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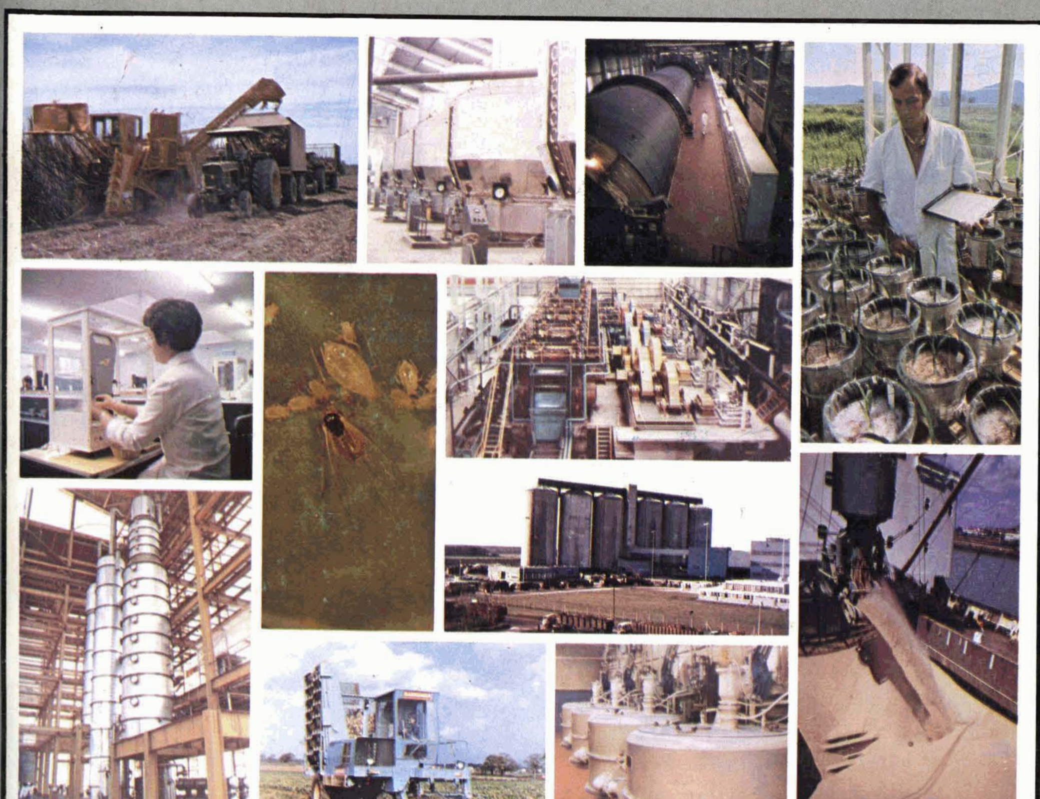

FEBRUARY 1979

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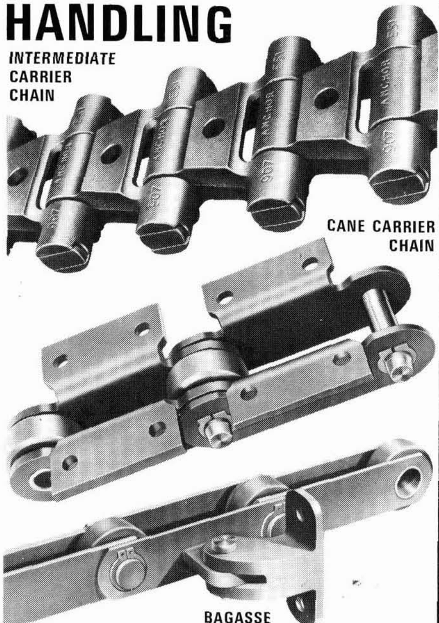

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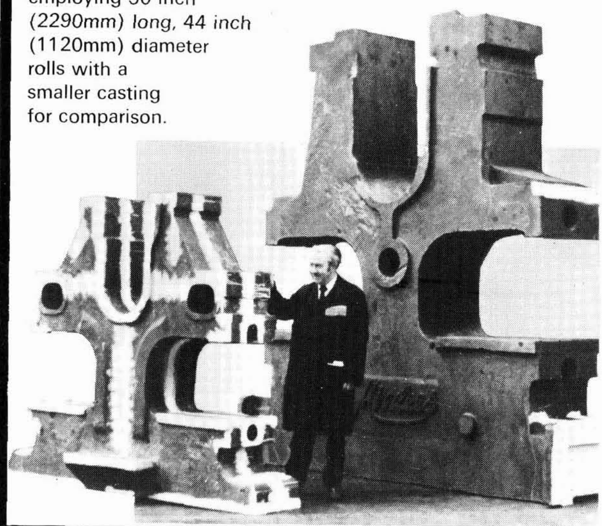

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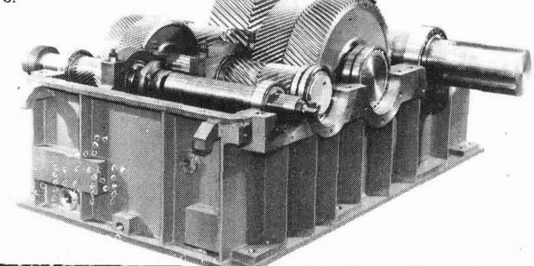

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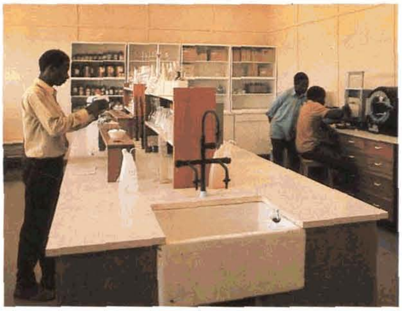

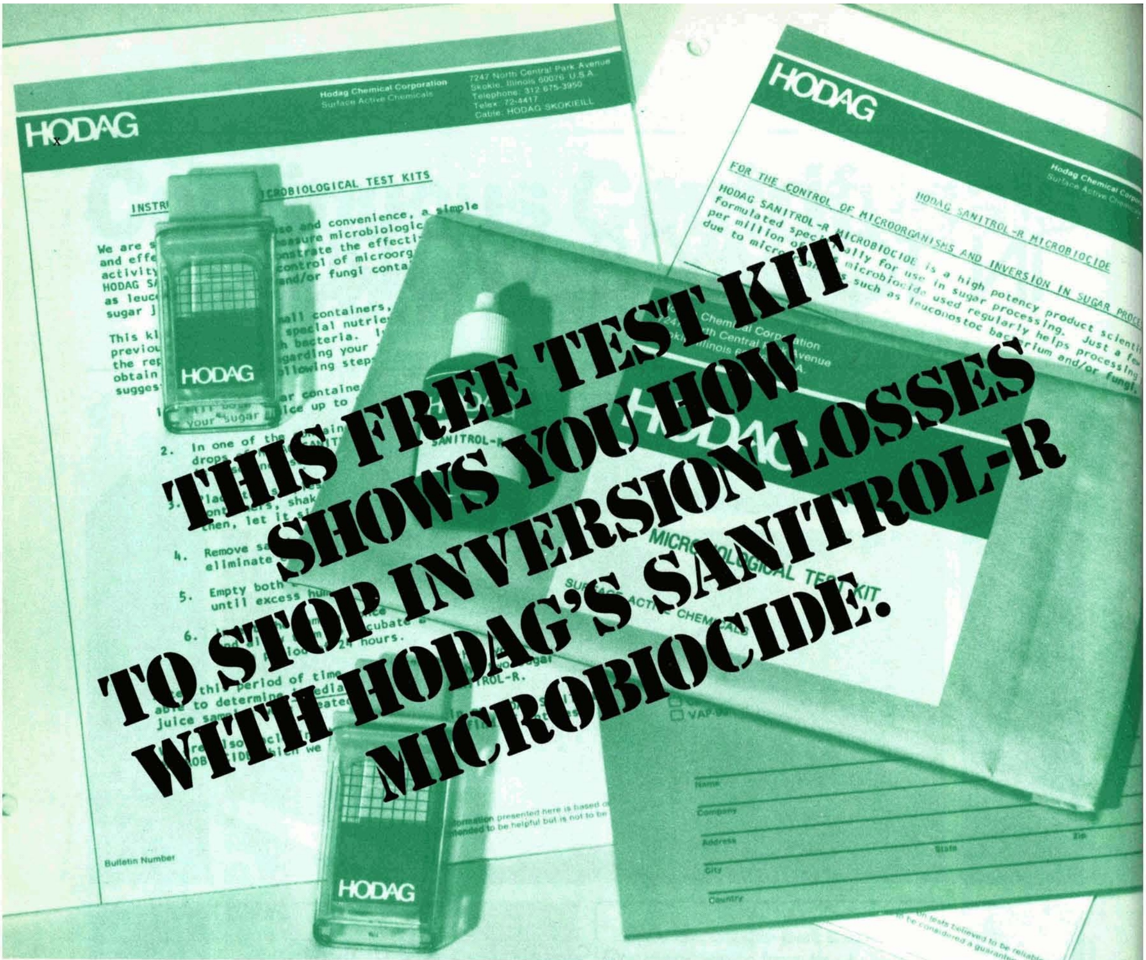

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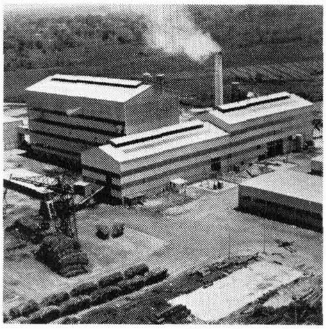

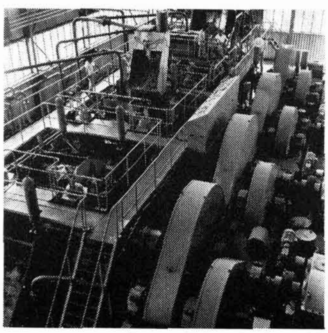

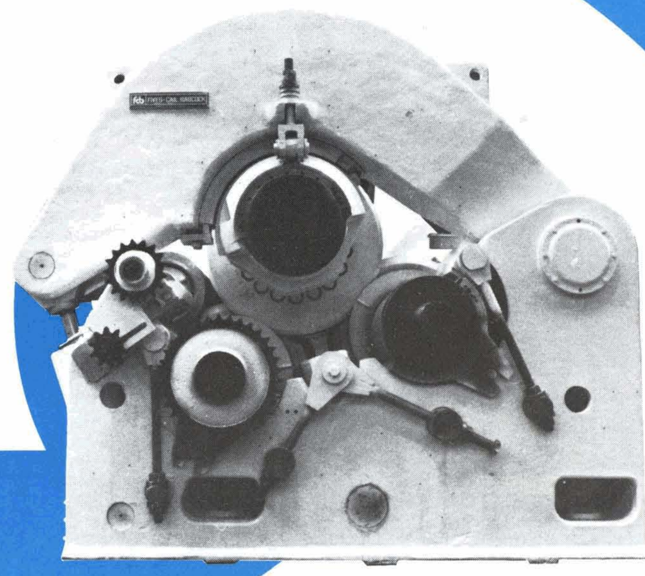

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NOTES AND COMMENTS

International Sugar Agreement

The second part of the fifth session of the International Sugar Council was held in London on December 13 and 14, 1978. The session was presided over by Mr. S. El Bous of Egypt, the Chairman for 1978, and was attended by the representatives of 31 exporting and 15 importing members.

The Council received applications for accession from Austria and Colombia. It defined conditions for Austria's accession and requested its Informal Working Group on Accessions to consider and propose conditions for Colombia's accession in 1979.

The Council noted that ten exporting and six importing members have not as yet completed their constitutional procedures and, under article 73, paragraph 2, extended the time limit for the deposit of these instruments to June 30, 1979.

Under article 6 of the Agreement, the Council agreed to a change of status of Yugoslavia in 1979 from an importing to an exporting member with a maximum export entitlement to the free market of 70,000 tonnes.

The Council extended to April 1, 1979, the relief under article 69 of members from their obligations under article 51 and the relevant rules under that article, and decided that if the requirements for a full implementation of that article by all members are not met by then, the relief will be further extended to July 1, 1979; and agreed to review at its next session the levels of the contribution to the Fund under article 51, paragraph 1. The Council also noted in this connexion that once article 51 is fully implemented, the Executive Committee will consider the question of borrowing bridging finance for payment of loans in respect of special stocks.

The Council agreed that prices in the Agreement should remain unchanged.

The Council agreed on measures concerning the relief from quota obligations to be granted to the Dominican Republic in 1979 in the light of the exceptional circumstances facing that country. [It has been reported[1] that the Dominican Republic has been awarded an initial quota increase for 1979 of 55,000 tonnes.]

