly reviewed, and the possibility of mathematical simulation of the crystallization process is examined. On the basis of the model developed, an experimental pan was built; this is described, and tests on it are reported. The results have been used as a basis for the main concepts of a factory scale model.

Energy conservation at a Canadian sugar beet factory. A report from the Manitoba Sugar Company. B. Karren and M. Ruchkun. *Sugar y Azúcar,* 1981, **76,** (1), 46-47, 50-51, 53. – In 1978, DDS Engineering studied the heat

economy of the Winnipeg beet sugar factory (slicing 3000 tonnes of beet per day) of BC Sugar and suggested a program under which the energy consumption could be reduced by 30%. Details are given of the changes carried out under Phase I of the project, involving additional heat surface area in both the evaporator and juice heaters, with heat recovery from the 5th effect and from the evaporator condensate and hot water systems (instead of using early-stage vapours and directly using exhaust steam as previously). The modified plant started operations in October 1980. Details are given of the modifications and of the improvements brought about, which included a steam consumption reduction from 54.6% to 44.5% on beet with slightly more massecuite boiled than in 1979, a standard fuel consumption of 5.34% on beet (6.19%) and an evaporation factor of 2.21 (1.69). Further changes were to be made under Phase I, while Phase II (in 1981) was to include installation of extra equipment for recovery of vapours from the white sugar pans.

The design basics of a suitable evaporator and its optimum incorporation in the heat economy of a factory. P. Hoffman. *Listy Cukr.*, 1981, **97,** 1-5 *(Czech).* The basic factors in the design of an evaporator and its installation that are discussed include the type of effect, tube material, temperature within each effect, arrangement of vapour bleeding, number of effects, possible use of vapour compression, and the dependence of the quantity of steam needed for the turbine on its pressure where the factory meets its energy requirements. Six examples are described which show the effect of evaporator arrangement and operation on steam consumption.

Technological evaluation of the TL-1000 pulp press. P. Kadlec, R. Bretschneider, Z. Bubnik and A. Svoboda. *Listy Cukr.*, 1981, **97,** 5-8 *(Czech).* – The performance of the title press was analysed in 1978/79 and 1979/80 and compared with that of a Polish ZUP 900 press. Full details are given.

Comparative evaluation of individual variants of raw sugar manufacture. J. Burianek. *Listy Cukr.*, 1981, **97,** 14-22 *(Czech).* – Four variants of *B*-sugar treatment in a 2-massecuite scheme (in which some raw sugar is processed to white sugar) are described by block diagrams: (1) in which the *B*-sugar is melted in the thick juice for use as *A*-massecuite feed together with raw sugar remelt, (2) where the *B*-sugar is spun and discharged without further treatment, (3) where the *B*-sugar is affined and the affination sugar used for liquid sugar manufacture, and (4) where the *B*-sugar is melted in thin juice, reboiled, spun and discharged. Comparison of the schemes by means of algorithms showed that variants (1) and (3) were best in terms of the amount of massecuite boiled and water evaporated.

Considerations on development of the energy concept at Zuckerfabrik & Raffinerie Aarberg AG. H. R. Brunner, W. Hoppe and G. von Lengyel-Konopi. *Zuckerind.*, 1981, **106,** 42-47 *(German).* – A 3-stage expansion of the beet end of Aarberg factory/refinery is to bring it to a daily slice of 6400 tonnes, although the sugar end capacity is to remain unchanged and the extra thick juice stored for post-campaign processing. Investigations have been undertaken to find ways of minimizing operational costs of the factory through establishment of a suitable heat scheme. Fossil fuels for steam raising were examined as well as alternative forms of energy. Twenty variants were studied, and the most economical ones selected for comparison with a basic scheme involving a quintuple-effect evaporator with mechanical vapour compression in the 1st effect and in the pan station. The various schemes are described and their advantages and disadvantages discussed. The final choice of scheme rests on a number of factors, including the level of energy costs and the thermal requirements of the evaporator juice, as well as socio-economic and political aspects.

Use of heat pumps in the sugar industry. H. Forte. *Zuckerind.*, 1981, **106,** 48-51 *(German).* – Possible applications of the heat pump are discussed, and four examples described in which it is used to heat various types of building in a sugar factory, particularly during the inter-campaign period. Advantages of the heat pump are given, as well as limitations.

Some problems in the operation of a KDA diffuser. N. N. Bilyk and P. N. Babii. *Sakhar. Prom.*, 1981, (1), 30-32 *(Russian).* – Problems that have arisen in the operation and overhaul of the Soviet KDA tower diffuser are discussed.

Thoughts on the energy economy of a sugar factory. G. Duchateau. *Sucr. Belge,* 1981, **100,** 3-14 *(French).* The heat economy of a beet sugar factory is examined, and how the energy and heat requirements of individual processes are met is discussed. The author indicates where reductions can be made in energy consumption (especially through decrease in the volume of water to be evaporated), and pays particular attention to sugar house operations; he describes methods of decreasing the quantity of massecuite by increasing the crystal content per strike and discusses ways of improving the energy economy at other stations in the sugar house, including the use of pan vapour recompression for heating purposes. It is stressed that any measure introduced for energy saving will complicate the overall manufacturing process, either directly or indirectly, and will increase the difficulties of control, as well as the operational, control and maintenance costs and the risk of breakdowns; this fact must be borne in mind as well as the direct cost of introducing a given measure when calculating its profitability. It is not necessarily the local economies of apparently major importance that will offer greatest benefits, but those that will optimize the overall factory economy; for an existing factory, this generally implies the implementation of a number of complementary modifications. A heat flow diagram is appended.

Sugar storage in silos. IV. Use of heat conductors to replace the heat losses in bins and silos. L. Budicek. O. Mukus and P. Hoffman. *Listy Cukr.*, 1981, **97,** 25-30 *(Czech).* – Where the temperature of stored sugar falls below 15°C in a TMS silo, it is shown that the loss can be made up by means of electrically heated thermal conductors placed betweeen the wall of the silo and a mineral insulation layer (separated from the outer wall by an air space and another cladding of insulation material). Use of night current is practical and cheap. It is stressed that the system is not suitable as a complete heating scheme on its own.

Microbiological sugar losses during diffusion and their evaluation by means of a cost analysis. T. Cronewitz, H. Schiweck and R. Strauss. *Zuckerind.*, 1981, **106,** 127-135 *(German).* – See *I.S.J.*, 1980, **82,** 345.

SUGAR REFINING

Innovations. M. Ya. Kafengauz. *Sakhar. Prom.*, 1980, (8), 38-40 *(Russian).* — Details are given of a system for boxing sugar packets which replaced nine men, and of modifications to a Chambon press concerning lubrication, cleaning of the surface of the rotor, the pneumatic packeting system and the cassette elevators.

The performance of a fluidized bed refined sugar dryer. J. R. Fitzgerald, K. Taylor and G. W. Bestwick. *Proc. 54th Ann. Congr. S. African Sugar Tech. Assoc.*, 1980, 52-55. — The performance of a fluidized bed drying system installed in the refinery section at Gledhow sugar factory is discussed. The system is highly attractive, having few moving parts and requiring only minor maintenance, and can be fully automated; it produces an undamaged refined sugar with a moisture content well below that currently specified. Tests are to be made on drying of VHP (very high pol) raw sugar, and it is expected that the required standard will be achieved. With proper adjustment of air velocities, dust and fines removal is possible without mechanical screening, and this could have significant benefits in subsequent bulk handling.

Further impact on the Crockett refinery of improved quality raw sugar (high pol raws). J. L. Meikle. *Rpts. Hawaiian Sugar Tech.*, 1979, 164-168. — Raw sugar intake at Crockett refinery was changed from about 98.5 pol in 1977 to about 99 pol in 1979. The reduction in non-sugar and colour load (about one-third) has given less improvement in refinery grain size and crystal colour than expected, and decolorization costs are about 75% of those which would have been incurred if raw sugar quality had been unchanged.

Bulk transport of sugar to sugar refineries. S. A. Brenman, N. S. Ivolga, A. A. Kozyarevich and E. P. Evreenko. *Sakhar. Prom.*, 1980, (9), 24-26 *(Russian).* — The question of bulk transport of beet raw sugar to refineries in the USSR is discussed. The recommendation is to transfer all the sugar from a given factory in crystal form, or partly in crystal and partly in liquid form, perhaps even partly in bagged form.

Application of a PZhS-P density meter in refined sugar manufacture. A. N. Gritskevich. *Sakhar. Prom.*, 1980, (9), 30-32 *(Russian).* — Laboratory and factory tests on the title density meter, a direct-flow analogue, pneumatic instrument covering the range 500-2500 $kg.m^{-3}$, are reported. Results showed that it was not suitable for use on affination liquor and other unfiltered refinery liquors, even after screening with a special cylindrical device.

Microbiological investigation of products in the melting section of a refinery. E. K. Popova. *Sakhar. Prom.*, 1980, (9), 48-49 *(Russian).* — Investigations showed that mesophiles constituted the major group of microorganisms in raw sugar entering a refinery, while the slime-forming mesophiles followed in second place and aerobic thermophiles came third. While the numbers were greatly reduced by melting of the sugar, they rose to levels higher than in the original sugar after screening, heat-tolerant bacteria then occupying third place before the aerobic thermophiles. It was found that only regular cleaning of the screening equipment reduced the numbers of bacteria appreciably; with prolonged intervals between cleaning, the numbers of mesophiles rose considerably.

Sugar losses in vacuum pan and evaporator vapours. P. H. Petri. *Sugar Bull.*, 1980, **58**, (21), 6-7. — Entrainment losses, although possibly significant, are often neglected because of difficulty in obtaining a good representative sample. The author describes a system used by refineries in the USA which comprises a perforated, stainless steel pipe mounted in the vapour pipe between the evaporator or pan and the barometric condenser. Entrained materials pass through the perforations and are collected in a floor-mounted pot, whence they are taken periodically for determination of sucrose by acid hydrolysis, using a Technicon Auto-Analyzer and resorcinol or anthrone as indicator.

Testing a BTH 14 Simplex automatic packing machine on filling of bulk materials. O. Rzsival. *Listy Cukr.*, 1980, **96**, 260-262 *(Czech).* — Information is given on a Czechoslovakian automatic packing machine which, in tests with icing sugar, proved comparable to an Italian ICA CSV 30 machine.

Development of a vertical continuous vacuum pan. I. I. Kensho, T. Yamaguchi, T. Yanakado, S. Hirai, S. Nakamura, S. Abe, K. Taguchi, N. Nakazato and T. Hurukawa. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1980, **29**, 88-93. II. *Idem ibid.*, 94-100 *(Japanese).*

I. A vertical continuous vacuum pan developed by the authors comprises five stages of equal volume, one above the other. A flow sheet is presented of a pilot plant. II. Tests were conducted on boiling of granulated and soft sugar. By comparison with a batch pan, the continuous pan gave sugar crystals of somewhat higher C.V., although the quality was satisfactory. The shorter residence time prevented increase in massecuite colour and deterioration of molasses, while steam consumption was substantially reduced, since no balancing water was needed. Pan response to disturbance was slow. Optimum was steady-state operation, with liquor, steam and seed being fed at a constant rate.