The Council also received an interim report under article 57, paragraph 7, on imports by members from non-members so far in 1978 and, in this connexion, expressed its satisfaction at the measures taken by the US Administration to limit US imports from non-members.

The Council unanimously elected Mr. H. Tabío York, of Cuba, as its Chairman, and Mrs. Colbjörnsen, of Norway, as its Vice-Chairman, for 1979. It also approved the composition of the Executive Committee and its other Committees for that year.

World sugar production, 1978/79

F. O. Licht GmbH have recently issued their second estimate of world sugar production for the crop year 1978/79[2] and this is reproduced elsewhere in this issue. As a consequence of the good weather in the later months of 1978, the beet sugar crops of Europe have been improved markedly since their first estimate and the higher figures have been the major influence in the higher world total, accounting for some 700,000 tonnes of the overall 1,100,000 tonnes increase to 92,160,000 tonnes, only 1·5% less than the record output of 1977/78.

Other important influences have been the higher expectations from the Cuban crop, and Licht acknowledge that their figure of 7·1 million tonnes may be on the conservative side. Major increases are also expected in India and Indonesia, while storm damage in the Philippines is the cause of the drop in the estimate for 1978/79 production in that country.

While other observers and officials in the countries concerned have indicated higher outturns than Licht's figures for China, Cuba, Dominican Republic, India, Mexico and the USSR, and adjustments may need to be made as the crop year proceeds, Licht prefer to be more cautious until more reliable and accurate guidance is available.

World sugar prices

Depressed conditions in the London market led to little difference between the LDP at the beginning and the end of December 1978. Currency fluctuations were the principal reason for an early rise from £99 per ton to £105 on December 5, but the price fell again to £99, rose to £103 on December 12 and then subsided slowly during the rest of the month, reaching £94 on December 29.

Though both sections of the market are suffering from oversupply, this is most apparent in the white sugar sector so that the premium of the LDP(W) over the raw sugar price remained at only £1–£2 for most of the month, and for two short periods white sugar was actually cheaper than raws.

US sugar legislation

On December 4, President Carter signed a Proclamation adjusting the annual quota limitation to 6·9 million short tones, raw value. Imports for the 24-month period from January 1, 1978 to December 31, 1979 were also limited by the Proclamation to 150,544 tons from countries not signatory to the International Sugar Agreement; since more than this amount was imported during 1978, such imports will be prevented in 1979. However, it is understood that, if a supplying country becomes a member of the Agreement, its sugar will no longer count against the total, which may leave room for additional non-member imports. At the same time, imports from Taiwan for 1978 and 1979 combined were limited to 210,987 tons, which leaves possible imports from Taiwan in 1979 of about 150,000 tons.

A Proclamation had also been expected at the beginning of December which would set a new import fee on imported sugar (that for 1978 has been 2·71 cents per pound for raw sugar). An inter-agency group had been set up to examine the various possibilities but was apparently unable to decide by the due date whether there should be a quarterly fee based on the prior month's price, with or without possible adjustment in

[1] C. Czarnikow Ltd., *Sugar Review*, 1978, (1418), 241.
[2] *International Sugar Rpt.*, 1978, **110**, (35), 1–7.

the quarter if the price exceeded or moved below certain bracket figures; a quarterly fee based on the past quarter's price, with or without possible adjustment; a monthly fee based on spot price; or a "trigger mechanism" based on a 10–15 day moving average. No decision was announced until December 29 when Mr. Carter issued a Proclamation that the import fee would be raised, with effect from January 1, 1979, to 3·35 cents/lb for raw sugar and 3·87 cents/lb for refined sugar imports. At the time of writing no details are available as to the method by which this new fee has been computed.

World sugar balance 1978/79

On November 30, F. O. Licht GmbH published their 3rd estimate of the world sugar balance for 1977/78 and the same figures were incorporated in their first estimate for the current crop year, published on December 15[1]. The figures are reproduced below and, as usual, correspond to the crop years September-August for each column.

	1978/79	1977/78	1976/77
		tonnes, raw value	
Initial stocks	30,619,000	25,442,000	20,758,000
Production	91,858,000	92,280,000	88,426,000
Imports	25,472,000	27,291,000	27,490,000
	147,949,000	145,013,000	136,674,000
Consumption ...	89,967,000	86,565,000	83,167,000
Exports	25,961,000	27,829,000	28,065,000
Final stocks	32,021,000	30,619,000	25,442,000

C. Czarnikow Ltd.[2] comment: "The initial assessment of the world market supply and demand situation published by F. O. Licht gives no reason to be complacent about the outlook for our commodity. Though the quota provisions of the ISA have led to production being curtailed in some important exporting countries, final stocks as at the end of August 1979 have been forecast by Licht to amount to 32·0 million tonnes, raw value, which is not only an increase in the course of the year in absolute terms but, at 35·6% of the year's consumption, even indicates an expansion from the previous year's level in the ratio of stocks to consumption.

"As the year progresses it will, of course, be necessary to make adjustments to all the 1978/79 figures from time to time, and probably also to some of the 1977/78 statistics, but the conclusion is inescapable that, without some large and unexpected demand developing, or a major crop failure occurring, conditions of heavy surplus will continue to prevail throughout the year.

"The segregation of Special Stocks, as provided for under the International Sugar Agreement, may help reduce the tonnage for sale, but in the prevailing conditions this can only help partly to ameliorate the situation. The ISA's quota restrictions will also limit the quantity of sugar which members will be able to export but there still remains a large amount of sugar produced by non-members.

"Though Licht's figures cover only the period to the end of next August, the International Sugar Agreement works on a calendar year and, for the purpose of an evaluation of prospects for 1979, it is necessary to look at the year as a whole. Stocks of 32·0 million tonnes at the beginning of September do not encourage optimism but much will depend on weather conditions, particularly in Europe, while it might not be too much to hope that current prices will discourage further expansion in some parts of the world".

Tanzania sugar expansion programme[3]

Internal consumption of sugar in Tanzania is currently running at 120,000 tonnes per annum, of which 115,000 tonnes are produced domestically and the balance imported. A study by Tate & Lyle Technical Services Ltd. and Booker Agriculture International indicates that requirements will reach 190,000 tonnes by 1990 and, to meet this increase, the following programme has been suggested at a cost of approximately $369,000,000: (1) expansion of the Kilombero mill (phases 1 and 2) to increase production from 76,000 to 128,000 tonnes; (2) allocation of supplementary land to the Tanganyika Planting Co. Ltd. in Moshi so that its factory can work at full capacity (80,000 tonnes/year); (3) expansion of Mtibwa sugar estate to increase annual production to 57,000 tonnes; and (4) development of the Kagera and Ruipa projects and development of phase 2 of the Inkongo project, which should produce 75,000 tonnes per year (Kagera and Ruipa) and 82,000 tonnes per year (Inkongo). The Kagera project requires an investment of $74,000,000 for its realization; this includes the erection of a sugar factory and the clearing of 12,000 hectares for cane cultivation. The Abu Dhabi Fund for Arab Development has taken part in this investment by granting a loan of $74,000,000 which will be used mainly for the purchase of machinery and construction of the factory. Kagera's production capacity will be 56,000 tonnes per year. At the same time that it is dealing with production problems, Tanzania will have to solve the problems of sugar transportation which are, in great part, responsible for the shortages suffered in some areas.

US sugar crop prospects[4]

The beet processing campaign has been in full swing since October, while the cane sugar crops began in mid-November in Florida and Texas. The Florida crop was on schedule while that in Texas was about three weeks late, but this resulted in a better sugar content. The Texas sugar cooperative does not plan to store 1978/79 sugar under the Commodity Credit Corporation Price Support Loan programme, but Florida sugar producers, who expect a crop of 9,700,000 short tons of cane yielding about 940,000 tons of raw sugar (against 894,000 tons in 1977/78), will be using the loan programme now that storage problems have been solved.

According to agricultural economists of the USDA, the 1978/79 beet sugar crop is expected to reach 3·3 million short tons, raw value, up from 3·1 million tons in 1977/78 but 800,000 tons less than the record 1976/77 crop. The beet area is up more than 4% from 1977/78 whereas the cane area will total 753,000 acres in 1978/79, down slightly from the previous season[5]. Cane sugar production may match the 2,680,000 tons of 1977/78, while corn sweeteners are expected to rise to 3·65 million tons in calendar year 1978 compared with 3·4 million tons in 1977. Sugar deliveries in 1979 are expected to total about 10·9 million tons, including imports of around 5 million tons.

[1] *International Sugar Rpt.*, 1978, **110**, (36), 1.
[2] *Sugar Review*, 1978, (1419), 245–246.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (29), 20–21.
[4] *ibid.*, (33), 15–17.
[5] *Public Ledger*, November 18, 1978.

Mexico sugar industry recovery

F. O. Licht GmbH have recently published information on the Mexican sugar industry[1] which demonstrates the recovery taking place from the major decline experienced in the mid-1970's. Tabulated below are details of Mexico's sugar balance for the past two crop years and an estimate for the current crop year November 1978/ October 1979.

	1978/79	1977/78	1976/77
		tonnes, raw value	
Initial stocks	594,000	340,000	300,000
Production	3,200,000	3,049,000	2,670,000
	3,794,000	3,389,000	2,970,000
Consumption ...	2,950,000	2,785,000	2,630,000
Exports	110,000	10,000	0
Final stocks	734,000	594,000	340,000

The 1977/78 crop of 3,049,000 tonnes, raw value, was a marked improvement over the previous season, when production had slumped to 2,670,000 tonnes and exports were nil. Some sources even suggested that the country had to import sugar to cover domestic requirements but this was denied officially and no confirmation has been given by purported suppliers.

Different causes blamed for lower production in the mid-1970's have included lack of efficient mill management and factory equipment, and poor cane quality. A major problem, however, was stagnation of cane production as a result of controlled prices of sugar for domestic consumption and little rise in prices for cane growers. Cane fields were abandoned and no adequate action was taken to restore these as late as 1976. Because of prolonged price controls in the home market and an inefficient agricultural structure in general, producers have also refused to invest and many have been saved from bankruptcy only by Government loans or take-overs.

The main problem of the Mexican sugar industry would appear to be structural: in the pattern of landholding, and in poor operating conditions. In 1976, of a total of 109,848 registered growers, many held less than 2 hectares and only 606 farmed more than 50 ha. In terms of machinery and industrial capacity, the picture is even bleaker; it was recently reported that the industry, which provides jobs for more than 280,000 people, has less than 4000 tractors and just 30 harvesters.

Owing to lack of cane, mills worked below capacity—only 65% in 1976, and during recent years replanting and expansion of cane fields has been deterred, basically because of the lack of profitability in cane production. With the severe curtailment of sugar exports during the period and the resulting lack of foreign exchange, prices paid to mills were below world prices, and low price levels were received by cane growers from the mills.

In October 1975, however, a Presidential proclamation changed the mechanism for determining the price paid for cane to a basis calculated on sucrose content and, at the same time, tied cane prices to support levels for grains and oil seeds. As a consequence, Mexico experienced a significant increase in cane planting during the spring of 1976. Since new cane usually requires 18 months before it reaches maturity in Mexico, the first harvest season to benefit from the new plantings was that of 1977/78. The total harvested area was 432,000 ha, 4% above that of 1976/77, and an estimated 10% increase in cane yield per hectare produced 32·4 million tonnes of cane compared with only 28·4 million tonnes in 1976/77. The average sucrose is also believed to have been higher, because of the new planting, and the timely delivery of harvested fields to the factory contributed to a higher extraction, the net result being a 14·2% rise in sugar production.

Because of the greater availabilities, Mexico again had sugar for export in 1977/78, the first time for four years, and it is expected that Mexico will meet its 1978 ISA quota of 70,000 tonnes. Despite a projected record level of domestic consumption, the 1979 export quota under the ISA is also expected to be met. Raw sugar production is expected to be 4·95% higher, mainly because of an anticipated increase in the cane area to 465,000 ha, 8% above 1977/78.

Domestic consumption of sugar continues to grow at an annual rate of 5–7%, compared with a population growth rate of 3·5%, owing to growing disposable income. Deliveries in calendar year 1977 fell to 2,457,059 tonnes, tel quel, from 2,475,555 tonnes in 1976; this was largely due to a distortion arising from the dual pricing system in Mexico. Quantities of sugar allocated for domestic consumption were illegally transferred to industrial firms at prices above the official domestic retail price but below that set for industrial firms, so that both parties made illegal profits. Those transactions resulted in shortages of sugar in supermarkets which were exacerbated by hoarding of supplies, and the true demand and stock position was thus distorted.

The sharp rise in domestic consumption per caput is due to the heavy subsidy of the retail price and, while the Administration aims for its eventual elimination, it is impossible to cut off the subsidy without other serious problems and it will be continued for a time. Some analysts consider that, if the policy of subsidization is not phased out, the country may have to import sugar again by 1980. However, the Government is making substantial efforts to stimulate the industry, and Mario Trujillo García, the newly-appointed head of the National Sugar Commission, has announced a speed-up in the mill repair programme, for which only 300 million pesos had been spent out of an allocated 1143 million pesos intended to ensure that all mills would be fully operative at the start of the 1978/79 season.

Officials are optimistic that production will increase to 3·2 million tonnes in 1978/79 and will reach 3·9 million tonnes by 1982. In April and May 1978 four new sugar factories with an annual production capacity of 90,000 tonnes of sugar each came on stream. These factories are located in the cane growing areas of Quintana Roo, in Tres Valles (Veracruz), Huixtla (Chiapas) and in Juchitán (Oaxaca). This raises the total number of factories to 71, of which 43 are state-owned and the remainder owned privately. A new project is planned for the Valle Escondido, near Altamerando (Queretaro), involving an investment of some U.S. $8 million. The factory is expected to come on stream in 1980/81.

More cautious observers have noted, however, that the recent detection of cane smut in Belize represents a serious threat to the sugar industry of Mexico. Although Mexico is currently free of the disease, smut spores can easily be spread by the wind from infected areas in Belize to cane fields in Quintana Roo, where it is estimated that about 85% of the crop is planted with a highly susceptible variety. The President of the National Union of Small Cane Producers has estimated that as much as 70% of Mexico's cane could be affected by smut.

[1] *International Sugar Rpt.*, 1978, **110**, (33), 3–7.

Interaction of metal ions with sucrose—a review

By LAURENCE PONCINI

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THIS review aims at those areas of interest to the sugar chemist where metal ion interaction with sucrose has in the past years been shown to have industrial application.

The information published to date on complexes involving alkali metals and alkaline-earth metals with carbohydrates has in most cases been vague and difficult to interpret, largely because (*a*) these metal ions in aqueous solution do not readily form stable complexes, and (*b*) the study of such weak interactions is beset with many analytical difficulties. It should be noted that complex formation in solution is relatively easy to detect but, as yet, no stability constants have been determined[1,2].

Work published before 1904 on such complexes was reviewed by E. O. von Lippman[3]. Vogel & Georg[4] compiled a comprehensive table of such complexes prepared up to 1930, and Rendleman[1] reviewed the field to 1965. It is important to note that many of the chemical formulae suggested by earlier workers were based on assumptions and insufficient evidence. This tendency unfortunately still exists in the literature even today.

As early as 1807, Sir William Ramsay[5] described an experiment in which he produced grey crystals from the interaction of calcium and strontium with sucrose but gave no analytical data. This experiment was not followed up until 1920, when W. D. Helderman[6] set out to provide proof of the existence of carbohydrate-salt adducts from solubility determinations of a three-component system (salt, water and either sucrose or D-glucose). However, I. M. Kolthoff[7] has pointed out that a faulty experimental procedure led Helderman to an erroneous conclusion. This publication nevertheless was the catalyst to other investigations into such systems. S. Matsuura[8,9], G. Tegge[10] and O. Wiklund[11] furnished proof of the existence of 2 D-glucose,NaCl,H_2O, 2 sucrose,3NaI,3H_2O and sucrose,NaI,2H_2O using a similar system to Helderman's. They were successful also in demonstrating that complex formation influences the solubility of both the carbohydrate and the salt.

Further evidence has been proposed for the existence of sucrose complexes. (*a*) Calcium carbonate is not precipitated when carbon dioxide is passed through an aqueous solution of sucrose and calcium hydroxide [12]. (*b*) When aqueous solutions of sucrose, calcium hydroxide and sodium aluminate are mixed, a water-soluble complex containing sucrose, aluminium and calcium is formed[13]. (*c*) Phase studies [14] of the ternary systems sucrose-water-barium hydroxide and sucrose-water-strontium hydroxide have shown the existence of complexes: sucrose,BaO, sucrose,3BaO, sucrose,SrO, and sucrose,2SrO. (*d*) Sodium carbonate-sucrose complex has been shown[15] to exist but no complex with potassium carbonate has been reported[1].

The isolation of crystals having a constant composition constitutes good evidence of adduct formation[1]. Sucrose,NaI,2H_2O crystals, several centimetres long and of constant composition, have been isolated[16]. If adduct formation had not taken place, sucrose and sodium iodide would have precipitated separately. K. B. Domovs & E. H. Freund[17] have observed that sucrose and many other carbohydrates are highly soluble in absolute methanol containing sufficient calcium chloride. Such a solubility effect suggests the formation of carbohydrate-calcium chloride complexes. Table I lists some of the complexes of sucrose with metal ions that have been isolated.

Table I. Sucrose adducts of alkali metal salts and alkaline-earth metal salts[1]

Salt	*Molar ratio, (Ligand:Salt)*	*Solvation (Molecules/ cation)*	*Solvent Medium*[a]	*References*
Barium bromide	2:1	—	H_2O	18[b]
Barium chloride	2:1	—	H_2O	18[b]
Barium iodide	2:1	—	H_2O	18[b]
Barium thiocyanate	1:1	2 H_2O	H_2O	16[b]
Calcium bromide	1:1	3 H_2O	H_2O	18[b]
Calcium iodide	1:1	3 H_2O	H_2O	18[b]
Lithium bromide	1:1	2 H_2O	H_2O	18[b]
Lithium chloride	1:1	2 H_2O	H_2O	18[b]
Lithium iodide	1:1	2 H_2O	H_2O	18[b]
Potassium acetate	2:1	—	NMP-EtOH-Et_2O	19
Potassium acetate	1:2	—	NMP-EtOH-Et_2O	19
Potassium iodide	1:1	2 H_2O	H_2O	11, 18[b]
Potassium thiocyanate	1:1	H_2O	H_2O	16[b]
Sodium acetate	1:1	—	H_2O	20
Sodium bromide	1:1	2 H_2O	H_2O	21
Sodium carbonate	1:1	None	H_2O	15
Sodium chloride	1:1	2 H_2O	H_2O	11,21,22,23
Sodium chloride	1:1	None	H_2O-EtOH	22, 23
Sodium iodide	1:1	2 H_2O	H_2O	11, 16[b]
Sodium iodide	2:3	H_2O	H_2O	11, 21, 24
Sodium propionate	2:1	—	NMP-EtOH-Et_2O	19
Sodium thiosulphate	1:1	H_2O	H_2O	16[b]
Strontium chloride	1:1	3 H_2O	H_2O	18[b]
Strontium bromide	1:1	3 H_2O	H_2O	18[b]

[a] NMP = N-methyl-2-pyrrolidinone
EtOH = ethanol
Et_2O = diethyl ether

[b] Gauthier gave no analytical data. Therefore results not corroborated by other workers should be viewed cautiously

Information on the stoichiometry of carbohydrate-salt interactions is based largely upon the composition of the complex isolated[1]. 1:1 and 2:1 complexes are the most frequently reported combinations; however, other ratios are possible (for other carbohydrates, see the work of Rendleman[1]), although adducts prepared in aqueous media have not exceeded 2:1.

Formation of carbohydrate-salt adducts has the same requirements as those for chelation between a metal ion and a multidonor molecule[1]. Proper orientation of a

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group of two or more hydroxyl groups, or a combination of a carbonyl group with one or more hydroxyl groups is necessary[2,19,25–41]. No evidence has yet been proposed to implicate the oxygen atom of an ether linkage (or of the glycosidic hemiacetal linkage) as an electron donor serving to bind a cation. Talalaeva and co-workers[42] have shown however that bonding of an alkali metal cation to an alkoxy group is possible and may contribute weakly to chelate stability.

Carbohydrates with many donor groups are able to form polycation adducts with more than one metal cation attached to a single donor molecule[1]. It should be noted that failure to isolate a particular adduct does not necessarily preclude its existence, for preparative conditions often dictate the stability, solubility, and ease of crystallization or precipitation of an adduct.

Numerous physical methods such as solubility[17], optical rotation[11,43–48], conductivity[49,51] and viscosity[52,53] determination, electrophoresis[19,54], potentiometry[55,56], infrared analysis[57–59] and most importantly nuclear magnetic resonance spectroscopy[2,37–39,60,61] have provided evidence for the existence of sugar-metal complexes in solution. The sum total of such evidence leaves no doubt that at least some metal cations form complexes with some sugars and polyols in solution.

Nomenclature in this area has not been well defined, mainly owing to inaccurate knowledge pertaining to structure. The terms most commonly found in the literature for inorganic complexes of carbohydrates are "saccharates" or "sucrates"; however the preferred nomenclature is that of Soubeiran[62], in which the name of the metal salt and of the sugar are combined, for example sucrose sodium bromide dihydrate ($C_{12}H_{22}O_{11}$,NaBr,$2H_2O$).

This latter compound is the only sucrose complex to date which has been studied by X-ray crystallography[63,64]. The structure suggests that each sodium ion is close to one bromine only and also in contact with two water molecules and three hydroxyls. Six-fold coordination around sodium indicated almost regular octahedral symmetry. Six-fold coordination was also shown by the bromine ion but with a much less regular arrangement. Only two intermolecular bonds were indicated between the OH groups themselves; the remainder are linked via the bromine and sodium ions and the two water molecules.

From an industrial and technical standpoint, the most important compounds of sucrose are the complexes formed by the combination of sucrose with various metallic bases (Table II). A large number of compounds of sucrose with other metals have also been prepared, such as saccharates of iron[67], aluminium[68], molybdenum[69], chromium[70], manganese[71], nickel[72], copper[73], lead[74] and mercury[72]. Some of these, such as iron, are used medicinally.

Table II. Sucrose complexes with alkaline-earth hydroxides[1]

Hydroxide	Molar ratio, (Ligand:Cation)	Solvent Medium	References
Ba	1:1	H_2O-EtOH	65
	1:1	H_2O	14
	3:1	H_2O	14
Ca	1:1	H_2O	65
	1:1	H_2O-EtOH	65
	1:2	H_2O-EtOH	65, 66
	1:3	H_2O	65
Sr	1:1	H_2O	14, 65
	1:2	H_2O	14, 65

Summary

A review is presented of the literature on complexes formed between sucrose and the hydroxides and salts of alkali and alkaline earth elements.

L'interaction d'ions de métaux avec le saccharose—une revue

On passe en revue la littérature concernant les complexes formés entre le saccharose et les hydroxydes et les sels des éléments alcalins et alcalino-terreux.

Wechselwirkung von Metallionen und Sukrose—eine Uebersicht

Es wird eine Literaturübersicht über die von Sukrose mit Alkali-Salzen und Hydroxiden und Erdalkali-Elementen gebildeten Komplexe gegeben.

Interacción de iones de metales con sacarosa—un examen

Se presenta una revista de la literatura sobre compuestos complejos formado entre sacarosa y los hydróxidos y sales de los elementos alcalinos y de tierras alcalinas. □

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Growing sugar cane on calcareous soils

By H. EVANS, O.B.E., D.Sc.*

Introduction

DURING the course of advisory work on the cultivation of sugar cane under difficult soil conditions, the writer has frequently found it necessary, in the absence of relevant information in the literature, to carry out *ad hoc* investigations with the object of solving the most important factors involved. The present paper describes studies made with the object of improving the growth of sugar cane on calcareous soils.

Very little information on this subject was available for sugar cane, although several papers have been published on "lime-induced chlorosis" in cane grown on calcareous soils and on "ratoon chlorosis", both of which are due to poor mobility of iron in the tissues.

Methods and procedures

The problems involved were studied using diverse approaches, particularly the following:

1. the practical method of comparing the growth of different varieties to identify those which performed best under calcareous conditions;
2. to determine the main nutritional abnormalities of sugar cane growing on highly calcareous soils;
3. to attempt to determine the mechanism of the processes leading to poor mobility of iron in the tissues;
4. to devise methods of combating the main limiting factors to growth and thus obtain satisfactory economical yields of cane and sugar.

A summary of the results obtained from these studies is presented under the above headings.

1. *Testing the relative adaptability of different varieties to acutely calcareous conditions*

Several tonnes of Barbados limestone (coarse ground coral limestone) were placed in "plots" (contained by wooden boards 15 inches wide) on the concrete floor of the dismantled Ogle sugar factory in Guyana. The calcareous beds were thus 15 inches deep and the plots were planted with the best planting material available from 102 sugar cane varieties in the form of single-eye setts replicated twenty times. Germination overall was 86% and assessments of adaptability were based on the growth made over a period of 2-3 months after planting. They were given a N-P-K mixture at rates normally used commercially in Guyana at the time (4 cwt sulphate of ammonia; 1 cwt triple superphosphate; 1·5 cwt muriate of potash). Differences in the growth of different varieties were not spectacular but B 49119, D 141/46, D 158/41, UCW 54/65 and HJ 5741 were selected for their somewhat better performance. Most of the 102 varieties used were Barbados or Demerara seedlings, but some Hawaiian, Coimbatore, Brazilian, Australian (CSR varieties), Louisiana and Florida (Canal Point) varieties were also included in the tests.