Research and development on the automatic control system of a 1 kg weighing machine. K. Fukunaga and T. Kamidoi. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1980, **29**, 111-120 *(Japanese).* — An automatic control system was developed for the weigher incorporated in the packing system at the authors' refinery. Two inspection switches for setting of the sugar quantity were replaced by a differential transformer to provide feedback control. A signal from the autochecker was used as input into the transformer, and automatic compensation provided to allow for the effects of various disturbances on the sugar weighing. As a result, the proportion of packaged product rejected fell from 4.02% to 2.98%.

NEW BOOKS

Sugar year book 1980. 338 pp; 9.8 x 14 cm. (International Sugar Organization, 28 Haymarket, London SW1Y 4SP, England.) 1981. Price: £10.00.

Statistics relating to sugar production, consumption, imports, exports and stocks (depending on the country in question) are presented for 126 countries (the EEC member-countries being represented as one block), with a section of general tables appended, covering such items as world sugar production, exports, imports, consumption, prices, etc. The material (valid up to July 1981) has been obtained from member-countries of the International Sugar Agreement under ISA rules or has been supplied (in the case of non-members) by the appropriate government, extracted from statistical publications or estimated; the figures are expressed, as far as possible, in terms of 96° pol raw sugar on a calendar year basis, and refer only to centrifugal sugar. The print is very clear, on matt paper, and reference is very easy; the format remains pocket-size, although this latest edition is even thicker than its predecessors.

The International Sugar Market: prospects for the 1980's. L. Chilvers and R. Foster. 113 pp; 20.7 x 29.3 cm. (The Economist Intelligence Unit Ltd., 27 St. James's Place, London SW1A 1NT, England.) 1981. Price: £50.00.

This, the latest (No. 106) in a series of Special Reports published by the EIU, is intended to look into the future on the basis of past history and current influences. The authors recognize the complication of market influences but draw some conclusions on which to view prospects for the present decade.

They start by examining the cyclical history of sugar prices and the patterns of world sugar production, consumption, imports and exports, using data from various I.S.O. Yearbooks and F. O. Licht figures for recent years. They then analyse the factors, traditional and novel, affecting demand for sugar and similarly treat factors influencing supply, with special attention to the International Sugar Agreement and other arrangements affecting trade both in the past and the present. They echo the familiar view that most of any future increase in sugar consumption will originate in the developing world, stimulating production in such countries. This potential for growth, they conclude, justifies a forecast that global sugar consumption in the 1980's will average not the 1.5% indicated by past trends, but about 2.6%.

The high cost of production capacity investment, particularly from scratch where no sugar industry has previously existed, is acknowledged, however, as is the trend towards greater cost increases in cane sugar production than in beet sugar production. The consequence, it is noted, is probably a lower level of cane sugar production, which is mostly in the developing world: a contradiction of the report's forecast. For the forecast to have substance would require massive investment in developing countries; since price instability makes this such a risky undertaking, it will need the willingness of banking consortia, governments and the World Bank to provide funds for the potential to be realized. Thus, political and sociological factors are playing a role of increasing importance by contrast with economics and technology in the development of the world sugar industry.

A bibliography of the sugar cane borer, *Diatraea saccharalis* (Fabricius), 1887-1980. R. M. Roe, A. M. Hammond, T. E. Reagan and S. D. Hensley. 101 pp; 19.7 x 26 pp. (U.S. Dept. of Agriculture, U. S. Sugarcane Field Research Laboratory, P.O. Box 470, Houma, LA 70361, USA.) 1981.

The bibliography contains 1193 references taken from ten standard bibliographic sources, from personal communications and from articles in which a reference is cited. All articles indexed in the sources under *D. saccharalis* and most of its synonyms are included. Each reference is given in alphabetical order of the author's name, followed by publication data and, where necessary, alphabetically by title of article and title of journal or book. An author index is given, as well as an index to references grouped by subject and by period of publication. Unsigned articles are listed under "Anonymous" in the bibliography and under the agency responsible for the article in the author index. The work is a valuable contribution to the literature on cane pests and their control.

Hawaiian sugar manual 1981. 41 pp; 15 x 23 cm. (Hawaiian Sugar Planters' Association, P.O. Box 1057, Aiea, HI 96701, USA.) 1981,

The latest edition of this statistical handbook closely follows the pattern set by previous editions; it is divided into four parts, covering the Hawaiian sugar industry, the US sugar industry, world sugar and a short glossary of sugar terms. The information has been updated to 1980. For readers interested in the Hawaiian and US sugar industries, there is probably no better source of concise information than this slim volume.

Annual report 1980. 76 pp; 21 x 29.5 cm. (Mauritius Sugar Industry Research Institute, Réduit, Mauritius.) 1980.

The first 50 pages of this report are devoted to sugar cane and sugar manufacture; in these pages are to be found a brief survey of the 1980 crop and of work on cane breeding and varieties, agronomy and plant physiology, diseases, pests, weeds and sugar technology. The information is well laid out, with a number of colour photographs illustrating various aspects (particularly symptoms of gumming disease), and the print is very clear.

Growing sugar cane in different states in India. P. S. Mathur and C. Behari. 95 pp; 14.7 x 10.6 cm. (Directorate of Sugarcane Development, 1 Shyam Enclave, Sahibabad, Ghaziabad Dist., U.P., India.) 1980.

The cane-growing practices adopted in each of the eight states of the sub-tropical belt and the seven states of the tropical belt in India are described in some detail; information is also given on varieties grown, time of planting and duration of the crop season. Details are then given of insect pests and diseases that occur in India, with descriptions of control methods (including integrated control of both pests and diseases), followed

by short chapters on ratooning, intercropping, cane maturity and harvesting, and brief notes on various aspects of cane growing. This small paper-back edition makes a valuable contribution to the literature of cane growing, and will be particularly useful to readers of Indian articles on cane agronomy.

Seed cane production. 16 pp; 22 x 28.4 cm (Experiment Station of the South African Sugar Association, P.O. Mount Edgecombe, 4300 Natal, South Africa.) 1981.

Bulletin No. 21 of the SASA Experiment Station is a recent example of the fine publications on important aspects of sugar cane agronomy available to growers in South Africa. It is intended to demonstrate the benefits that can be derived from improving the quality of the seed cane planted in commercial cane fields and to outline simple schemes that can be adopted with this aim in mind. It is divided into five sections, entitled "Why worry about seed cane quality?", "Planning seed cane nurseries", "Hot water treatment", "Nursery management", and "Does good seed cane pay?". Each section is neatly laid out, with numerous colour illustrations and diagrams, and the producers of the work are to be congratulated on its excellence.

81st Annual Report 1981. 74 pp; 19.6 x 27 cm. (Bureau of Sugar Experiment Stations, P.O. Box 86, Indooroopilly, Queensland 4068, Australia.) 1981.

In a foreward to this report, the Director of the BSES, Mr. Owen W. Sturgess, states "Because of the high level of technology adopted on cane farms and in mills, the Australian sugar industry has become one of the most efficient in the world. In 1980, 3,148,955 tonnes of sugar were produced compared with 893,921 tonnes in 1950. During this 30-year period, the area of cane harvested increased from 104,313 hectares in 1950 to 274,259 hectares (in 1980)". The BSES has played a major role in this remarkable progress, and the latest report outlines the work being carried on by this organization. In fact, with statistics for the individual factories and factory regions, the report constitutes a useful survey of the Australian sugar industry for 1980-81.

First Annual Report, Commercial Research & Extension, Sind Sugar Corporation Ltd. 140 pp; 22.1 x 28.1 cm. (Sind Sugar Corporation Ltd., G.P.O. Box 3730, Karachi, Pakistan.) 1980.

This report mainly concerns research experiments on the use of fertilizers, particularly potash, and describes the extension methods adopted by the Sind Sugar Corporation, which operates two sugar factories, at Dadu and Thatta. The work sheds some light on the activities within one of the lesser known sugar industries of Asia.

Pests of sugar cane in South Africa. 23 pp; 22 x 28.4 cm. (Experiment Station of the South African Sugar Association, P.O. Mount Edgecombe, 4300 Natal, South Africa.) 1981.

This is a revised version of Bulletin No. 8 and covers those insects and nematodes most frequently damaging sugar cane in South Africa and Swaziland. The classes of insect are considered in approximate order of importance and, as far as possible, are grouped according to the type of damage they cause. For each pest, details are given of the appearance and damage caused, its biology and control methods. While the preference is to avoid use of insecticides wherever possible, reliance being placed more on biological control, this is not the case with nematodes, for which nematicides are the basic control means. Colour illustrations are provided as an aid to identification of the pests.

Queensland Canegrowers Annual Report 1981. 52 pp; 21 x 17.3 cm. (The Queensland Canegrowers' Council, G.P.O. Box 1032, Brisbane, Queensland, Australia 4001.) 1981.

In its 1981 report, the QCGC surveys the 1980 cane crop and sugar production and examines a number of topics of importance to the Queensland cane farmer. Of particular interest is the work being conducted on flood mitigation and major irrigation projects (considered to be moving at too slow a pace), research on herbicides 2,4-D and 2,4,5-T in the light of adverse publicity, particularly regarding the latter chemical in the USA, and the question of cane fibre determination, expecially in regard to the material used for manufacture of the bags in which the prepared cane sample is placed for analysis. These and other matters are discussed with the aid of colour photographs of an extremely high standard of clarity; the result is a report which will undoubtedly be of great value to those of our readers interested in the Queensland sugar industry.

F. O. Licht's International sugar economic yearbook and directory 1981. 449 + 66 pp; 21.7 x 29.7 cm. (F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany.) 1981. Price: 105.00 DM.

The latest edition of this well-known publication provides details of companies, organizations and institutions concerned with sugar throughout the world, gives (where possible) up-to-date locations and capacities of beet and cane sugar factories in more than 100 countries, presents a number of technical and economic review articles by leading specialists, product reports and a buyers' guide, and carries a collection of world sugar statistics for 1980/81 and previous years in a special pocket on the inside of the back cover. The details of the sugar factories are clearly printed on a matt paper. Unlike previous editions of the yearbook, the present one omits details of sugar factories in the USSR and China because of lack of up-to-date information. However, most of the information given on other countries is correct. Certainly, for those readers seeking outline information on the sugar industries of individual countries, this book will prove invaluable.

Experiment Station Annual Report 1980-81. 87 pp; 21 x 29.7 cm (Experiment Station of the South African Sugar Association, P.O. Mount Edgecombe, 4300 Natal, South Africa.) 1981.

The SASA Experiment Station is financed entirely from funds contributed by the South African sugar industry and serves as the headquarters for all sugar cane research, development, advisory, extension, education and training services, as well as an extensive cane breeding program. Hence, the work described in this report represents an important contribution to one of the foremost sugar industries. Much of the material will be of interest far outside South Africa.