2. *The main nutritional abnormalities of sugar cane on a pure calcareous medium*

In spite of the normal fertilizer application made, tillering was very poor and the leaves were pale at 3 months. A foliar analysis of the leaves showed very low nitrogen and critically low phosphorus levels, a slight potassium deficiency, with adequate or more than adequate levels of calcium and magnesium. The level of iron (as Fe) in the leaf tissue varied from 50 to 100 ppm, but manganese, copper and zinc were low at 5-9 ppm, 2-3 ppm and 6-8 ppm, respectively.

Although there was no intervein chlorosis, positive responses were obtained to leaf painting with iron and to a lesser extent with manganese; there were no responses to painting the leaf with copper or zinc, in the coral limestone cultures.

Subsequent pot cultures also in coral limestone indicated that normal single applications of nitrogen and of phosphate were inadequate to promote growth and, in particular, the cane plants apparently had great difficulty in absorbing phosphorus from highly calcareous soil.

Moreover, the application of massive dosages of soluble phosphate fertilizer to sugar cane growing in pure coral limestone resulted in a marked increase in the intervein chlorosis known as lime-induced chlorosis.

3. *Attempts to determine the mechanism of lime-induced chlorosis*

It was considered that two approaches to this subject would be investigated:

(*a*) the redox potential of the root surface, and

(*b*) the introduction of mineral elements into the sugar cane stalk tissues while by-passing the root system.

In certain crops, of which some cultivars are very susceptible to lime-induced chlorosis whilst other are resistant, e.g. soybean, it has been established that in the susceptible cultivars the reduction potential at the root surface is very weak and the roots are therefore unable to reduce the oxidized (insoluble) ferric iron present in the calcareous soils to soluble ferrous iron, and therefore no, or very little, uptake occurs. In the resistant cultivars the roots have a very high reduction potential so that ferric iron in contact with the root surface is readily reduced and the ferrous iron then taken up by the plant.

Trials with sugar cane root systems developed in pure ground coral limestone showed that all had ample redox potential (as shown by the reduction of potassium ferricyanide) and that penetration of ferrous iron into the plant was not a limiting factor. Sectioning of the stalk and microchemical examination of the vessels and tracheids in the stalk, and particularly in the nodal tissues, showed that iron was being precipitated in the conducting tissues, mostly as ferric phosphate. In serious cases of lime-induced chlorosis, insoluble iron was present in the conducting tissues of the stalk to within a few centimetres of the apical meristem and in the veinous system of the leaf sheath and leaf lamina. The problem was thus one of immobility within the plant and failure to deliver adequate amounts of iron for the synthesis of chlorophyll in the chloroplasts.

It was decided that the uptake of mineral elements would need to be made by introducing such elements by means other than through the rooting medium.

To achieve this use was made of the technique for the preservation of arrows in the sugar cane breeding programme, first discovered in Hawaii some half-a-century ago.

In the intact sugar cane stalk oxidizing enzymes and their substrates are kept apart from each other, either in different cells or in different locations of the same cells.

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When the stalk is cut, the enzymes and their substrates become mixed and the sap is drawn up into the conducting system under tension, and the oxidation of the substrate(s) by the enzymes results in blockage of the conducting elements with yellowish-brown to dark brown plugs which effectively prevent water uptake. As a result, a sugar cane quickly loses turgidity when cut and placed in water, but the plugging reaction is prevented by reducing agents, of which sulphur dioxide in solution (i.e. sulphurous acid) was found by the Hawaiians to be effective. Later the H_2SO_3 solution was stabilized by the addition of about 100 ppm of the antioxidant, phosphoric acid (H_3PO_4).

This technique was used by the writer to introduce any desired chemical into the sugar cane stalk.

The element under trial, e.g. iron as 0·25% $FeSO_4$, or 0·25% iron citrate or tartrate; manganese, zinc and copper as sulphates at a concentration of 0·05%, 0·01% and 0·005% respectively; urea at 1%; and increasing rates of phosphoric acid up to 1%, was added to a 0·02% SO_2 solution containing 100 ppm of phosphoric acid.

Stalks of some 6-7 months bearing healthy green leaves were supported in stands with the cut end in the solution to be tested and left for the whole day. Uptake per stalk varied from some 300 to 400 cm³ according to the suitability of the climatic conditions for rapid water uptake (i.e. evaporative capacity of the air). The treated stalks were then split and the location of the introduced chemicals followed by microchemical methods.

Iron introduced in this manner reached the apical growing point very quickly, as evidenced by its combination with catechol tannins to give dark-coloured, almost black growing tips. However, it was not translocated into leaves subsequently produced, which still showed intervein chlorosis, which could be corrected by leaf painting if carried out early enough. Manganese was similarly relatively immobile, but zinc was much more mobile.

Fig. 1. Shoots from single-eye cuttings made from stalks which had been fed with 300–400 cm³ of 0·1% phosphoric acid. Note absence of tillers

In the main the method was used, however, for increasing the reserves of phosphate in particular but also of nitrogen in the stalk and to use such enriched stalks for cuttings to be planted in pure coral limestone. Originally 0·1% phosphoric acid was used but it was found possible to introduce as much as 300 cm³ of a 1% phosphoric acid solution into a single leafy sugar cane shoot and a few days later to divide this into single-eye cuttings which were planted in pure limestone. These cuttings germinated well and the growth made on the reserve of phosphorus within the cutting was well correlated with the amount of available phosphorus introduced (see Figs. 1-4). However, there was no tillering when 0·1% H_3PO_4 was used, but some single-eye cuttings of L 6025 developed to flower normally when treated in this manner. The use of 1% H_3PO_4 allowed good tillering to occur (Fig. 2).

Fig. 2. Shoots from cuttings as in Fig. 1, but fed with 1% phosphoric acid

Fig. 3. Shoots from cuttings as in Fig. 2, but also fed N and K

Some cuttings injected with phosphoric acid were given N and K applied to the calcareous medium and the leaves sprayed later with 1% phosphoric acid—such plants tillered well. Various supplementary treatments, such as the incorporation of green legumes with the limestone, did not result in improved growth (Fig. 4).

By placing clear polyethylene bags over the cane plants grown in coral limestone it was shown that applying nitrogen fertilizers to the soil at a depth of 6 inches resulted in a severe loss of nitrogen as ammonia. In fact, the air in the clear polyethylene bag was so high in ammonia gas escaping from the applied fertilizer that it was asphyxiating to breathe.

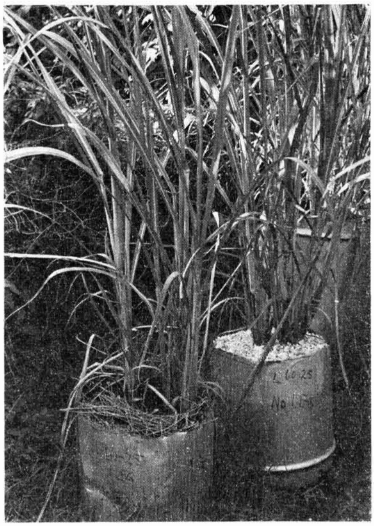


Fig. 4. Comparison of growth with and without legumes. Foreground—with legumes on left, without legumes on right. No beneficial effect of legume addition was observed

These and other trials carried out using Barbados coral limestone as a medium showed that the main problems involved in growing sugar cane on calcareous soils are the following:

(*a*) The difficulty of uptake of phosphorus from these soils and the danger of bringing about severe lime-induced chlorosis if phosphate and iron uptake are occurring through the roots at the same time. The presence of bicarbonate ions (which results in a higher pH of the vascular sap) and the combination of iron and phosphorus in the conducting elements in the tissues result in iron precipitation within the vessels. The balance of phosphorus to iron is significant—soils very poor in phosphorus, although highly calcareous, may not show any lime-induced chlorosis although they may have a generally diffuse pale colour which may be corrected with iron sprays. If, however, phosphorus has already been introduced into the planting material, or if subsequent enrichment with phosphate is made by leaf sprays, no lime-induced chlorosis occurs.

(*b*) The severe losses of nitrogen which occur when nitrogenous fertilizers are applied to calcareous soils. Even when the applications are made below the surface and covered, the losses remain very high by volatilization as ammonia.

4. *Methods of combating the factors inimical to the growth of sugar cane on calcareous soils*

It will be readily apparent that the experimental techniques used in the elucidation of the problems associated with calcareous soils are not directly applicable to large-scale sugar cane culture. Of the alternative methods available for the introduction of substantial reserves of phosphorus and nitrogen into the planting material, by far the best method is by spraying the growing seed cane as it stands in the field with a liquid spray containing 1% to 2% phosphoric acid (H_3PO_4) and 5% urea, preferably applied by aircraft. It is immaterial that some scorching of the leaves may result from this treatment—the objective is to get these nutrient elements into the plant. A few days later the cane may be cut at the soil surface and placed in a cane planting furrow without removal of the leaves, chopped into suitable length cuttings *in situ* (i.e. 4–5 bud cuttings), and covered.

Germination is generally enhanced by this treatment and the phosphate and nitrogen which have remained in the leaves provide a good source of subsequent supplies of these nutrients which are to some degree protected from interaction with the soil, which, if calcareous, results in phosphate fixation and nitrogen volatilization.

It is not possible to introduce enough nutrients to produce large crops of sugar cane by this means alone and subsequent applications must be made either by soil applications or by foliage sprays. Sugar cane can be sprayed with urea at concentrations of from 5% to 10%, although 10% solutions may cause a temporary (reversible) damage. It is also possible to introduce any micronutrient into the urea spray. It is convenient to apply the nutrients by directed spray applications (using, for example, a 4- to 6-row weed control sprayer); for cane which has covered over, it would be more convenient to apply solid fertilizer by aircraft, e.g. urea, ammonium phosphate or muriate of potash in the pelletized form, or granulated triple superphosphate.

It is to be noted that the preliminary investigations reported here used coarsely-ground Barbados coral limestone as the substrate. Later, the writer had occasion to use these techniques on cane grown on oolitic limestone. Oolitic limestone differs from coral limestone in that it consists of limestone dissolved by sea water and reprecipitated when, because of temperature changes, the sea water becomes super-saturated. This process is much like the purification of chemicals by recrystallization.

Fig. 5. Cuttings from cane, aerially sprayed with 1–2% phosphoric acid, growing on oolitic limestone and showing severe zinc deficiency symptoms. These symptoms do not occur when 0·1% zinc sulphate has been added to the phosphoric acid used in aerial spraying

Seed cane sprayed with phosphoric acid (at 1-2% concentration), with or without urea, germinated extremely well on oolitic limestone soils, but within two months the cane was showing severe symptoms of zinc deficiency (Fig. 5). Zinc deficiency symptoms in cane grown from cuttings differ from the rapid acute symptoms developed in sugar cane seedlings (as pictured by Martin & Evans[1]) and are quite similar to zinc deficiency in maize—i.e. a broad white or pale chlorotic area at the base of the leaf becoming triangular in shape as the leaf margin develops a green colour (Fig. 6).

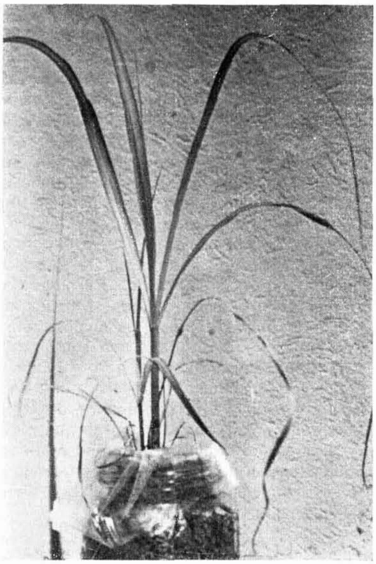


Fig. 6. Symptoms of zinc deficiency produced by the author in nutrient culture

Without corrective treatment the zinc deficiency symptoms would severely stunt the growth of the stool, but the condition, when present, can be completely corrected by spraying with 0·1% zinc sulphate.

Because of the much greater mobility of zinc in the tissues, however, the condition can be prevented by adding 0·1% zinc sulphate to the phosphoric acid spray applied to the seed cane, and this is the method that is recommended for oolitic limestone soils since prevention is much better (and cheaper) than cure. The zinc sulphate (and also manganese or copper sulphate if required) remains completely soluble in the 1% or 2% phosphoric acid.

Using the methods described above, good crops of sugar cane (up to 100 tonnes per hectare) have been produced on soils containing 60–70% of calcium carbonate. Calcareous soils stimulate the production of massive fibrous rootlets and once the cane has covered over, the surface soil is well exploited by ramifying fibrous rootlets, greatly facilitating uptake of aerial applications of fertilizer.

Summary

The main factors inhibiting the growth of sugar cane on calcareous soils are described and the results of some practical investigations to improve growth on such soils are summarized. Coral limestone differs from oolitic limestone in that the latter is extremely low in zinc, whereas coral limestone, being derived from the remains of living organisms, has adequate amounts. The main recommendations are that the seed cane, whilst still standing in the field, is sprayed with phosphoric acid at a concentration of 1-2% in order to introduce the maximum amount of phosphate reserves into it. For cane to be planted in oolitic limestone soils 0·1% zinc sulphate is added to the phosphoric acid. The levels of potassium and nitrogen in the stalk tissues may also be increased by partly replacing phosphoric acid with potassium hydrogen phosphate and the addition of urea to give a concentration of 5-10%. When the treated cane is planted the leaves are not removed but are left in the planting furrow after chopping the whole cane into the optimum sized cuttings (4 to 5 buds). Early growth is rapid but additional dressings of fertilizer are essential to maintain growth. Some fairly serious losses of nitrogen occur when soil applications are made, and under very calcareous conditions directed spray applications using herbicide type applicators may be used, or, after the canopy is complete, aerial applications of pelletized fertilizer are very efficient, since a large proportion is intercepted by the leaves, whilst such fertilizer as reaches the soil surface comes into contact with the mat of fibrous rootlets in the superficial soil layers, which is a characteristic of root development on calcareous soils.

La culture de la canne à sucre sur terrains calcaires

Les principaux facteurs qui freinent la croissance de la canne à sucre sur sols calcaires sont décrits et les résultats de certaines recherches pratiques pour améliorer la croissance sur de tels sols sont résumées. Le calcaire corallien diffère du calcaire oolithique en ce que ce dernier renferme extrêmement peu de zinc, tandis que le calcaire corallien, qui provient des restes d'organismes vivants, en contient de quantités appréciables. La recommandation principale est d'asperger les boutures sur champ avec de l'acide phosphorique à une concentration de 1-2% afin d'y introduire le maximum de réserves en phosphate. Pour la canne à planter sur sols calcaires oolithiques on ajoute 0,1% de sulfate de zinc à l'acide phosphorique. Les taux de potasse et d'azote dans les tissus des tiges peuvent également être augmentés en remplaçant partiellement l'acide phosphorique par du phosphate acide de potassium et par addition d'urée pour obtenir une concentration de 5-10%. Lors de la plantation de la canne les feuilles ne sont pas enlevées, mais elles sont laissées dans le sillon de plantation après avoir découpé la canne entière en sections de longueur optimale (4 à 5 noeuds). La croissance au départ est rapide mais des doses supplémentaires d'engrais sont nécessaires pour maintenir la croissance. Si les applications se font sur le sol, il peut se produire des pertes relativement importantes en azote; si le sol est très calcaire on peut appliquer la fumure par pulvérisation en jet dirigé en utilisant des machines à pulvériser du type employé pour les herbicides ou bien, une fois la couverture foliaire développée, des applications aériennes d'engrais pelletisé; celles-ci sont très efficaces, une grande partie étant interceptée par les feuilles alors que, si l'engrais touche le sol, il entre en contact avec le tapis de radicelles fibreuses des couches superficielles du sol, ce qui est caractéristique pour le développement radiculaire sur sols calcaires.

[1] "Sugar cane diseases of the world", Vol. II. Ed. Hughes, Abbott and Wismer (Elsevier, Amsterdam). 1964, p. 229.

Anbau von Zuckerrohr auf kalkhaltigen Böden

Beschrieben werden die wichtigsten Faktoren, die das Wachstum von Zuckerrohr auf kalkhaltigen Böden behindern. Die Ergebnisse von praktischen Versuchen das Wachstum auf solchen Böden zu verbessern, werden zusammengefasst. Korallenkalkstein unterscheidet sich von oolithischem Kalkstein durch den extrem niedrigen Zinkgehalt des letzteren, während Korallenkalkstein, entstanden aus den Überresten lebender Organismen, einen ausreichenden Gehalt hat. Die wichtigste Anforderung ist, dass das Pflanz-Rohr, wenn es noch im Feld steht, mit 1-2%iger Phosphorsäure besprüht wird, um die Phosphatreserven zu maximieren. Bei Rohr, das in oolithischen Kalkstein gepflanzt werden soll, wird der Phosphorsäure 0,1% Zinksulfat hinzugefügt. Der Gehalt an Kalium und Stickstoff in den Stengelblättern kann auch durch teilweises Ersetzen der Phosphorsäure durch Kaliumhydrogenphosphat und Zugabe von Harnstoff in einer Konzentration von 5-10% erhöht werden. Beim Pflanzen des behandelten Rohrs werden die Blätter nicht entfernt, sondern in der Pflanzfurche gelassen, nachdem das ganze Rohr in optimal grosse Stücke geschnitten worden ist (4 bis 5 Knoten). Das erste Wachstum ist sehr schnell, aber zur Unterstützung des Wachstums ist weitere Düngung wichtig. Ziemlich starke Stickstoffverluste treten bei Bodendüngung auf, und bei sehr kalkreichen Böden sollte die Düngung durch gezieltes Sprühen erfolgen, wobei man Herbizid-Geräte einsetzt, oder, bei völligem Kronenschluss, aus der Luft mit pelletisiertem Dünger, was sehr wirkungsvoll ist, da ein grosser Teil des Düngers an den Blättern hängen bleibt, während der Teil, der den Boden erreicht, in der obersten Bodenschicht mit dem Faserwurzelnetz in Kontakt kommt, das eine charakteristische Wurzelentwicklung auf Kalkböden ist.

Cultivación de caña de azúcar en suelos calcáreos

Los factores principales que impiden el desarrollo de caña de azúcar en suelos calcáreos se describen y las resultas de algunas investigaciones prácticas para mejorar desarrollo en tal suelo se resumen. Caliza coralina es diferente de caliza oolítica que tiene un contenido muy bajo de cinc, mientras que caliza coralina, derivado de los restos de organismos viviendos, tiene cantidades adecuadas. Las recomendaciones principales son que la caña semillera, antes de la corta, es tratado con un aspersión de ácido fosfórico en una concentración de 1-2% para introducir la cantidad máxima de reserva fosfática en sus tejidos. Para caña que se planteará en caliza oolítica, se añade 0,1% de sulfato de cinc al ácido fosfórico. Los niveles de potasio y de nitrógeno en los tejidos del tallo pueden crecerse por sustitución parcial del ácido fosfórico por fosfáto potásico hidrogénico y adición de urea para obtener una concentración de 5-10%. Cuando la caña tratada es planteado las hojas no se separan pero se dejan en el surco después de cortar la caña entera en trozos de tamaño óptimo (4 o 5 brotes). Desarrollo inicial es rápido pero se necesitan abonos adicionales de fertilizantes para mantener crecimiento. Pérdidas bastante serias de nitrógeno ocurren cuando se aplica al suelo y, en condiciones muy calcáreas, es posible usar aplicaciones de aspersiones dirigidas con equipos del tipo usado para herbicidas o, despues de cumplimiento del dosel, aplicaciones por avión de fertilizante en forma de bolitas son muy eficaz por que una mayor proporción son interceptado por la hojas, mientras que el fertilizante que llega al sobreficie del suelo se pone en contacto con la estera de raicitas fibrosas en capas superficiales del suelo que es una caracteristica del desarrollo de raices en suelos calcáreos. □

Newark replacement and expansion project

By F. ROBSON and M. FLACK

Paper presented to the British Sugar Corporation Ltd. 24th Technical Conference, 1978

PART I

Introduction

NEWARK sugar factory—"Kelham" to its founders—first commenced operations in 1921. Those of the original operators able to return a few years ago would have found little overall change in the factory. Indeed, in some areas, items of original plant were still operating. Capacity was some 1500-1800 tonnes of beet per day and one of the few diffusion batteries still in existence was used for extraction of sugar from the beet. It was, therefore, necessary to replace the bulk of the existing plant. At the same time it was decided to expand the production capacity, whilst bringing the factory up to modern standards.

Several concepts influenced the design of the new factory and the planning of the programme: the necessity to operate the factory each campaign; the undesirability of commissioning a completely new plant in one operation; space in which to expand was limited, since the factory is on a raised area surrounded by floodlands on which it is not permitted or is impracticable to build; for environmental and planning reasons the old factory main building or its facade at least was to be maintained; and the food or sugar end of the factory would be separated from the raw material or beet end, by housing in different buildings.

An example of the application of these concepts was that towers were used for diffusion because they could be erected outside the buildings thereby saving radical alterations to the old factory building which would house the new beet end, and also they took up much less floor space which was at a premium.

The original phasing of the programme, taking into account all the above factors, is described later in this paper. The project, in effect, involved the construction, during these phases, of a completely new factory as opposed to the extension of an existing unit. This was a much more difficult and complicated operation than construction on a green-field site. The need to operate each campaign led to many temporary works to allow each year's production to take place. At the same time all existing operations, services, and the like had to be maintained throughout the duration of the whole project.

Such a major task involved the cooperation of all departments of the Corporation. All drawing and design work, together with original plant sizing and specification, was carried out by the Central Design Office team in conjunction with other technical departments. A main contractor (John Laing Construction) was appointed for all civil and building work with nominated sub-contractors for steelwork (Boulton & Paul) and sheeting and roofing of buildings (Robertson & Briggs Amasco). The main contractor for all electrical works was Elequip.

Corporation workshops supplied plant wherever possible, particularly vacuum pans, juice heaters, beet elevators, stone and weed catchers, granulators and coolers, pulp coolers and part of the pulp dryers, sugar dissolvers, G.P. filters, various tanks and vessels, and complete control panel and instrument racks for the whole project.

Many other contractors and suppliers, too numerous to name, were also involved.

A reconstruction team was appointed at the factory to operate under the Works Manager, consisting of: the Reconstruction Manager, a Superintendent, basically responsible for the co-ordination and overseeing of all civil and building works, a Mechanical Engineer, an Electrical Engineer, an Instrumentation and Control Engineer, and an Accountant. This team was responsible for contractor liaison and supervision, checking of plant specifications, ordering, delivering and installation of all plant on site and assistance with commissioning of same. Liaison with existing factory staff, who were also heavily involved with the reconstruction as well as factory operation, was essential.

The original "Kelham" factory has been mentioned. Of this little remains except memories. Of the 1973 factory only the sugar warehouse, packeting plant and a few ancillaries are left. However, the new factory could not have been built without the efforts of all those who built and operated the old one.

An extract from "History of the Home Grown Sugar Industry", an official report published by His Majesty's Stationery Office in 1931, is of interest at this point: "The Kelham factory was not ready for operation until 1921. The total cost, owing to inflation in the prices of materials and labour, was £500,000 instead of the prospectus estimate of £300,000". The new factory experienced similar problems. History repeats itself. . . .

PROGRAMME PHASING

Preliminary works

These included a new beet intake road, weighbridges, tarehouse and beet sampling probes, sufficient plant being installed to operate until the final phase when the rest of the plant for full capacity would be installed.

1974. Phase 1: Demolition of old pulp dryers. Erection of buildings and plant for steam and power generation. Installation of electrical distribution equipment. Erection

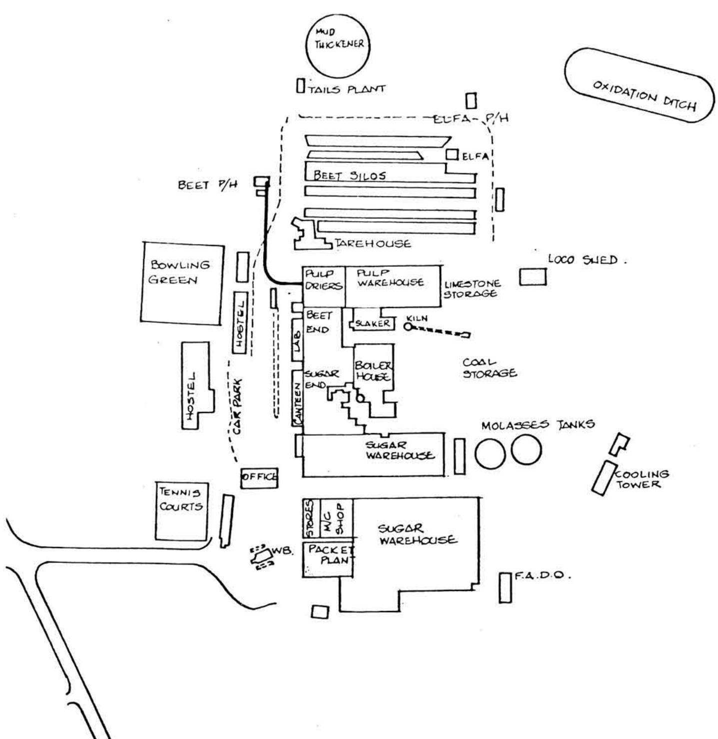


Fig. 1 Layout of old factory

of lime kiln, slaker house and ancillary plant. Erection of pulp dryer building and chimney with one pulp dryer (the second dryer to be installed during Phase 4). Installation of pulp bagging, conveying and loading equipment. Erection of pulp warehouse, subsidiary buildings for factory vehicles and locomotive, and storage and repair, joiners' shop, etc.