LABORATORY STUDIES

Amino-acid composition of fermented molasses worts and of the vinasse obtained from them. V. N. Stabnikov, T. B. Protsyuk, V. I. Barantsev *et al. Ferment. Spirt. Prom.,* 1979, (5), 11-12; through *S.I.A.,* 1980, **42,** Abs. 80-1471. – Contents of 15 amino-acids were determined by paper chromatography in corresponding pairs of wort and vinasse; results for five pairs are tabulated. The total content was 6.27-7.6 $g.l^{-1}$ in wort and 4.4-5.19 $g.l^{-1}$ in vinasse. The most abundant components were proline (respectively 0.53-2.33, 0.48-0.63), alanine (0.71-0.86, 0.57-0.69), methionine (0.64-1.1 0.42-0.66), leucine + isoleucine (0.53-0.97, 0.44-0.58) and tyrosine (0.32-0.8, 0.32-0.51).

Effect of sugar solution colour on measurements of quartz-wedge saccharimeters. H. Melle, K. Zander and A. Emmerich. *Sugar J.,* 1980, **43,** (5), 11-15. – See *I.S.J.,* 1981, **83,** 185.

The effect of non-sugars and colouring matter on the sucrose crystallization rate. H. Zaorska. *Gaz. Cukr.,* 1980, **88,** 173-179 *(Polish).* – Laboratory crystallization of factory thick juice and syrups (prepared, in some cases, from decolorized thin juice) and of refinery liquors, with and without colouring matter added, was compared with the results for pure sugar solution; curves were prepared showing the effects of colouring matter and non-sugars % (the latter expressed as purity difference between pure and impure solutions) on crystallization rate *W*. From the results, a mathematical equation was derived:

$W = 7080.\eta_1.\eta_2$, where $\log \eta_1 = -0.04762$ non-sugars, and $\Delta \log \eta_2 = -0.187(\frac{42 - \text{non-sugars}}{42}).\Delta \log E_{560}$, where E_{560} is the extinction measured at 560 nm. Values of η $(= \eta_1.\eta_2)$ and of η_1 are given for purity in the range 60-98.

Preventing rotting of frozen beets. L. Urbanowicz. *Gaz. Cukr.,* 1980, **88,** 190-192 *(Polish).* – Laboratory tests were conducted on spraying of beets, previously exposed to temperatures of between –5 and –7°C, with various preparations and then allowing them to thaw at between +5 and +6°C for up to 12 days. After 8, 10 and 12 days the beets were analysed for sugar and invert sugar and their physical state determined. Best results, by comparison with a water-sprayed control, were given by a 1% concentration of Sanspor, an ICI product containing 40% Kaptofol, while 1% Kamin, a Polish product, gave almost as good results.

Trace elements and free amino-acids in white and yellow sugar. J. Vucetic and M. Balan. *Zuckerind.,* 1981, **106,** 51-52 *(German).* – At Kovacica sugar factory in Yugoslavia white sugar is produced as well as direct-consumption yellow sugar (affined low-grade sugar). Details are given of average pol, invert sugar content and colour of the white sugar and two grades of yellow sugar (of 99.3 and 99.0 pol) as well as counts of total bacteria, moulds and yeasts, free amino-acids and trace elements (Mn, Zn, Fe, Cu, Cr and Ni). The data show that yellow sugar contains more trace elements and amino-acids than white sugar and can replace white sugar as a foodstuff as well as for industrial uses. The combined manufacture of white and yellow sugar permits a substantial energy saving at increased factory throughput (hence giving a shorter campaign) by comparison with normal operations.

Temperature compensation in a pH measuring system having a tungsten electrode. Z. S. Voloshin and A. V. Pogrebnyak. *Sakhar. Prom.,* 1981, (1), 23-26 *(Russian).* – Details are given of investigations to establish the error in pH measurement due to temperature variation using an instrument with a tungsten self-cleaning electrode, and an automatic compensation system is described. Adjustment of the modified instrument is explained.

Lime solubility in concentrated sugar solutions. I. F. Bugaenko and T. N. Samoilova. *Sakhar. Prom.,* 1981, (1), 27-28 *(Russian).* – Investigations are reported in which aqueous refined sugar solutions of 30-60% dry solids were prepared and Ca hydroxide added (5 g/100 ml) before stirring at 3000 rpm for 6 hours. After heating, the solid phase was separated by centrifuging at 6000 rpm, and the Ca content determined in the supernatant at 20 and 70°C. Results showed that solubility rose with temperature but fell with increase in sucrose concentration above 36%, in contrast to an increase with rise in concentration from 30 to 36%. The significance of the findings relative to factory juice processing is discussed.

Polarographic study of the colorants present in raw sugar molasses. L. Gonzalez C., A. Li A. and A. Pareja P. *Centro Azúcar,* 1980, **7,** (1), 17-27 *(Spanish).* – The effects of the components of a cane molasses and a model molasses on the maximum of the polarographic wave of oxygen were studied, as were the polarographic waves of caramelan and the products of alkaline degradation of glucose. Uneven behaviour was observed in the way that the polarographic maximum of oxygen is eliminated by the different individual molasses components, and the half-wave potentials of the caramelan and alkaline degradation products were obtained using reductive polarography.

Study of the microflora of the ambient air of the sugar factory. T. Sais H. and T. Castillo D. *Centro Azúcar,* 1980, **7,** (1), 29-48 *(Spanish).* – Sterile agar gel media in Petri dishes were exposed to the air for one minute at 22 locations in the sugar factory and then cultured, after which the micro-organisms on them were identified and counted. The most heavily contaminated areas were the juice screens and filters, where there were strains of *Staphylococcus* and *Aspergillus* spp. as well as the bacteria found throughout the factory. This fact and the presence of yeasts and fungi in the centrifugals section of the boiling house emphasize the need for application of adequate hygiene practices.

Preliminary polarographic study of the colorants present in sugar products. L. González C., A. Li A. and M. R. Pérez. *Centro Azúcar,* 1980, **7,** (1), 91-101 *(Spanish).* Caramels and melanoidins were prepared in the laboratory and their influence on the maxima of the polaro-

graphic wave of oxygen was studied, as was the effect of fractions excluded and separated by gel separation with dextran. The influence of molasses colorants of low M.W. was investigated and an uneven pattern of elimination of the polarographic maxima observed which depended on the colorant under study.

Study of the sedimentation of calcium phosphates using tagged phosphorus. R. Fajardo G., L. D. Bobrovnik and E. Olivé. *Centro Azúcar,* 1980, **7**, (1), 113-118 *(Spanish).* A technique using radio-active phosphorus to study the sedimentation of the calcium phosphates which form during the defecation of cane juice is described. It permits measurement of the size of calcium phosphate particles in the presence as well as in the absence of synthetic polyelectrolyte. The particle size distribution curves are illustrated.

Obtaining sucrose monocrystals. L. Carrazana R., C. Pérez B. and M. Fernández D. *Centro Azúcar,* 1980, **7**, (1), 129-139 *(Spanish).* — A sucrose-water-ethanol system was studied of 1.02-1.30 supersaturation at 30-40°C. It was found that, between 1.10 and 1.25 supersaturation, no appreciable variation occurred in viscosity when the temperature changed from 30° to 40°C. An equation $\tau = T^{-A}.e^{B}$ is proposed for calculation of the latent time for supersaturated solutions in terms of temperature T (A and B being constants having values of 35.5 and 210.8, respectively, at 1.25 supersaturation). A method is described for growing single crystals of sucrose on a support of horsehair or fine nylon (weighted so that it does not touch the sides of the container), which involves maintaining in thermostatic conditions in a tube in a water-ethanol-sucrose solution prepared at 30°C to be of 1.1 supersaturation but then cooled to 27°C when the supersaturation rises to 1.23 without any increase in viscosity.

Determination of the concentration of colouring matter and ash content in refined sugar. P. Kadlec, M. Pavlikova and M. Vachkova. *Listy Cukr.,* 1981, **97**, 31-36 *(Czech).* The ICUMSA method of colouring matter determination, based on spectrophotometric absorbancy measurement at 420 nm and conversion to ICUMSA units, was applied to refined sugar solutions and the results analysed statistically. Results showed that the method gave reproducible values. Reflectance measurement was used to investigate the possible relationship between (1) the difference in colouring matter concentration before and after passage through a membrane filter and (2) the volume of impurity particles adhering to the filter surface. However, no clear relationship was found. Three different sample concentrations were used in determination of the conductimetric ash content, viz. 50 $g.dm^{-3}$, 260.26 $g.dm^{-3}$ and 280 $g.kg^{-1}$. The most accurate results were given by the last. No linear relationship was established between colouring matter concentration and conductimetric ash.

Chromatographic separation of molasses constituents I. Recovery of sucrose from molasses. K. Sayama, Y. Senba and T. Kawamoto. *Proc. Research Soc. Japan Sugar Refineries' Tech.,* 1980, **29**, 1-9. **II. Separation of betaine from molasses.** *Idem ibid.,* 10-19. **III. Recovery of inositol from molasses.** *Idem ibid.,* 20-27 *(Japanese).* I. Ion exchange chromatography was used to recover sucrose from beet molasses using Dowex 50W X 4 resin in Na^+ form. Optimum conditions were a refractometric Brix of 30°, a treatment rate of 0.125 litres per litre per cycle, a flow rate of SV 1.3 and temperature of 80°C. Under these conditions, about 85% of the sucrose was recovered at a daily treatment rate of 2 tonnes of molasses per m^3 of resin; purity of the product fraction was approx. 87.5%.

II. For betaine separation, the same resin was used, but in Ca^{++} form. Optimum conditions were: Brix 40°, treatment rate 0.20 litres per litre per cycle, flow rate SV 1.5 and temperature 80°C. The quantity of molasses treated per unit resin was at least double that for sucrose recovery. In earlier cycles some of the Ca^{++} ions in the resin were substituted for Na^+ ions in the molasses, but this had no effect on chromatographic efficiency. Crystallization of the crude betaine fraction was easily achieved by concentration. Purification was carried out by re-crystallization and active carbon treatment. Certain characteristics of betaine were investigated, including its drying and hygroscopic properties, the relationship between betaine solids content and Brix, and solubility. Analysis of the betaine is also given.

III. After determination of the inositol and galactinol contents in various beet molasses samples, it was found that a molasses from a factory equipped with both ion exchange demineralization and the α-galactosidase process was most suitable for inositol recovery. A method of recovery was investigated which incorporated ion exchange chromatography using the same resin as for betaine recovery, culturing of yeast in the resultant inositol fraction for sugars removal, liming and phosphatation, demineralization with Amberlite IR-120 resin in H^+ form followed by Amberlite IRA-401 in OH^- form, and finally evaporation and crystallization. This procedure gave recovery of more than 70% of the inositol present in the molasses. Full details are given of the process parameters.

Sample preparation by dry ashing prior to determination of metals in sugars. S. Saito and M. Kamoda. *Proc. Research Soc. Japan Sugar Refineries' Tech.,* 1980, **29**, 36-44 *(Japanese).* — Dry ashing of raw sugar samples before determination of heavy metals was investigated. Results showed that 0.5-1.0N HNO_3 was suitable for dissolving the ash and that Fe and Mn recovery was unaffected by ashing time, whereas that of Cd, Pb and Cu decreased with time and with rise in ashing temperature. The heavy metals were markedly adsorbed by residual carbon as a result of incomplete ashing. Other metals in the sample interfered to some extent with the analysis. There was no relationship between ash content and ashing time. The optimum ashing temperature was 550°C. Sulphate ashing was better than carbonate ashing for analytical purposes.