These buildings were erected in areas originally used for coal and limestone storage, ash ponds, and a small pumping, conveying, washing and slicing plant, 50% of beet unloading and beet silo storage, transport water mud thickener, oxidation ditch and effluent ponds, and the second pulp dryer.

1977/78. Campaign to operate with part of beet unloading and silos, one tower diffuser, to slice 3500/4000 tonnes per day up to the full diffuser capacity.

1978. Phase 5: Final completion of all plant, including thick juice storage.

1978/79. Campaign to operate at full slice.

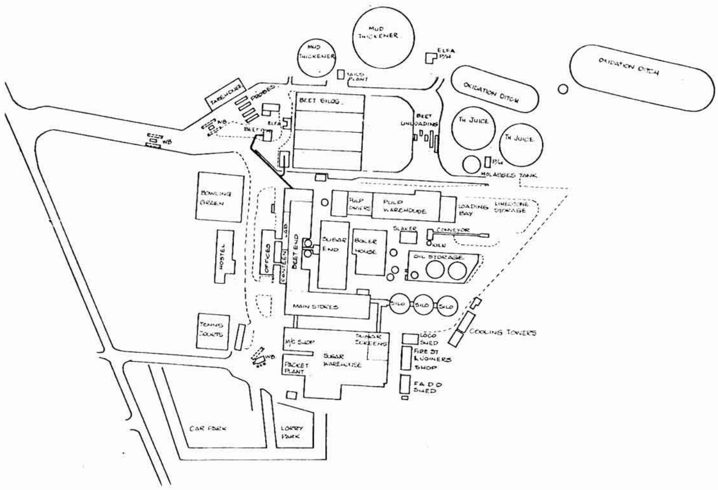


Fig. 2. Layout of new factory.

pulp warehouse which could be released for work to continue.

1974/75. The campaign to operate with the old plant, together with temporary arrangements for feeding stone and coke to the lime kiln, coal to the boilers and similar operations.

1975. Phase 2: Following the campaign, demolition of the old boiler house, power house, lime kiln. Buildings and plant for the whole of the evaporators, heaters, sugar end, sugar conveying in the areas cleared by this demolition. Demolition of molasses tanks, to allow construction of sugar silos. Erection of new molasses tank.

1975/76: Campaign to operate with new plant as in Phase 1, commissioned together with remaining old plant.

1976. Phase 3: Immediately following campaign, demolition of the sugar end, evaporator and filtration area and juice clarifier in old factory. Erection of sufficient filtration plant to operate factory with existing diffusion battery and carbonatation plant. Erection of new juice clarifier. Erection of tower diffusers.

1976/77. Campaign to operate as above together with commissioning of Phase 2 plant plus part of the beet end filtration plant and juice clarifier.

1977. Phase 4: Immediately following campaign, demolition of the rest of the old factory plant, beet flumes, beet pumping, stone and trash catching, etc. Erection of the remainder of the beet end plant, bee.

Throughout these phases the necessary work on roads, drainage, water supply, electrical and instrumentation work was to be carried out; all services would be kept in operation.

IMPLEMENTATION

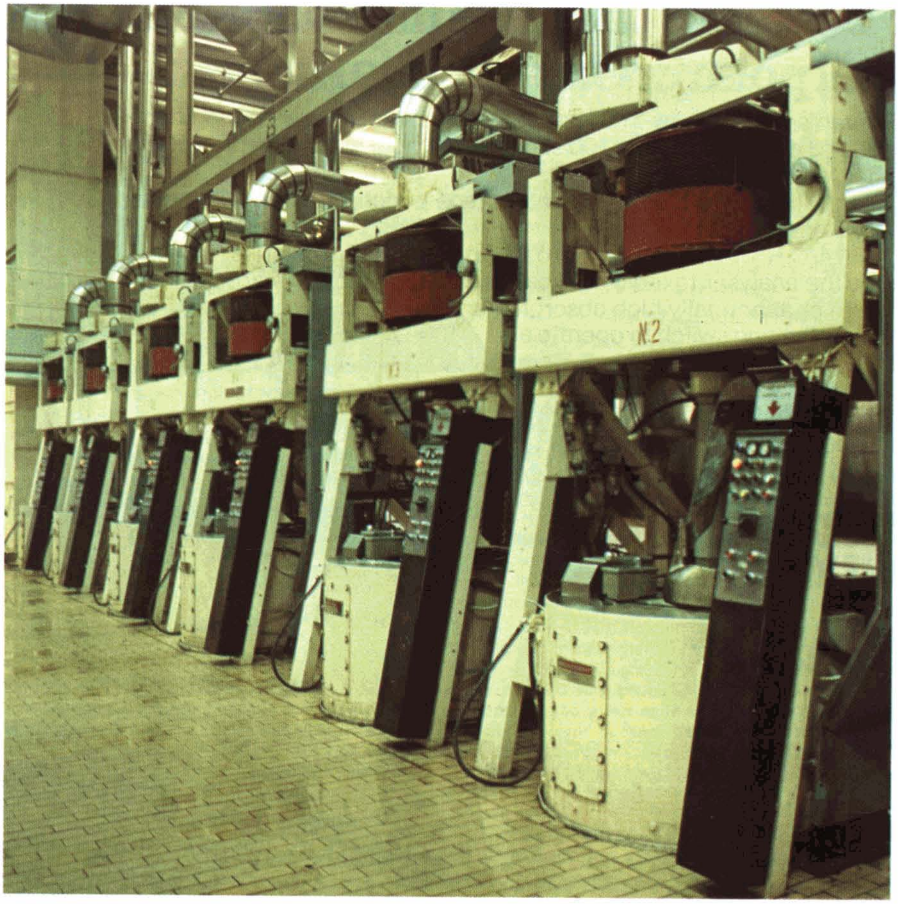
The "off-season" programme each year was to a very tight schedule with little or no slack time. There were delays, however, owing to the "three-day week", consequent shortages of steel and other materials, industrial disputes by contractors' labour, and many late deliveries of plant.

At an early stage of the project maximum capacity was increased from some 5000 tonnes per day to 7000 tonnes per day. This involved rapid recalculations and drawings of evaporator and sugar end plant to enlarge or add to them to increase sugar end capacity.

It was necessary to operate during 1974/75 without pulp drying and bagging equipment. All the pressed pulp was sent to other factories for drying.

The commissioning of Phase 1 plant in the 1975/76 campaign was carried out very successfully and was relatively trouble-free.

During 1976 it was decided that the Common Market, financial and various other considerations necessitated the compression of Phase 5 into the same year as Phase 4. Following this, when it became obvious that the beet crop of 1976 would be disappointingly poor, the decision was taken to cancel operations for the 1976/77 campaign



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so that the Phase 4 demolition could take place earlier and the combined Phase 4 and 5 work be accelerated.

Rapid re-scheduling of works took place and with valiant effort and co-operation between all factory staff and contractors the bulk of the programme was completed. However, owing to some late deliveries and to industrial relations problems with the labour force of the site contractors and suppliers, some items had to be deferred for completion in 1978. Priority was given to implementation of slicing, which commenced in late October 1977.

Since it was necessary to commission much more plant in one year than originally anticipated, a commissioning controller was appointed to check the final completion of plant installation and supervise the preliminary dry and wet pre-testing of all plant prior to steam trials. This proved a very successful exercise without which commissioning would have been almost impossible. All areas were checked as they became available with the exception of those where late plant deliveries or electrical supplies made this impossible.

In addition, to assist with this and with campaign commissioning, the bulk of the graduate trainees in the Corporation were concentrated at Newark. These were split into groups covering various areas of the factory and proved invaluable in starting-up of plant and operator training.

Pre-commissioning and testing of sugar-end plant and evaporators was carried out very successfully. The plant was ready and reasonable time was available.

The beet end and yard proved more difficult.

The re-scheduled programme for the final years allowed no slack time at all. Inclement weather during the winter of 1976/77 severely delayed the civil works. Rains were such that at one period the whole factory was surrounded by water.

This hold-up in civil works was complicated by the reaction of contractors' employees to the Government Pay Policy, which led to what may be described as "unenthusiastic working to rule". The access of plant and other contractors and ourselves was delayed. Deliveries of electrical and control plant were protracted. The electrical work is of necessity compressed into the final programme stages. When the plant and buildings were available and the electrical items delivered, there were difficulties with the electrical contractors' employees over pay.

Despite all this, basic water tests and some pre-commissioning were carried out on diffusion plant, carbonatation and parts of the beet end filtration areas. The campaign commenced with work still going on in beet unloading and fluming areas, completion of the beet end filtration plant, the beet end building walls and floors and in parts of the pulp bagging and bag conveying plant which had been extended.

PLANT DESCRIPTION

Beet reception

Incoming lorries are weighed on two Mangood Limited 15 m × 3 m 50-tonne load-cell weighbridges. Documents are taken by conveyor from vehicle cab to weighman. The "out" weighbridges are exactly the same as the "in" units.

Each vehicle load is sampled by a Cocksedge automatic beet probe with shaker/splitter. Full buckets are conveyed to a three-stream tarehouse with eight sample washers and three of the latest Cocksedge beet saws. Samples passed through an automatic digestion and filtration unit to an automatic saccharimeter by Thorne Automation Limited.

All lorries are unloaded dry by using tipping bays and hydraulic lorry tipplers. The latter, designed by Gough Econ Ltd., raise a gross load of 50 tonnes to a 55° angle. Turn-round was generally under 3 minutes. The beet from the above lorries is conveyed by plate feeder and belt conveyor to two belt trippers with luffing and slewing conveyors, each automatically filling two beet silos, of 19,000 tonnes total capacity. A small wet silo is available for emergency diversion of beet after the beet pump.

Beet fluming

All beet is flumed by remote control from the beet end control room using air-operated on/off valves and fixed angle water nozzles fed from pipes running along the base of each flume. Each gun is individually operated from a push button in the beet end control room. Television cameras span the flumes, the viewing screen

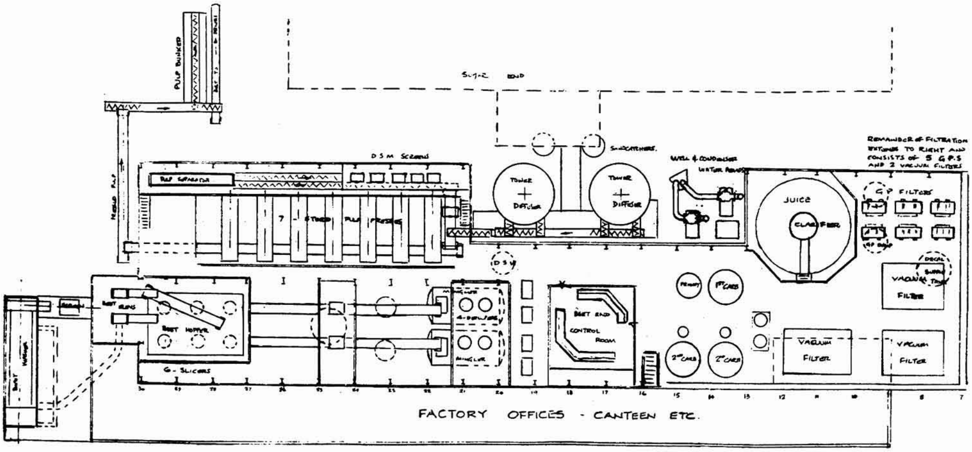

Fig. 3. Plan of beet end

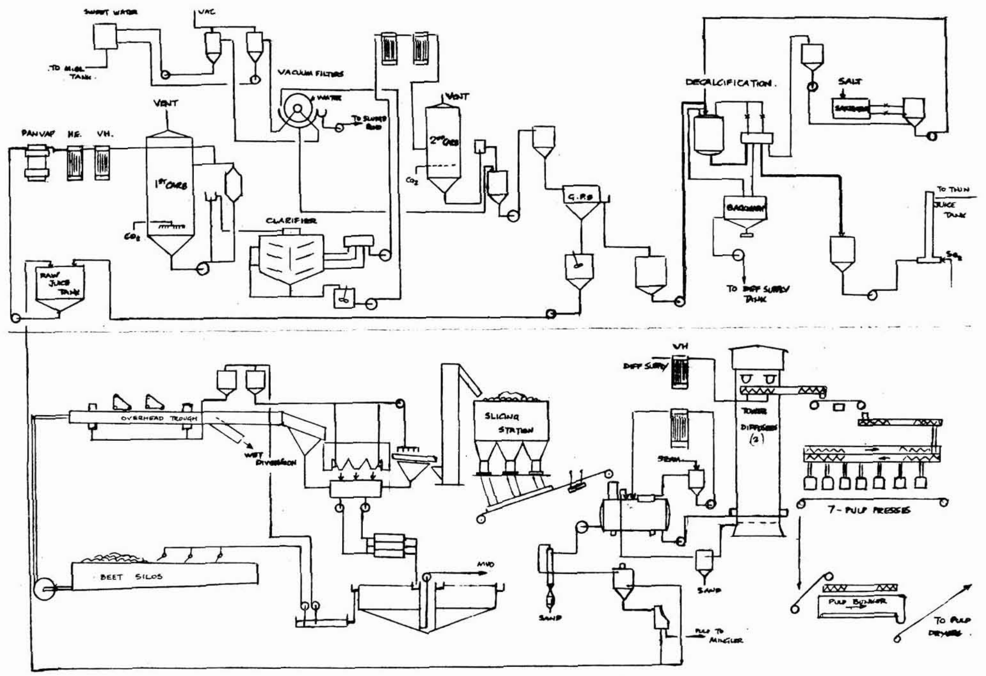

Fig. 4. Schematic flow sheet—yard and beet end

being on the flume control panel. 5000 gal.min^{-1} of water is supplied at 70 p.s.i. to all nozzles. A beet pump rated at 6500 gal.min^{-1} elevates beet and water to an overhead metal trough where stones and trash are removed. Stone traps are of the continuous discharge type. Weedcatchers are of the belt-and-rake type. A grid water separator precedes the Cocksedge beet washer which also has sand and stone pockets. Water is added via stone pockets. Clean beet and water are separated using a vibrating screen after which the beet flow is separated into two elevators before the roots are conveyed to a 250-tonne capacity hopper above the slicers. Dirty water, sand and tails are pumped via tails separator drags to two Dorr mud thickeners of 120 ft and 200 ft diameter.

Beet end

Beet are sliced by two streams of three horizontal disc-type slicers manufactured by Dreibholz & Floering Ltd. Each machine is rated at 3000 tonnes.day^{-1} and is driven by variable speed D.C. motor. Manual/automatic control is available.

Cossettes are fed to two BMA counter-current cossette minglers via belt conveyors, on which they are weighed by Inflo belt weighers type RF4A.

Scalded cossettes are pumped into the bottom of two 3500 tonnes.day^{-1} 5·8 m diameter BMA tower diffusers. Cossette pumps are of BMA manufacture.

Circulation juice overflowing from the mingler is pumped via defoaming tanks to vertical tubular vapour heaters and back to minglers to maintain the diffusion temperatures at 70°C.

Sand and pulp are removed from raw juice from each mingler before it enters the raw juice tank from where it is pumped, through heaters, to 1st carbonatation. Heating is by pan vapours, general hot water and evaporator vapours.

Table I. Heater design calculations

Heater duty	*Vapour used*	*Grade of vapour*	*Outlet temp.*	*Inlet temp.*	*H.T.C.*
Circulation Juice A	0·94	4	76·00	72·00	145·98
Circulation Juice B	0·94	4	76·00	72·00	145·98
2nd Carbonatation	1·81	4	90·00	82·00	475·61
Raw Juice B	4·03	4	85·00	65·00	649·31
Dissolver	0·81	2	95·00	90·00	192·13
Diffuser supply......	1·27	4	72·00	65·00	167·26
Thick Juice	0·20	4	90·00	83·00	10·87
Thin Juice 1	3·85	3	105·00	87·00	234·78
Thin Juice 2	2·20	2	115·00	105·00	182·18
Thin Juice 3	1·79	1	123·00	115·00	171·27

Continuous 1st carbonatation is standard as at other British Sugar Corporation factories. After a fixed lime addition juice is gassed by controlling the venting of CO_2 supplied by three Waller-Roots compressors, two of 3000 ft^3.min^{-1} and one of 5000 ft^3.min^{-1} capacity. Carbonatated juice is continuously recirculated whilst excess overflows to a 32 ft diameter Dorr Oliver A2TV juice clarifier. The decanted juice goes on to standard 2nd carbonatation followed by filtration through G.P. filters, eleven of which are available. Cleaning is automatic on a timed cycle.

Clarifier mud is run by gravity using "Magflo" meters and control valves into a receiving tank. This supplies mud to five Stockdale rotary vacuum filters, having a total of 250 m^2 filtering surface. Each filter has a rotary brush cleaning facility. Vacuum is produced by a Roots compressor.

Decalcification

Filtered 2nd carbonatation juice is passed through two of three 9 ft diameter columns containing ion exchange resins. These resins remove calcium and, when saturated, are re-generated using salt solution. The process of regeneration is automatically controlled.

Decalcified thin juice is treated with SO_2 which is provided either from a bulk liquid supply or by burning solid sulphur. The juice thus treated is passed to two evaporator streams.

Pulp drying

The spent cossettes from the tower diffuser are conveyed past an overband magnet into a battery of seven Stord Bartz type RS64S presses, the final three having variable speed D.C. motors controlled by the load in the feed system. Press water is returned to diffusion with pan condenser water used as make-up.

Pressed pulp is fed to two 3·25 m pulp dryers via a Schnitzel storage bunker which has an export facility. The dryers are oil-fired and use Hamworthy Sulzer burning equipment. Each dryer is capable of handling pulp from a daily slice of just over 3000 tonnes. Molasses is added to pressed pulp in proportion to its weight measured while it passes over a Simon belt weigher.

Evaporators

There are two parallel evaporator streams of four stages, each vessel of 1360 m² heating surface. The 200 m² concentrator is common to both streams.

Thin juice entering the first bodies is first heated in a three stage A.P.V. plate heater using 3rd, 2nd and 1st vapours. The level in each evaporator is controlled by Fischer "Leveltrol" devices. High level in any of the four evaporators opens the export valve and passes juice downstream. The rate of feed into both streams is set by an operator from the Central Control room using "Magflo" meters except when an override situation arises. Thick juice flow from concentrator is also selected by operator. Flow is automatically reduced when the filtered standard liquor tank is full. All vapours are used for heating juices. 2nd and 3rd vapours are normally used on the pan floor with emergency 1st vapour available.

Thick juice can be extracted from the concentrator and passed to a flash evaporator and conditioning system for treatment before storage. Brix, pH and temperature must be all as required before discharge will take place. Conditioned thick juice is stored in two tanks, 40 m diameter by 19 m high, each holding 27,000 tonnes of juice. This juice can be processed after the campaign

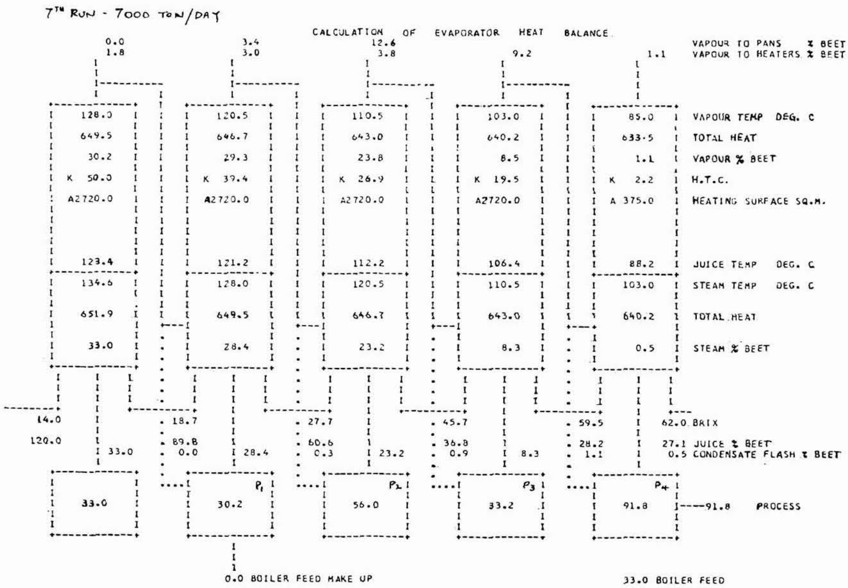

Fig. 5. Evaporator design calculations

or brought back during campaign in the event of an extended beet end stoppage, in which case the sugar end can be kept at full capacity.

Melting and filtration

Thick juice from the concentrator is used to melt 2nd product sugar. To this is also added white remelt and wash syrup. Heat is supplied by circulating melt liquor through a vapour heater. A Brix control is used to add water when density is too high.

Standard liquor is passed to a battery of five Schenk filters. Each filter is pre-coated with filter aid before use and the whole cycle of cleaning and pre-coating is automatic. A clean filter is left on standby with filtered juice returning to the unfiltered juice tank until required on stream. Dosing of unfiltered liquor with filter aid is carried out on a timed basis.

Dried molasses pulp is passed through Corporation-designed and manufactured pulp coolers before being weighed and packed on six Simon weighers and valve packets. Simon continuous checkweighers followed by a Howe Richardson reject conveyor are installed in two bag conveyor streams. Two outloading points with luffing and tracking conveyors are installed. A further one is to be installed for the 1978/79 campaign.

Lime kiln

A 230 m³ Cocksedge lime kiln was installed in 1974. This is to be extended this year to give 255 m³. "Mag/chrome" bricks are used in the burning zone. Limestone and coke are weighed by Darenth weighers and added automatically using a gamma-source level indicator to initiate and stop loading. Milk-of-lime from the slaker is produced automatically and de-sanded before being pumped to the 1st carbonatation head tank.

(*To be continued*)

SUGAR CANE AGRONOMY

Salinity effect on growth and photosynthetic productivity in sugar cane variety Co 740. G. V. Joshi and G. R. Naik. *Indian Sugar,* 1977, **27,** 329-332.—The response of Co 740 cane to salinity was studied by growing 3-bud setts in Hoagland's medium in glass bottles; after 2 months, the salt concentrations were gradually raised, and after 3 months the leaves were analysed for total chlorophyll, total photosynthetic area, proline and total protein, all of which tended to fall with increase in salt concentration. There was a difference between the effects of NaCl and Na_2SO_4 whereby at 0·05M NaCl the values of the four parameters were greater than in the control, after which they fell, while 0·05M sulphate had no such stimulating effect, indicating that sulphates are more injurious to cane than are chlorides. Salt also reduced K uptake. Cane yield fell by 50% even at as low a conductivity as 3 mmho.cm^{-1}. Because of excessive irrigation in Maharashtra, more cane areas are exhibiting salinity, so that the development of salt-tolerant varieties is important.

Scheme for development of sugar cane in Maharashtra. S. B. Chougule. *Maharashtra Sugar,* 1977, **3,** (2), 25-38.—A programme is set out for use in raising cane yield in the state. It includes soil surveys to establish cropping patterns, soil testing to determine fertilizer requirements, land preparation, irrigation, seed cane production and plant protection.

Study of mixed cropping of lady's finger and soyabean in sugar cane adsali (Maharashtra). J. D Chougule and K. U. Sanghavi. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 19-Ag. 25.—Intercropping trials were conducted in July-planted (adsali) cane. Both lady's finger (sweet potato) and soyabean affected cane growth parameters and final yield but not germination, while the net profit was greater from intercrop plus cane than from cane alone, lady's finger + cane proving the more profitable combination.

Effect of methods of planting and intercropping sequences on cane yield and juice quality in central U.P. K. S. Rathi, R. A. Singh and V. P. Singh. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 27-Ag. 34.—The effects of four methods of planting and of intercropping on autumn-planted cane yield and juice quality were determined, but the economics were not investigated. All intercrops reduced cane yield, but some systems increased juice quality. Those tested were cane + mustard and cane + potato + late-sown wheat (the wheat being planted after lifting of the potatoes). Maximum cane yield was obtained with an inter-row spacing of 60 cm, while a 30-cm spacing after a skip of 150 cm gave poorest yield. (The other planting methods were an inter-row distance of 90 cm and a 30-cm spacing after a 90-cm skip.)

Evaluation of results of investigations of cane quality in sugar factories of Uttar Pradesh during 1975-76 and 1976-77 seasons. A. P. Gupta and S. V. Singh. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 47-Ag. 60.—Processing data from eight sugar factories which are typical, as regards climatic and soil conditions of the area, of those throughout Uttar Pradesh are analysed as a means of establishing reasons for poor performances. It is concluded that efficiency can be increased by paying more attention to the problems of cane varietal distribution, ratoon crop supplies, harvesting on the basis of cane maturity, climatic factors and post-harvest deterioration of cane.

Response of sugar cane to phosphorus and potash application in laterite soils of Bidar (Karnataka). B. Sharanappa, J. T. Ramachandra and B. S. Nadagoudar. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 107-Ag. 110.—The response of IC 225, an early cane variety, to applications of P_2O_5 and K_2O was determined. (The same quantity of N was applied in all cases.) At the rate of 100 and 200 kg.ha^{-1}, both nutrients increased cane yield and improved juice quality, but P_2O_5 had a greater effect on yield than did K_2O, while the order was reversed with regard to the effect on juice quality.