Refining of final molasses by ultrafiltration. T. Ebashi. *Proc. Research Soc. Japan Sugar Refineries' Tech.,* 1980, **29**, 72-78 *(Japanese).* — Of six membranes tested for final molasses ultrafiltration, the most suitable was found to be a DUY-20 membrane of 20,000 molecular weight cut-off. This was used in the tubular technique to handle a molasses of about 35°Bx at a concentration ratio (feed volume: concentrate volume) of 4, an outlet pressure of 8 $kg.cm^{-2}$ and a molasses temperature of 33-36°C. At a flow rate of 1.5-1.8 kg of solids per $m^2.hr^{-1}$, 73-89% of the colour was removed, 81-97% of the turbidity and 55-68% of the gum content. Where molasses contains a large quantity of suspended and colloidal matter, tubular modules are suitable because they are easy to clean and do not necessitate pretreatment.

BY-PRODUCTS

The plasticity of dried beet pulp as a function of pressing parameters. V. L. Kegeles and V. P. Borodyanskii. *Izv. Vuzov, Pishch. Tekh.,* 1980, (4), 65-67 *(Russian).* Laboratory experiments on pulp briquetting showed that plasticity *P* was a function of moisture content, pressure and particularly temperature. For production of briquettes of adequate strength and density, a pressure of 60-80 MPa should be applied. From response curves for *P* in the range of 94-98.8% (*P* being the percentage ratio of residual to total deformation), values of moisture content and temperature can be selected which will provide the required quality at maximum efficiency.

Yeast in 1980. L. Freisz. *Sucr. Franç.,* 1980, **121,** 383-391 *(French).* – A survey is presented of bakers' yeast manufacture in France, where molasses has been the chief raw material since 1922. Details are given of the fermentation processes used, the mechanism involved, the composition and characteristics of the yeast produced, and details of the autolysates obtainable by various enzymes as well as the dietary role of yeast.

Carbohydrates as chemical feedstocks. R. Khan and A. J. Forage. *Sugar Tech. Rev.,* 1980, **7,** 175-196. The potential of various carbohydrates as chemical feedstock is discussed against the background of rising petroleum prices, and a survey is presented of products of chemical degradation as well as chemical synthesis and fermentation. The review is mainly concerned with sugars and starch derivatives, and some of the processes, reactions and cycles involved are described.

Operational wear inside a drum-type pulp dryer. J. Malczewski and B. Sikora. *Gaz. Cukr.,* 1980, **88,** 153-154 *(Polish).* – Details are given of the wear of internal parts of a beet pulp drum dryer after six campaigns (during three inter-campaign periods the dryer also handled corn).

Manufacture of CO_2 from fermenter gas. R. S. Dubey. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), E.5-E.22. – The uses of solid, liquid and gaseous CO_2 are described, and the practical aspects of their production from the fermenter gas in a distillery manufacturing alcohol from cane molasses are examined. The economics are also discussed.

Ethanol, a by-product of the sugar industry. B. B. Paul. *Proc. 30th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1980, (1), E.49-E.62. – Aspects of alcohol manufacture from cane molasses are discussed and details given of a single-stream continuous process as well as a proposed waste heat recovery system.

Bagasse fly-ash as a useful by-product. R. T. Wong Too Yuen. *Rev. Agric. Sucr. Maurice,* 1980, **59,** 51-56. Possible uses of bagasse fly-ash are briefly examined. It can be dried and mixed with bagasse for use as fuel, or dried and burnt on its own in a secondary furnace to give synthesis gas or heat for steam production. Producer gas and water gas can be manufactured by burning fly-ash, leading to production of CO_2 and ammonia, which can then be reacted together to form ammonium carbonate fertilizer, while methanol can be obtained from water gas after removal of the CO_2. So far only one spot test has been carried out, but the potential of fly-ash appears to be very promising. Advantages of fly-ash utilization are listed. Apart from tests on fly-ash use, studies are also required on its collection, handling and storage.

Genetic aspects of alcohol manufacture from beet. M. Desprez. *Ind. Alim. Agric.,* 1980, **97,** 1225-1228 *(French).* – The possiblity of large-scale production of fuel alcohol from beet is discussed in terms of the quantity of fermentable dry matter that can be produced per ha. Particular attention is focused on the cross-breeding of fodder beet with sugar beet, as has been carried out over the last 10 years, and it is found that the soluble dry matter yield is higher for fodder-sugar beet hybrids than for fodder and sugar beet individually. (The maximum theoretical quantity of alcohol that can be produced is calculated as 1 tonne per 2½ tonnes of dry matter.)

Strains and culture medium for lysine production. T. J. B. de Menezes. *Colet. Inst. Tecn. Alim.* (Brazil), 1978, **9,** 265-279; through *S.I.A.,* 1980, **42,** Abs. 80-1645. – To find optimum conditions for making lysine from cane molasses, eight strains of bacteria (three *Micrococcus glutamicus,* three *Brevibacterium flavum* and two *Corynebacterium glutamicum)* were incubated in shake-flasks at 30°C and pH 8 on pre-sterilized media based on 220-250 g molasses, 36.6 g NH_4Cl and 61.5 g $CaCO_3$ per litre; strains giving lysine concentration > 15 g.l^{-1} (two *M. glutamicus* and one *B. flavum*) were studied further. All three gave better yields with NH_4Cl than with urea or four other NH_4 salts; *B. flavum* (ATCC 21 129) consistently reached a higher maximum yield sooner; yield was much lower if molasses concentration was altered to 110 or 300 g.l^{-1}. The maximum yields recorded were 21.6 g.l^{-1} in four days with NH_4Cl concentration of 36.6 g.l^{-1}, and 22.5 g.l^{-1} in five days with 73.2 g.l^{-1}. Using pre-centrifuged molasses and Ca phosphate instead of $CaCO_3$ in a 7-litre fermenter gave a maximum yield of 12.8 g.l^{-1} in 72 hr.

Bioconversion of stillage for fungal biomass production. P. R. de Lamo and T. J. B. de Menezes. *Colet. Inst. Tecn. Alim.* (Brazil), 1978, **9,** 281-312; through *S.I.A.,* 1980, **42,** Abs. 80-1654. – Conversion of vinasse into biomass by 11 fungal strains was studied, the most efficient strains of *Aspergillus oryzae* and *A. niger* being tested under various conditions. Performances are reported as tables and graphs showing biomass, pH and BOD or COD *vs.* time. When grown in a stirred 30-litre fermenter aerated at 0.5 vol/min for 3 days at 30°C, with the pH kept at 4.4-5.5 by H_2SO_4 addition (to suppress microbiological competitors), the *A. oryzae* removed 70-80% of the pollution (COD and BOD initially 48 and 25.8 g.l^{-1}) and converted about half of the assimilated organic matter into biomass containing approx. 39% protein.

Storage and economic aspects of pressed pulp marketing. E. Thier. *Zuckerind.,* 1981, **106,** 60-65 *(German).* The major problems associated with pressed beet pulp

are the very much greater mass of material to be transported than in the case of dried pulp, and its poor storage quality. Ensilage at the factory could reduce the need for rapid transportation and for anaerobic bacterial preservation. Chemical preservation of stored pulp should be investigated. The value of pressed pulp as fodder is governed by the values and costs of other feedstuffs, although it does have a number of basic advantages over other materials. However, its marketing requires long-term planning.

Distillation and rectification in the production of water-free alcohol. E. R. de Luzuriaga. *Sugar J.*, 1980, **43**, (7), 11-12. – The stages in water-free alcohol manufacture from cane molasses are explained, and details given of the azeotropic non-pressure process with benzene as dehydrating agent used at the Manapla distillery of Victorias Milling Co. in the Philippines, which started operations in September 1980.

Substitution of maize by raw sugar in diets for dairy cattle. I. Milk production, energy efficiency and rumen fermentation. I. Jérez, A. Elías, A. Zamora and J. Ugarte. *Cuban J. Agric. Sci.*, 1980, **14**, 131-138. – The effect of replacing maize with raw sugar on the milk yields of 12 lactating cows was determined. Results showed that milk yield was highest (14.1 kg/day) where no raw sugar was included in the ration and was next highest (13.2 kg/day) when the maize quantity was double that of raw sugar. A raw sugar:maize ratio of 2:1 gave only 10.9 kg/day, while complete replacement of the maize with raw sugar gave 11.9 kg/day. In all cases, the fish meal quantity was increased with the amount of raw sugar. The possible substitution of maize by raw sugar as energy source for milk yields of 11 kg/day is suggested.

Preliminary study of the mathematical model of a single-disc refiner for semi-chemical bagasse pulp. A. Ribot E., I. Vega R. and E. González S. *Centro Azúcar*, 1980, **7**, (1), 1-27 *(Spanish)*. – The effect on electrical power demand and production cost of refined pulp of factors which influence production capacity, i.e. wear of the discs, pressure in the disc chamber, Kappa number, feed consistency and organic matter content, was studied. The experiments were carried out in a paper factory which employed a Swedish refiner type RGP-36, and they were designed on the basis of Plackett-Burman and Box-Wilson methods. The results showed that only the first two factors had significant influence on both power consumption and cost; the Kappa number had a significant effect on power consumption only. Linear models were developed for these influences and their adequacy confirmed by practical tests.

Rheological study of fibrous suspensions of bagasse chemical pulp. A. García R., M. J. Carrillo A. and A. G. Majonin. *Centro Azúcar*, 1980, **7**, (1), 141-160 *(Spanish)*. The properties of bagasse pulp have been found to differ from those of other cellulosic fibres in tests carried out using an East German Reotest 2 instrument. Bagasse pulp produced industrially was examined at concentrations of 0.4-1.0% and at temperatures of 30-80°C. The data obtained were analysed by computer and identified the bagasse pulp as a pseudo-plastic fluid. It was demonstrated that pulp viscosity decreases with increase in temperature and velocity. Addition of salts delayed flocculation of the pulp. When the consistency was increased, the torque and viscosity also increased, demonstrating that, at least in the ranges studied, it is possible to carry out investigations of this type using a rotary viscometer.

Alternatives to the use of sulphuric acid in distillation of fermentation alcohol; effects on the formation of incrustations and on the corrosion resistance of some materials. A. Frignani, G. Mantovani and G. Trabanelli. *Ind. Sacc. Ital.*, 1980, **83**, 152-156 *(Italian)*. – Scaling has been observed in distilleries where sulphuric acid is used to adjust the pH and the fermentation medium is derived from cane molasses of certain origins. To overcome this problem, trials were carried out on the use of hydrochloric and nitric acids for acidification, and their effect on corrosion of copper and stainless steel AISI 304, alone and coupled, determined. Electrochemical and weight loss measurements showed that, within the pH range studied, there was no appreciable corrosion of the copper or stainless steel, whether alone or coupled; provided the chloride ion concentration present in the operational conditions was taken into account, HCl could be used to solve the scaling problem without causing corrosion.

Pressed pulp – the feed for the eighties J. Harland. *British Sugar Beet Rev.*, 1981, **49**, (1), 26-27. – Benefits of pressed beet pulp as animal fodder are discussed, with mention made of various trials being conducted in the UK, and some advice is offered on short-term storage and ensilage.

Prime beef from beet pulp. W. Hollowell. *British Sugar Beet Rev.*, 1981, **49**, (1), 27-28. – Reference is made to the feeding of pressed beet pulp as primary diet to cattle at a beef fattening unit.

Prospects for treatment of vinasse with environmental and economic benefits. I. C. A. B. Dias. *Brasil Açuc.*, 1980, **96**, 169-177 *(Portuguese)*. – An account is given of the treatment of vinasse by anaerobic fermentation which reduces the polution load and, by formation of recoverable methane, provides a benefit since it is an energy source. Aspects of the treatment needing careful study are discussed and a cost/benefit analysis is made.

Application of vinasse through the infiltration furrow irrigation system to sugar cane. E. J. A. Leme, E. Scardua and J. Moretti. *Brasil Açuc.*, 1980, **96**, 231-243 *(Portuguese)*. – An account is given of trials in which vinasse was applied to a cane area through a furrow irrigation system. The importance of the gradient is emphasized as is the inflow rate and the spacing between furrows. Inflows from 1.18 to 2.23 litres of vinasse per second, in furrows having slopes of 0.25-1.0%, allow the application of N and K to the soil, provided the K concentration is less than 0.35 $kg.m^{-3}$. It is difficult to use the system if the total volume applied is less than 1000 $m^3.ha^{-1}$.

Determination of the matrix which characterizes the system of preparation of kraft cutting in the "Damují" Paper Enterprise. E. González S. and L. Hernández C. *Centro Azúcar*, 1980, **7**, (2), 57-63 *(Spanish)*. – In Cuba, cardboard and corrugated paper are made using a mixture of bagasse pulp with either wood or cutting pulp, and the properties of the finished product depend on the mix and the properties of the components. The development of an experimental design for determining the effect of the individual stages in secondary pulp treatment on these properties is described; it is recommended that the experimental matrix is included in a total mathematical model of the paper manufacturing process.

PATENTS

UNITED KINGDOM

Beet topper. M. Laforge, of Hermonville, France. **1,567,336.** December 13, 1976; May 14, 1980.

Beet harvester. W. J. L. Dehondt and J. M. E. R. Dehondt, of Cany-Barville, France. **1,568,001.** December 12, 1977; May 21, 1980.

Production of ethanol from cellulose. General Electric Co., of Schenectady, NY, USA. **1,568,014.** March 3, 1978; May 21, 1980. — A process for fermenting a fibrous cellulosic material, e.g. bagasse, involves the combined growth of a mixed culture of thermophilic cellulolytic gram-negative sporocytophaga and thermophilic ethanol-producing gram-positive bacillus, the former always being associated with a gram-positive thermophilic bacillus, whereby the cellulose is exposed, mixed with an aqueous nutrient mineral broth to form a suspension of pH 7 – 8 (7.2 – 7.8), mixing the culture with the suspension and fermenting at pH 7 – 8 (7.2 – 7.8) and 50 – 65°C (55 – 65°C) to produce a significant amount of ethanol. The process may be carried out in a partial vacuum (100 – 400 mm Hg) whereby the ethanol produced is vapourized; the vapour is withdrawn and the ethanol condensed.

Immobilized enzymes on pullulan carriers. Sumitomo Chemical Co. Ltd., of Osaka, Japan. **1,568,328.** February 16, 1978; May 29, 1980. — The enzyme (glucose isomerase) is immobilized on a carrier comprising a hydrophilic pullulan gel obtained by cross-linking pullulan with a bifunctional compound X-Y-Z where X and Z are each either halogen or an epoxy group and Y is an aliphatic radical of 1 – 30 C atoms, optionally interrupted by O atoms. Alternatively the pullulan (of mol. wt. 10^4 – 10^6) may be reacted (in a water/alcohol or water/acetone solution) in the presence of an alkaline compound [KOH, NaOH or $Ca(OH)_2$ at 10 – 70°C] with a compound of formula X_1-R-Z_1 where X_1 is a halogen or epoxy group, R is a C_1 – C_4 alkyl group which may be hydroxyl-substituted, and Z_1 is a carboxyl group, phosphoric acid group, sulphonic acid group, guanidino group or NR_1R_2 or $NR_1R_2R_3^+$, where R_1, R_2 and R_3 are each either H, methyl, ethyl, 2-hydroxyethyl, 2-hydroxypropyl, *n*-butyl or phenyl. Alternatively R may be $-(CH_2)_m-C_6H_4-(CH_2)_n-$ where m is 1 – 3 and n is 0 – 3. The enzyme is held to the carrier by ionic adsorption or by covalent bonding and the gel is in the form of spherical beads 10 – 500 μm in diameter and capable of taking up 1 – 50 g of water per g of dry gel. [The pullulan may be reacted with epichlorohydrin, epibromohydrin, ethylene glycol diglycidyl ether, diglycidyl ether, dichlorohydrin, dibromohydrin, triethylene glycol diglycidyl ether, 1,6-hexanediol diglycidyl ether, 2-diethylaminoethyl chloride, 2-dimethylamino-*iso*-propyl chloride, 3-diethylamino-1,2-epoxypropane, chloroacetic acid, bromoacetic acid, 2-bromoethane sulphonic acid, 2-chloroethane sulphonic acid or a salt of these, 2-dimethylaminoethyl chloride, 2-diphenylaminoethyl chloride, 2-(N,N-dimethylphenylamino)-ethyl chloride, 3-amino-1,3-epoxypropane, 3-dimethylamino-1,2-epoxypropane, 3-di-*n*-butylamino-1,2-epoxypropane, 3-diphenylamino-1,2-epoxypropane, 3-(N,N-dimethylphenylamino)-1,2-epoxypropane, N,N-dimethyl-(2,3-epoxypropyl)-aniline, 2-chloroethylamine, 2-chloropropionic acid, chloromethane sulphonic acid or a salt of these.]

Recovering useful products from carbohydrate-containing materials. Ingredient Technology Corp., of New York, NY, USA. (A) **1,572,607.** (B) **1,572,608.** May 25, 1976; July 30, 1980.

(A) Carbohydrate-containing material (molasses) is flowed through an ion exclusion resin (a sulphonated styrene-divinylbenzene copolymer in the Na^+ form) in the following steps: the resin is brought into contact with (a) a first portion of the material (at 45 – 60°Bx), then (b) a second portion at (lower temperature and at) a lower density than the first (10 – 25°Bx) and then with (c) an aqueous eluting medium after which (d) eluted solutions, mainly carbohydrate, are collected from the resin. Before stage (a) the resin may be treated with a portion of the material (at lower temperature and) at lower density than (a) (10 – 25°Bx). The resin is used in the form of a column having a height:diameter ratio of 0.8:1 – 5:1.

(B) Molasses is treated with Fe^{+++} ions (at 60 – 120°F) and the precipitated non-sugars removed. (The Fe^{+++} ions remaining are removed by adding a phosphate and raising the pH to 7.0, and high mol. wt. material is removed by passing the molasses through a membrane filter.) The treated molasses is then passed through an ion exclusion resin and the latter eluted to yield a first fraction mostly of salts, a second fraction containing salts and sugars, and a third fraction containing mostly sugars.

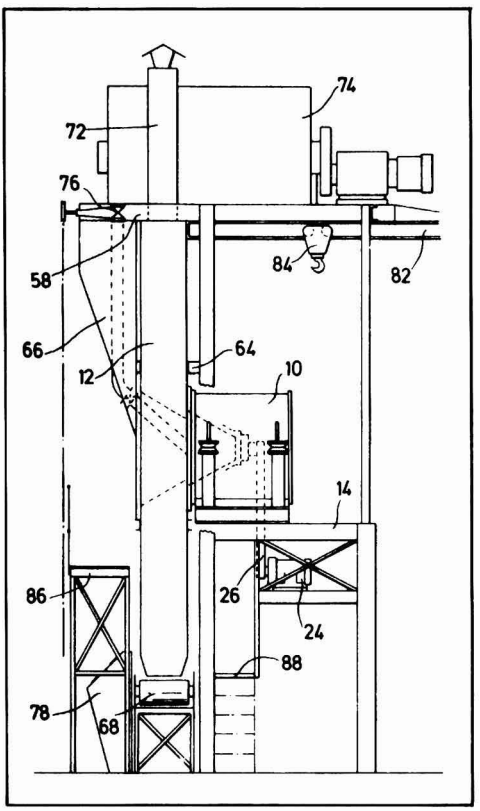
A process for solidifying molasses. Hokkaido Sugar Co. Ltd., of Tokyo, Japan. **1,572,727.** February 8, 1977; August 6, 1980. — Molasses is mixed with oils and/or fats and/or esters of fatty acids containing 8 – 22 C atoms and sufficient alkali to give an initial pH of 8 – 12, and the mixture concentrated and reacted at 110 – 175°C (at 80 – 130°C under reduced pressure and then at 120 – 160°C).

Continuous centrifugal installation. Fives-Cail Babock, of Paris, France. **1,574,399.** January 13, 1978; September 3, 1980.

The continuous conical basket centrifugal 10 is mounted on a framework 14 and driven by motor 24 through belt 26. The rim of the basket passes through a circular aperture in the nearer vertical wall of chamber 12 while massecuite from mixer 74 passes down through valve 76 into a feed duct which passes through the further vertical wall of chamber 12 and so into the basket.

The chamber is of large diameter, e.g. 6 metres diameter, so that crystals discharged from the basket are slowed down and not damaged when they strike the

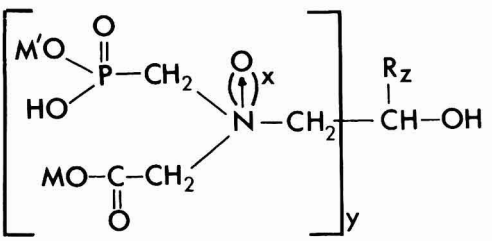
Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price £1.45 each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington,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



periphery. The crystals fall to the bottom of the chamber 12 and collect on a belt conveyor 68 which removes them. Moist air is vented through chimney 72, while the process may be controlled from a console 78 and access to the centrifugal may be obtained from the platform 86 through suitable trapdoors in the vertical walls of chamber 12. Above the dryer is a beam 82 carrying a hoist so that, should it be necessary, the centrifugal 10 may be disconnected from its mountings and replaced by another unit.

Synthetic organic flocculants to clarify raw sugar liquor. American Cyanamid Co., of Wayne, NJ, USA. **1,575,933.** May 30, 1977; October 1, 1980. – To a raw sugar liquor is added (1) [300 – 5000 (500 – 3000) ppm of] a melamine:formaldehyde acid colloid (having a melamine:formaldehyde ratio of 1:1.8 – 1:2.2) and (2) (1 – 25 ppm of) a polyacrylamide containing 3 – 40 (10 – 30) mole % of its repeating units in the form of sodium acrylate groups and having a molecular weight of at least 500,000 (10 – 20 x 10^6), the amounts of (1) and (2) being effective to flocculate the impurities in the liquor, (followed by addition of up to 175 ppm of H_3PO_4 and up to 250 ppm of CaO) thereafter clarifying the liquor (at 160° – 185°F).

Treatment of sugar cane to increase its sugar content. Monsanto Co., of St. Louis, MO, USA. **1,575,949.** August 12, 1977; October 1, 1980. – The sucrose content of cane is increased by application, 2 – 10 (3 – 7) weeks before harvest, of an effective amount (about 0.11 – 5.6 kg.ha^{-1}) of a compound of the formula



where x is 0 or 1 (1), y is 1 or 2 (1), z is 0 or 1 (1) and y + z = 2; R is H, CH_3, C_2H_5, hydroxymethyl, lower alkoxymethyl or lower alkenoxymethyl; M is H, lower alkyl or alkali metal, and M' is H, lower alkyl, phenyl or alkali metal (M and M' are both alkali metals). The compound may be applied as an aqueous solution, suspension or emulsion (including a surfactant) or as a solid dust.

Ion exchanger regeneration. British Sugar Corporation Ltd., of Peterborough, England. **1,576,100.** May 31, 1978; October 1, 1980. – An ion exchanger which has been used in e.g. the Quentin process, whereby Na and K in the sugar syrup is exchanged for Mg which allows more complete crystallization of sucrose from the syrup, is regenerated with a solution of kieserite (a crude and relatively cheap form of $MgSO_4$), prepared by reducing the kieserite to powder form and stirring into water (condensate) at 70° – 95°C to give a Mg content of 0.01 – 0.05 g.cm^{-3} (with heating by steam injection).

Cane harvesters. J. M. Mizzi, of Ingham, Queensland, Australia. **1,576,918.** May 5, 1978; October 15, 1980.

Sugar cane processing equipment. Intercane Systems Inc., of Windsor, Ont., Canada. **1,577,693.** November 29, 1977; October 29, 1980. – See US Patent 4,151,004[1].

Continuous multistage fermentations. Mitsui Engineering & Shipbuilding Co. Ltd., of Tokyo, Japan. **1,579,633.** June 16, 1977; November 19, 1980. – In a continuous, multistage culture process for producing microbial protein and lipid, a fermentation liquid [e.g. a 4% glucose solution, diluted molasses, etc., in which is cultured a yeast *(Candida utilis* or *Rhodotorula glutinis)*] flows between a number of individual culture tanks, and the pressures in the respective tanks are maintained at different levels to control the amounts of liquid flowing.

Coating beet seed. S. A. Interox, of Brussels, Belgium. **1,580,248.** December 9, 1977; November 26, 1980. Beet seeds are coated to provide a uniform shape (preferably spherical) which lends itself to automatic precision sowing. A suitable coating has been found which does not reduce germination; the seed is coated with [0.01 – 90% (0.05 – 50%)w/w of] calcium peroxide [plus 25 – 99.9% of] at least one filler (an organic filler based on cellulose or wood powder, and/or an inorganic filler such as silica, a silicate or carbonate (bentonite, talc, a diatomaceous earth, fullers' earth, clay or chalk) plus (0.001 – 10% of) (0.01 – 1% of) an adhesive (methyl cellulose, a hydroxylated polymer, gum arabic, soluble starch or gelatine)] (the coating comprising 0.05 – 50% w/w of calcium peroxide, 0 – 10% adhesives, 50 – 99.9% filler and 0 – 5% miscellaneous additives).

[1] *I.S.J.*, 1981, **83**, 222.

TRADE NOTICES

Active carbon regeneration and waste sludge disposal. Schumacher Filters Ltd., 39/41 Cavendish St., Sheffield S3 7 RZ, England.

An infra-red system for treatment of spent active carbon, which can then be recycled, is announced. The spent carbon is fed into the Infratex system via a dual-rotor airlock and dropped onto a high-temperature mesh belt where it is levelled to a pre-set thickness and spread over the width of the belt for thermal regeneration. The weight loss is about 1% with granular carbon and about 14% with powdered carbon. The system can also be used for waste sludge disposal; the material is dried and then heated by the hot exhaust gases before it is transferred to the combustion zone of the infra-red incinerator where the temperature is about 1000°C. The residual ash is discharged for bulk disposal or disposal by mechanical conveying means.

Centrifuge test unit. KHD Humboldt Wedag AG, Postfach 91 04 57, D-5000 Köln 91, Germany.

Centrifuges are becoming increasingly popular for specific purposes in the sugar industry, for instance in mud dewatering; however, the customer has difficulty in assessing the type and size required because of the inability to predict the performance of the machine under a given set of conditions. To overcome this problem, KHD Humboldt Wedag have built a self-contained, portable test unit which can be made available at low cost for centrifuging trials; it embodies a SO-1 solid-bowl centrifuge of 2 $m^3.hr^{-1}$ capacity equipped with a full set of drive pulleys for bowl speeds in the range 2304-4400 rpm. The unit is mounted on a steel frame together with a screw conveyor for cake disposal, flexible hoses for sludge, separated liquid and water, pumps, polymer preparation equipment, storage tank and control panel.

Cane top roller flotation gauge. Edwards Engineering Corp., 7400 Townsend Pl., New Orleans, LA 70126, USA.

The Edwards top roller flotation gauge provides an instantaneous and continuous visual reading of the top roller position and movement. Each 1/8 inch of the roller movement is clearly indicated on the face of the instrument so that the operator can see it from a distance and make adjustments to maintain the desired position. Slip joints with 2 inch overtravel are designed to allow passage of any tramp iron through the rollers, thereby protecting the gauge and assuring its continued accuracy. Leaflet No. 7802 gives a description of the gauge.

A.C. motor controller. Renold Power Transmission Ltd., Renold House, Styal Rd., Wythenshawe, Manchester M22 5WL, England.

A new, low-cost, variable-speed A.C. motor controller to handle small motors up to 0.55 kW has been introduced as an addition to the existing range of motor controllers in the range 0.75-3.7 kW. It is available in two versions (as a chassis unit with speed demand control supplied separately or as a complete unit with speed demand control, stop/start pushbuttons, etc.). Both versions are suitable for standard 3-phase A.C. motors.

Boiler control check system. Bestobell Mobrey Ltd., 190-196 Bath Rd., Slough, Berks. SL1 4DN, England.

One of the commonest causes of boiler failure is blockage of the water connexion between the boiler shell and the float chamber, resulting in a water level inside the chamber which is independent of the level in the boiler; if the boiler level falls to a dangerously low level under these circumstances, the controls will not detect it and thus will not cut out the burner. The blockages (caused by accumulation of silt and sludge) can be prevented by a daily blowdown of the level control chamber and water leg. The Mobrey control check system ensures regular and effective blowdown lasting 4½ hours. It can be programmed to indicate when the blowdown sequence is to commence; if blowdown does not take place, the burner is locked out and is not allowed to start up until the correct blowdown procedure is carried out. The system will operate with all types of boiler water level controls fitted with blowdown valves and is quickly and easily installed.

PUBLICATIONS RECEIVED

Air Industrie. Air Industrie, 19 avenue Dubonnet, 92411 Courbevoie Cedex, France.

A leaflet from Air Industrie outlines the various activities of the Group, which include air pollution control (dust separation and gas scrubbing) and transport air conditioning systems.

Resistance thermometers and thermocouples. Kent Industrial Measurements Ltd., Howard Rd., Eaton Socon, St. Neots, Huntingdon, Cambs. PE19 3EU, England.

Leaflet 0112 is a specification sheet describing Kent Industrial Measurements thermocouple assemblies, while Leaflet 0114 describes the company's resistance thermometer assemblies. Both of these new leaflets give detailed specifications on all component parts as well as a step-by-step guide to their selection. All the components are completely interchangeable and compatible with the Clearspan range of recorders, indicators and controllers.

Sugar processing chemicals. Drew Chemical Corp., 1 Drew Chemical Plaza, Boonton, NJ 07005, USA.

A new 4-page colour brochure from the Specialty Chemicals Division of Drew Chemical Corp. describes its complete line of chemicals for use in the sugar industry, including anti-foam agents, flocculants, microbiocides, scale inhibitors, surfactants for use in boiling and crystallization, boiling-out chemicals and chemicals for treatment of cooling water, boiler water and fuel.

Polarimeters. Optical Activity Ltd., Industrial Estate, Bury Rd., Ramsey, Huntingdon, Cambs. PE17 1NA, England.

A leaflet from Optical Activity describes the AA-10 automatic polarimeter for which the company has received the Queen's Award for Technological Achievement. For use as a saccharimeter, the model has a range of ± 130°S and is accurate to within ± 0.02°S. Operating at a wavelength of 589 or 546 nm, it uses a tungsten lamp as light source and is provided with a digital display. Reading time is less than 10 sec. The leaflet also features accessories for use with polarimeters, including digital printer, analogue interface, remote display, auto-sampler, stainless steel tubes and cells, and quartz control plates.

"Consultancy services in energy management and economics". WS Atkins Group, Woodcote Grove, Ashley Rd., Epsom, Surrey KT18 5BW, England.

A new publication carrying the above title describes the three main areas of the energy consultancy work of the WS Atkins Group: formulation of energy policies, making more efficient use of energy, and use of alternative energy sources; it also briefly describes recent examples of consultancy commissions carried out by the Group.

Trade notices

Water and waste water treatment. AWS Delta Ltd., Hillbottom Rd., Sands, High Wycombe, Bucks. HP12 4HJ, England.

The product range featured in a brochure from AWS Delta includes clarifiers, filters, ion exchange systems and deaerators. In addition to the wide range of equipment it offers for use in numerous applications, the company has supplied more than 400 units operating on the Carborundum dissolved air flotation system for treatment of various types of effluent. In this system, air is injected into the effluent in a retention tank, and impurities are carried in the air bubbles to the surface when pressure is reduced. The scum is continuously swept from the top of the flotation cell by means of a scraper arm and deposited in a sludge hopper, treated effluent being withdrawn near the bottom of the cell. Flocculants may be added in the wet cell preceding the retention tank.

Bagasse pulp plant. Ishikawajima-Harima Heavy Industries Co. Ltd., New Ohtemachi Bldg., 2-1 Ohtemachi 2-chrome, Chiyoda-ku, Tokyo 100, Japan.

Issue No. 167 (1981, Vol. 15) of the IHI Bulletin carries, on p. 4, details of a bagasse pulp plant supplied to the Taiwan Sugar Corporation and put into operation in 1979. The plant, of 300 tonnes/day capacity, produces pulp of 88°GE brightness, stated to be the highest quality of such pulp produced anywhere in the world. A flow chart is provided as well as descriptions of the individual process stages, and mention is made of the difficulties posed by silica when graminaceous materials are used for pulp manufacture.

Packaging equipment. SIG Swiss Industrial Co., CH 8212 Neuhausen Rhine Falls, Switzerland.

A brochure especially produced for Interpack '81 gives information on SIG packing machinery available for various applications, including free-flowing powders and granular products.

Weighing equipment. StreeterAmet Measurement Systems, Division of Mangood Corp., 155 Wicks St., Grayslake, IL 60030, USA.

A new 16-page colour booklet, "The complete catalogue of weighing", describes the various weighing systems available from StreeterAmet for road and rail trucks as well as platform scales and custom-designed micro-processor systems, tank and hopper scales and conversion kits for mechanical scales.

Cane fire fighting cart. Eshowe Wagon Works (Pty.) Ltd., P.O. Box 74, 3815 Eshowe, South Africa.

The Uphold fire-fighting water cart for use in cane fields has a priming tank which will fill itself in 10 min from any water source and can be custom-built to any requirements up to 4500 litres capacity.

Cane harvesters for Papua/New Guinea. — Claas OHG have received an order for seven CC 1400 green cane harvesters from Ramu Sugar Ltd. for its sugar project at Gusap in Papua/New Guinea. The harvesters will be used to handle two-thirds of the 350,000 tonnes of cane at the rate of 2000 tcd, while the remaining third will be harvested manually.

Irrigation company sold. — Tate & Lyle Agribusiness has sold its Farrow Irrigation division to Wright Rain Ltd., a subsidiary of Birmid Qualcast, who will continue to manufacture Farrow equipment in the UK as well as market the equipment and provide service and spares for existing Farrow installations. The Spalding plant of Farrow Irrigation has ceased operations.

Fermentation enzyme business acquired. — Corning Glass Works and Rohm & Haas Co. have announced their agreement to the sale of the Rohm & Haas fermentation enzyme business to Corning, who plan to build a new plant for enzyme production. During the last few years, Corning have expanded their expertise in biotechnology into a number of areas including enzyme development. A licence has been granted by Corning to CPC International for the production of high fructose corn syrup using immobilized enzymes.

Bulk containers. — Reed Medway Sacks Ltd. has been appointed sole agent in the UK for the sale of ½- and 1-tonne flexible intermediate bulk containers manufactured by J. & L. F. Goodbody Ltd., of Clara, County Offaly, Ireland.

Conveying systems order. — UESCO Manufacturing Co. Ltd., has been awarded a contract worth over £300,000 for the supply of a belt and scroll conveying system to be installed in the sugar screening plant at the Spalding factory of British Sugar Corporation Ltd. This will be the eighth BSC sugar factory to be equipped with UESCO conveying systems. The Spalding contract calls for the supply and commissioning of 11 screw conveyors up to 5.5 m long, 11 belt conveyors up to 800 mm wide and 70 m long, four bucket elevators 13.75 m high and a number of storage bins, the largest having a capacity of 85 tonnes.

Molasses desugaring. — FinnSugar Engineering, a division of the Finnish Sugar Co. Ltd., has signed a contract with Amino GmbH for the supply and erection of a beet molasses desugaring plant based on chromatographic separation. The plant will have an annual capacity of almost 60,000 tonnes of molasses. The FinnSugar process was chosen mainly because of the savings in energy and labour costs it offers as well as favourable environmental aspects. The plant, to start operations by the end of this year, will be used in the production of liquid sugar.

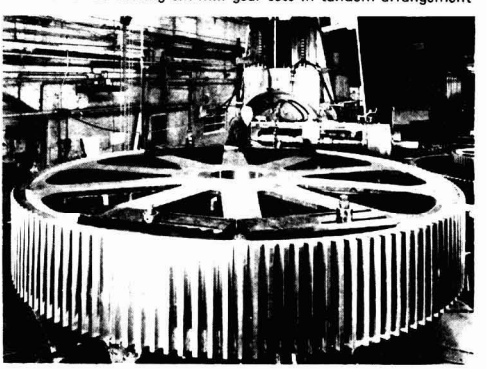
Indonesian sugar factory order. — Hitachi Zosen have received an order for the supply of a sugar factory having a daily crushing capacity of 4000 tonnes of cane for completion in January 1984.

Conveying plant for BSC. — Geo. Robson & Co. (Conveyors) Ltd. have won a contract worth over £400,000 for conveying, storage and retrieval plant to serve the packaging facilities at the Bury St. Edmunds factory of the British Sugar Corporation. The plant will include worm feeders, belt conveyors, elevators, stainless steel hoppers, four double conveyor gantries with belt conveyors, vibrating screens, magnetic separators and a large platform measuring 48 m long x 9 m wide x 6 m high. The same company recently installed one of the largest worm conveyor systems in the world at the Bury St. Edmunds sugar factory.

Environmental protection. — IPS Engineers Inc. and its affiliate, International Planning Services Inc. of Baton Rouge, Louisiana, and West Palm Beach, Florida, announce the formation of their Environmental Division, which will be actively seeking opportunities to help the world's sugar industry solve environmental problems.

Beet wash water sludge treatment. — Three Humboldt Wedag S 6-1 centrifuges are being installed at the Gross-Gerau sugar factory of Süddeutsche Zucker-AG, in West Germany, for dewatering beet washer mud. The solid-bowl centrifuges will increase the solids content of the mud from the Brukner clarifiers from 15-20% to at least 60%. Approx. 4800 m^3 of sludge is produced daily from about 7000 tonnes of beet. The dewatered sludge will be used for agricultural purposes and the clear water recycled.

Gear order from Thailand. — David Brown Gear Industries Ltd. have received an order for the supply of six sets of final reduction cane mill gears and pinions, worth £350,000, to the Mitr Phol Sugar Corporation Ltd. as part of an expansion program for their sugar factory. The three existing 1400 hp steam turbines driving six mill gear sets in tandem arrangement



will now drive three single gear trains, employing David Brown pinions and 13-ft diameter final reduction spur gear wheels at 100 in centre distances to give a mill speed of 6.2 rpm. A further three complete transmissions incorporating David Brown final gear wheels and pinions for matching speeds and powers will be required to drive three additional single mills, thus uprating the mill outputs and improving performance. The illustrations shows a mill spur gear wheel of the type to be supplied to Thailand.

BREVITIES

New enzyme-produced sweetener. — A collaborative research and development program of the UK Milk Marketing Board and Corning Glass Company of the US has resulted in a process for the production of food-grade sweeteners from whey, the by-product of cheese-making. In the past, whey has been run to waste or fed to pigs; more recently it has been dried to a powder but this requires much energy. It contains protein and lactose but the low sweetening power of the latter has limited its market. The new process involves passage of the whey — direct, deionized or treated by ultrafiltration — through a column of glass beads on which is immobilized a β-galactosidase enzyme of fungal origin. Using a pH of 4.5 — 5 and at 28 — 30°C, 90% hydrolysis of the lactose is achieved during a residence time of 10 minutes and provides a glucose/galactose syrup with or without the presence of whey protein, depending on the feed-stock, which may be used as an ingredient in foods such as confectionery, ice-cream, desserts and bakery products.

Taiwan sugar factories for Indonesia. — Taiwan Machinery Manufacturing Corporation recently beat several competitors from India and Japan to win a $70 million contract from the Indonesian government for supplying two complete sugar factories, the first to be exported by Taiwan. One factory will have a capacity of 4000 t.c.d. and the other of 3000 t.c.d.

New Spanish beet sugar factory[1]. — Cooperativa Agraria Onésimo Redondo (ACOR) is to erect a new beet sugar factory in the Province of León. Its daily beet processing capacity will be 5000 tonnes and the facility will be operational by 1984. Total investment is said to involve some $62.6 million.

Thailand sugar and cane financing[2]. — The result of a survey conducted by the Sugar Institute and the two associations of sugar millers indicates that sugar cane production for the 1981/82 season will be about 22 million tonnes against 25-28 million tonnes predicted earlier by the Agricultural Economics Office[3]. The Government has recently set up a centre to manage the distribution of white sugar in the domestic market in an effort to regulate the trade and ensure fair pricing. After more than six months of wrangling over the cane price, the government has stepped in and fixed the minimum price at Baht 540 per tonne, Baht 110 less than that of the 1980/81 season, as a consequence of the decline in the world sugar price. The wholesale and retail prices for white and refined sugar will remain unchanged, however. The government will assist sugar producers from the export premium fund to the extent of Baht 30 per tonne but up to a maximum of Baht 780 million. The export premium collected in excess of this amount will be passed on to the sugar cane planters provided that the total cane price does not exceed Baht 600 per tonne.

Guyana sugar production, 1981[4]. — Sugar production in Guyana in 1981 reached 300,750 long tons, tel quel (approximately 318,000 tonnes, raw value), 90% of the target, according to industry sources. Unfavourable weather and mechanical failures at the factories were the major problems of the industry during the year. Despite the problems encountered, production was 10% up from 1980, which reversed a downward trend in output since the industry was nationalized in 1976. However, output in 1981 was still far below peak production of 375,000 tonnes in 1971. The output target for 1982 has been set at 320,000 tonnes, despite the fact that production costs are above current world market prices, since the country urgently needs foreign exchange.

HFCS projects in Asia[5]. — Both Pakistan and China have announced plans to build high fructose syrup plants. The Chinese unit will have a daily capacity of 15,000 — 20,000 bushels of maize and is to be built over the next two years. Pakistan hopes to produce 45,000 tonnes of syrup per year from a factory to be built north of Karachi and using rice milling residues as raw material.

The British Society of Sugar Cane Technologists

The Annual General Meeting for 1982 will be held at the Royal Commonwealth Society, 16-20 Craven Street, London WC2N 5BJ, at 10 a.m. on Tuesday April 6, 1982. The A.G.M. will be followed by a technical symposium on the theme "A Decade of British Achievement in Cane Sugar Technology". Admission will cost £12.50 (inclusive of buffet lunch).

Applications for Membership and admissions should be made to:— W. N. L. Davies, Secretary/Treasurer, B.S.S.C.T. c/o Tate & Lyle Agribusiness, Enterprise House, 45, Homesdale Road, Bromley, Kent BR2 9TE, not later than March 19, 1982.

Jamaican rejection of Tate & Lyle offer[6]. — The Jamaican government has rejected an offer from Tate & Lyle to take over and manage the island's debt-ridden, state-owned sugar industry[7]. In a recent report it was said that the government had decided, instead, to put the industry "on trial" for the next two years. If there is not an improvement in output and financial viability by 1983, the industry is likely to be scrapped. Tate & Lyle had offered to manage the eight state-owned sugar factories which produce about 75% of the island's sugar and which, ironically, were run by Tate & Lyle before being taken over by the government eight years ago (when production was 383,282 tonnes, raw value). The eight factories, now run by the state agency, the National Sugar Company, last year produced about 205,000 tonnes. Two aspects of Tate & Lyle's proposals made the government reluctant to accept the offer; the Agriculture Minister said earlier this year that some of the recommendations in the Tate & Lyle proposals concerning the exclusion of unions and the role of the sugar cooperatives were totally unacceptable. He added that the government has no intention of agreeing to proposals which would recolonize the sugar industry. Over the past years the industry had been affected by poor weather, smut and rust diseases, outdated machinery and production methods, lack of fertilizer and other materials because of the problems of the Jamaican economy which forced imports to be curtailed. One embarrassing result of this was that, in 1981, after meeting the 125,000 tonnes quota for the EEC under the Lomé Convention, the domestic market of 95,000 tonnes had to be supplied with imports from the US. With the industry on trial for the next two years, the government says it will be providing all the machinery and materials which are needed to make it improve. Subsidies are being provided for fertilizer and other chemicals, for example, and 59,000 acres are being planted with varieties which are resistant to rust and smut diseases. The production target for 1982 is 220,000 tonnes, rising to 280,000 tonnes in 1982, according to official sources. If this is achieved, the aim is for 300,000 tonnes in 1984 and 330,000 tonnes in 1985.

PERSONAL NOTES

Dr. H. P. Hoffmann-Walbeck, since 1961 Head of the Department for Microbiology and Waste Water Technology at the Institut für landwirtschaftliche Technologie u. Zuckerindustrie (attached to the Technische Hochschule, Braunschweig, in West Germany) has retired. Dr. Hoffmann-Walbeck is the Referee of Subject 21 (Microbiological tests) of ICUMSA and is also a member of the Scientific Committee of the Commission Internationale Technique de Sucrerie (CITS).

The death is announced, at the age of 85, of **Eugen Gottlieb von Langen**, for several years Chairman of the Board of Wirtschaftliche Vereinigung Zucker (WVZ), the West German sugar economic organization. He joined the sugar company Pfeifer & Langen in 1922 and was their Managing Director from 1926 to 1969, subsequently becoming Chairman of the Board. He was also Vice-Chairman of the Committee of the Verein der Zuckerindustrie, as well as Vice-President (and President for a 4-year term) of the Comité Européen des Fabricants de Sucre (CEFS).

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[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 33.
[2] *Standard Chartered Review*, December 1981, 29.
[3] *I.S.J.*, 1982, **84**, 31.
[4] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 36.
[5] *Public Ledger's Commodity Week*, December 12, 1981.
[6] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 73.
[7] *I.S.J.*, 1981, **83**, 226.

World sugar production estimates, 1981/82[1]

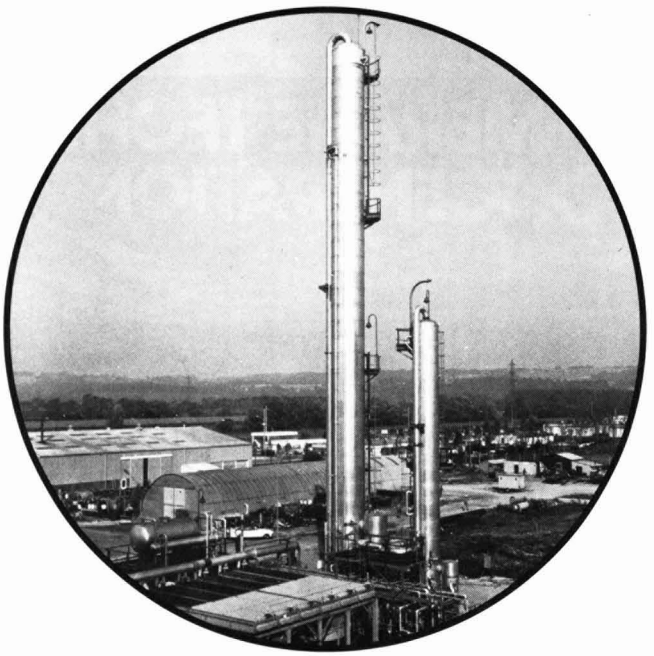
	1981/82	1980/81	1979/80
	tonnes, raw value		
BEET SUGAR			
Belgium/Luxembourg	1,100,00	870,000	991,000
Denmark	516,000	464,000	492,000
France	5,510,000	4,253,000	4,313,000
Germany, West	3,600,000	2,982,000	3,094,000
Greece	350,000	189,000	319,000
Holland	1,082,000	951,000	927,000
Ireland	196,000	161,000	190,000
Italy	2,209,000	1,932,000	1,698,000
United Kingdom	1,212,000	1,202,000	1,260,000
Total EEC	*15,775,000*	*13,004,000*	*13,284,000*
Austria	490,000	456,000	410,000
Finland	91,000	123,000	100,000
Spain	1,039,000	965,000	714,000
Sweden	385,000	327,000	350,000
Switzerland	136,000	105,000	118,000
Turkey	1,380,000	935,000	1,068,000
Yugoslavia	850,000	728,000	852,000
Total West Europe	*20,146,000*	*16,643,000*	*16,896,000*
Albania	40,000	40,000	40,000
Bulgaria	240,000	250,000	240,000
Czechoslovakia	870,000	830,000	910,000
Germany, East	740,000	600,000	679,000
Hungary	587,000	480,000	510,000
Poland	1,740,000	1,130,000	1,580,000
Rumania	640,000	553,000	570,000
USSR	7,800,000	7,150,000	7,700,000
Total East Europe	*12,657,000*	*11,033,000*	*12,229,000*
Afghanistan	4,000	4,000	4,000
Algeria	10,000	10,000	12,000
Azores	9,000	9,000	9,000
Canada	128,000	89,000	106,000
Chile	158,000	250,000	63,000
China	720,000	695,000	480,000
Iran	260,000	250,000	500,000
Iraq	10,000	25,000	38,000
Israel*	11,000	11,000	0
Japan	520,000	581,000	512,000
Lebanon	5,000	12,000	5,000
Morocco	322,000	331,000	335,000
Pakistan	39,000	35,000	32,000
Syria	47,000	32,000	26,000
Tunisia	7,000	8,000	7,000
Uruguay	54,000	42,000	65,000
USA	3,039,000	2,643,000	2,612,000
Total Other Continents	*5,343,000*	*5,027,000*	*4,806,000*
Total Beet Sugar	38,146,000	32,703,000	33,931,000
CANE SUGAR			
Spain	13,000	15,000	4,000
Total Europe	*13,000*	*15,000*	*4,000*
Barbados	95,000	96,000	135,000
Belize	100,000	104,000	109,000
Costa Rica	204,000	194,000	202,000
Cuba	7,400,000	7,359,000	6,787,000
Dominican Republic	1,100,000	1,032,000	1,039,000
Guadeloupe	84,000	60,000	98,000
Guatemala	500,000	448,000	385,000
Haiti	49,000	52,000	54,000
Honduras	218,000	183,000	187,000
Jamaica	205,000	205,000	236,000
Martinique	3,000	5,000	8,000
Mexico	2,700,000	2,518,000	2,765,000
Nicaragua	223,000	193,000	171,000
Panama	200,000	187,000	200,000
Puerto Rico	122,000	159,000	158,000
St. Kitts	35,000	32,000	36,000
Salvador	190,000	180,000	184,000
Trinidad	100,000	93,000	114,000
USA Hawaii†	943,000	941,000	928,000
Mainland	1,669,000	1,544,000	1,488,000
Total N. & C. America	*16,140,000*	*15,585,000*	*15,284,000*

	1981/82	1980/81	1979/80
	tonnes, raw value		
CANE SUGAR, contd.			
Argentina	1,623,000	1,716,000	1,411,000
Bolivia	266,000	262,000	288,000
Brazil	8,450,000	8,627,000	7,027,000
Colombia†	1,270,000	1,185,000	1,247,000
Ecuador	359,000	368,000	357,000
Guyana†	320,000	318,000	286,000
Paraguay	80,000	89,000	73,000
Peru†	710,000	493,000	552,000
Surinam	11,000	9,000	7,000
Uruguay	37,000	37,000	26,000
Venezuela	310,000	291,000	374,000
Total S. America	*13,436,000*	*13,395,000*	*11,648,000*
Angola	35,000	27,000	36,000
Cameroon	45,000	36,000	55,000
Chad	25,000	20,000	20,000
Congo	22,000	12,000	12,000
Egypt	718,000	679,000	672,000
Ethiopia	177,000	165,000	164,000
Ghana	6,000	8,000	6,000
Ivory Coast	176,000	135,000	103,000
Kenya*	419,000	440,000	436,000
Liberia	5,000	4,000	4,000
Madagascar	112,000	116,000	117,000
Madeira	1,000	1,000	1,000
Malawi	175,000	155,000	114,000
Mali	20,000	18,000	16,000
Mauritius	610,000	504,000	730,000
Morocco	43,000	31,000	24,000
Mozambique	185,000	177,000	220,000
Nigeria	36,000	34,000	41,000
Réunion	252,000	228,000	262,000
Senegal	62,000	48,000	41,000
Somalia	45,000	40,000	22,000
South Africa	2,185,000	1,731,000	2,244,000
Sudan	332,000	234,000	145,000
Swaziland	372,000	327,000	253,000
Tanzania	127,000	124,000	130,000
Uganda	8,000	5,000	5,000
Upper Volta	27,000	26,000	28,000
Zaire	36,000	36,000	55,000
Zambia	102,000	111,000	102,000
Zimbabwe	390,000	359,000	314,000
Total Africa	*6,748,000*	*5,831,000*	*6,372,000*
Bangladesh	179,000	155,000	110 000
Burma	40,000	44,000	42,000
China	2,720,000	2,566,000	2,280,000
India	7,000,000	5,587,000	4,191,000
Indonesia	1,460,000	1,272,000	1,371,000
Iran	140,000	130,000	100,000
Iraq	15,000	15,000	25,000
Japan	245,000	233,000	240,000
Malaysia	59,000	58,000	52,000
Nepal	10,000	7,000	10,000
Pakistan	1,087,000	893,000	592,000
Philippines	2,450,000	2,394,000	2,343,000
Sri Lanka	32,000	27,000	21,000
Taiwan	810,000	767,000	874,000
Thailand	2,040,000	1,641,000	1,098,000
Vietnam	50,000	50,000	30,000
Total Asia	*18,337,000*	*15,839,000*	*13,379,000*
Australia	3,500,000	3,418,000	2,961,000
Fiji	465,000	410,000	490,000
Total Oceania	*3,965,000*	*3,828,000*	*3,451,000*
Total Cane Sugar	58,639,000	54,493,000	50,138,000
Total Beet Sugar	38,146,000	32,703,000	33,931,000
Total World Sugar	96,785,000	87,196,000	84,069,000

* These world production estimates are on a crop-year basis wherein all campaigns which do not begin earlier than May of one year nor later than April of the following year are included in the same crop year. Each country's total annual production is credited to the May/April year in which sugar production began.

† 1982, 1981, 1980.

[1] F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 21-25.



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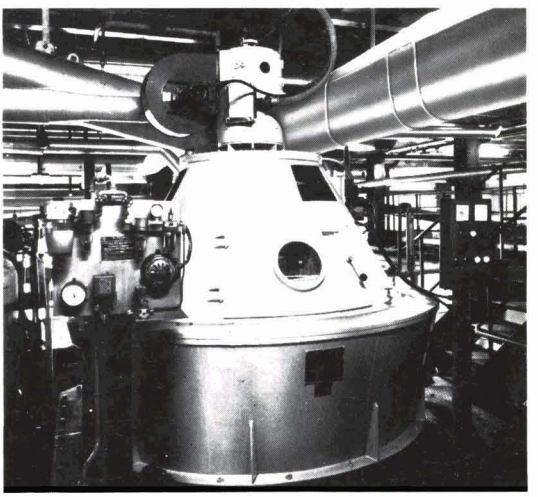

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