Chemical ripener studies—big mill tests (BMT) at sugar factories in Tamil Nadu. K. C. Rao and S. Asokan. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 133-Ag. 151.—Cane was sprayed with "Polaris" at 2 kg.acre^{-1} or with sodium metasilicate at 1·6 kg.acre^{-1} in three factory areas 6-8 weeks before harvest. Cane sugar recovery was increased by up to 16·2% by treatment with "Polaris" compared with untreated controls, while sodium metasilicate gave up to 15·5% increase, in both cases response depending on cane variety. Sodium metasilicate costs less than "Polaris" and so gave a higher profit margin on the extra sugar.

Biochemical responses of sugar cane to some chemical ripener treatments. A. S. Chacravarti, A. K. Thakur and A. K. Sarkar. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 167-Ag. 174. Studies were made of the effects of six chemical ripeners on the invertase and diastase activities in cane and on the contents of alcohol-soluble matter, reducing sugars, sucrose, total sugars, starch, hemicellulose, cellulose, lignin, alcohol-soluble and -insoluble N and total N. The percentage increases and decreases are tabulated alongside values for the untreated control. Three ripeners, "Planofix", "Cycocel" and cycloleucine, gave significant increases in sugar recovery compared with the control, but only "Cycocel" caused increases and decreases in the above-mentioned cane components where required, although cycloleucine (which satisfied eight of the twelve criteria) gave a slightly greater increase in sugar content than did "Cycocel"; "Planofix" satisfied ten of the criteria, while "Hostacycline" and "Polaris" satisfied eight and "Regim 8" only seven criteria.

Result of oriented management of sugar cane development. G. K. Zende. *Maharashtra Sugar,* 1978, **3,** (3), 25-32.—The need for results of cane research to be readily disseminated so that they can be adopted by farmers is stressed, and some important findingswhich


Sugar cane producers around the world are harvesting greater profits with ETHREL® Plant Growth Regulator. That's because ETHREL Plant Growth Regulator increases the sugar content of the cane by up to 15%.
But ETHREL Plant Growth Regulator does a lot more.
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have a considerable economic potential but which have yet to be accepted on a large scale in India are examined as well as major problems which require investigation.

Proper placement of fertilizer. R. P. Humbert. *World Farming*, 1977, **19**, (12), 10, 18, 48.—Studies with radioactive phosphate fertilizers in the 1950's showed that the most effective use was made of the fertilizers when they were placed with the seed cane at planting, so that all roots passed through the fertilizer as the system extended into larger volumes of soil; with this method, all of the shoots became radioactive from the ^{32}P as opposed to only one-third with subsurface placement near the cane stool. Shoots exhibited no radioactivity for several weeks (or until the roots had grown sufficiently to reach the fertilizer) when the phosphate was placed in the centre of the inter-row. The results of omitting P from the fertilizer programme where a highly-leached and highly-weathered soil in Malaysia contained little available phosphorus are shown in a photograph; the poor germination and early stooling with 160 kg N and 200 kg K per ha are in marked contrast to the results obtained by applying only 80 kg P per ha. While N and K can be placed with the seed cane at planting in most soils, in relatively dry soils there may be slight "salt" toxicity from the fertilizer as the new roots grow into the band of concentrated fertilizer, although in normal moisture regimes this effect is short-lived and root extension becomes normal once the root has passed through the fertilizer band. Split applications of N and K are recommended in sandy soils and where high rainfall causes leaching losses. Plastic-coated, slow-release "Osmocote" fertilizers are showing excellent promise as starter fertilizers. The quantities of N, P and K to apply in plant cane crops are briefly discussed. K deficiency is marked by a restriction in the amount or green leaf area, which reduces photosynthesis and hence cane and sugar production. A colour photograph depicts severe K deficiency symptoms on young cane in Indonesia. In ratoon crops, considerable yield differences result from variation in fertilizer placement, which should be 10-15 cm below the surface on both sides of the cane stool, and as near to the stool as possible; fertilizer placed on the surface is vulnerable to soil erosion and losses by volatilization. Phosphorus is fixed in most soils and so is not available to the ratoon until it is ploughed into the root zone. K fertilizers move slowly, so that surface placement results in delayed usage. N from various sources is usually converted to nitrate N which moves with the soil moisture; hence, if the soil is dry at the time of application, as much as 20% of the applied N may be lost by volatilization, and up to 50% in alkaline soils. Normally the tillage and fertilizer application are carried out 1-2 weeks after harvest when the ratoon is small. Photographs show clearly the results of surface and subsurface placement of N-P-K, *viz.* yields of 75 and 100 tonnes.ha^{-1}, respectively.

Sprinkler irrigation in Africa. R. P. Humbert. *World. Farming*, 1977, **19**, (12), 34-35, 47.—Information, accompanied by colour photographs, is given on the sprinkler irrigation systems used by Big Bend and Tambankulu estates in Swaziland. The benefits of the systems include increased cane and sugar yields and reduced production costs and labour requirements. Cane yields of 150-180 tonnes.ha^{-1} are common with early-harvested cane, while at Tambankulu as much as 235 tonnes of cane per ha has been produced at an age of 13 months.

Weed control in Mauritius. Anon. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1976, 51-56.—In tests to evaluate new herbicides, "Avirosan", "Buban 37" and "Enide 50" did not give satisfactory weed control but did not affect cane growth or germination. "Dosanex", "Malerbane C" and "Frenock" were even less effective than the first three herbicides, while "Malerbane C" at rates higher than 3 kg a.i. per ha severely affected cane growth and germination, as did "Oryzalin" which, however, did give satisfactory weed control. "San 9789 H" and "Spike" were also satisfactory but not as effective as "Oryzalin" which had about the same effectiveness as DCMU. In small plot trials of 13 pre-emergence herbicides, two of the most effective were "Spike" at 3·23 and 4·30 kg.ha^{-1} and "Erbotan" at 2·15 and 3·23 kg.ha^{-1}, but both severely checked cane growth, except the latter herbicide at its lower dosage rate. The other herbicides still gave very good results. Good control of *Cynodon dactylon* (Bermuda grass) was obtained with two applications of "Roundup" (on January 20 and June 1) at 2 kg.ha^{-1}, giving a total kill of 95%; doubling the dosage rate gave a total kill of 99%. Addition of 1 kg.ha^{-1} ammonium sulphate to 2 kg.ha^{-1} "Roundup" did not enhance the action of the herbicide, whereas 4 kg.ha^{-1} added to "Roundup" in a single application on June 1 gave 95% weed control. "Roundup" + DCMU gave a quick burn of the foliage of the grass, but almost complete regrowth occurred 5 weeks after spraying. Two applications of TCA + "Dalapon" at 25 + 10 kg.ha^{-1} gave only 73% complete kill. Two trials were carried out on control of *Digitaria horizontalis* with pre- and post-emergence herbicides. All the pre-emergence treatments ("Sencor", "Velpar" and DCMU) gave satisfactory control for 4 months. "Sencor" and DCMU used singly or together were equally good in plant cane, while "Velpar" was suitable in ratoon cane, with or without DCMU. Some of the post-emergence herbicides caused scorching of cane leaves. By far the best results was given by "Asulox" (88% kill 3 months after spraying) at 3 kg.ha^{-1}; the next best control (52% kill) was given by "Ansar 529" at 3 kg.ha^{-1} which also, however, caused fairly severe scorching of cane leaves. The phytotoxic action of "Asulox" is slow and is not apparent until 4-5 weeks after application. Experiments to determine the effect of "Velpar", alone or mixed with a surfactant or DCMU, on cane yield showed that it significantly reduced yield in one trial when used at 2 kg.ha^{-1}, causing severe chlorosis within a few weeks of spraying. In the other trials, it caused slight chlorosis and leaf tip scorching when applied at rates greater than 0·5 kg.ha^{-1}, whether alone or in mixtures. Good weed control without any adverse effect on cane yield was obtained with "Velpar" + DCMU at 0·5 + 2·0 kg.ha^{-1}; addition of surfactant did not enhance the action of "Velpar". The advantages of minimum tillage practice (MTP), whereby cane stools are destroyed by spraying with herbicide instead of being uprooted, are listed. In trials on slopes where uprooting of stools necessitates use of manual labour, spraying with "Roundup" at 9·5 litres.ha^{-1} favoured growth of shoots on new stools at one location but showed no marked difference in this respect by comparison with conventional uprooting.

CANE PESTS AND DISEASES

Losses from infestation of the scale insect *Melanaspis glomerata* Green on Co 62175. A. V. Rao and M. S. Murty. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 93-Ag. 95.—Investigations showed that *M. glomerata* reduced cane weight, sucrose content and juice purity perceptibly when the cane carried more than 1 g of incrustation, whereas at less than 1 g the reductions were insignificant.

Studies on the comparative virulence of samples of red rot fungus (light race) collected from Co 419 and Co 997. M. N. Sarma and M. A. Rao. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 97-Ag. 101. In recent years crops of Co 997 and Co 419 cane have been found to be severely infected with red rot in certain areas of Andhra Pradesh. The existence of biotypes has been shown by the fact that in some cases diseased cane of one of the varieties mentioned has surrounded disease-free cane of another variety; however, isolates taken from the two varieties in different locations did not differ appreciably in certain morphological characteristics. Pathogenicity tests with 14 isolates taken from Co 419 and Co 997 showed that reactions of particular cane varieties differed according to isolate, indicating a specificity between variety and isolate. Under these circumstances, it is regarded as desirable to use a mixture of light race isolates of the fungus in varietal screening.

How cooperative sugar factories fight pests and diseases of sugar cane. V. V. Tembheker and D. K. Patel. *Sugar News* (India), 1977, **9**, (6/7), 16-23.—The activities of cooperative sugar factories in cane pest and disease control are described, details being given of successful campaigns against the top borer (*Scirpophaga nivella*), stem borer (*Proceras indicus*), scale insect (*Melanaspis glomerata*), smut (*Ustilago scitaminea*) and grassy shoot (eradicated in the Bardoli factory district, chiefly by aerial spraying to control the main vector, *Pyrilla perpusilla*).

Aerial spraying problems connected with toxicological and environmental pollution. K. K. Nirula. *Sugar News* (India), 1977, **9**, (6/7), 28a-28b.—Trials to determine the toxicological effects of pesticides sprayed from the air are briefly reported. While the crops sprayed were cotton, in two trials the pesticide applied was "Quinalphos" which has also proved effective against the cane leafhopper. The trials showed that at 400-500 $cm^3.acre^{-1}$ "Quinalphos" did not prove toxic to humans or animals.

Prospects of chemical control of the top borer (*Tryporyza nivella*). J. S. Sandhu and M. S. Duhra. *Sugar News* (India), 1977, **9**, (6/7), 30-35.—After trials had shown that "Carbofuran" at 1 $kg.ha^{-1}$ was effective in controlling *T. nivella* and increasing cane yield by 47·5% compared with the untreated control, it was applied to CoJ 64 cane in five factory areas, as a result of which the cane escaped attack by the borer. "Phorate" at 3 $kg.ha^{-1}$ also proved highly effective against the pest and is recommended. Tests in which "Carbofuran" was applied at dosage rates below 1 $kg.ha^{-1}$ together with "Phorate" at 3 $kg.ha^{-1}$ gave inconclusive results, since the borer incidence was too low, even in the untreated control.

Integrated control of the sugar cane stalk borer *Chilo auricilius* Ddgn. O. P. Singh. *Sugar News* (India), 1977, **9**, (6/7), 36-43.—The literature on *C. auricilius* and its control is reviewed, and the use of an integrated control programme advocated, in which chemical control with "Ekadrin" is carried out in July-October, biological control with *Sturmiopsis inferens* in November-February and a chemically sterilized male technique in February-July.

Bionomics and control of white grub in India. G. K. Veeresh. *Sugar News* (India), 1977, **9**, (6/7), 44-56.—A review is given of the literature on distribution, life history and methods of control of white grubs, with brief mention of host plants, pattern of attack and nature of damage.

Sugar cane scale insects and their control. B. H. K. Rao. *Sugar News* (India), 1977, **9**, (6/7), 57-71.—*Melanaspis glomerata* is a major pest in India, although the author states that little research has been done on its ecology and possible control. Details are given of the incidence of the pest in India, its description and symptoms of attack, biology and seasonal behaviour, factors favouring its incidence and losses caused by it, while methods of control discussed include preventive agricultural measures, chemical and biological control.

Integrated control of sugar cane pests and diseases. P. N. Avasthy. *Sugar News* (India), 1977, **9**, (6/7), 72-73. Integrated systems (combining agronomic practices with biological and chemical control) are tabulated for various pests and diseases prominent in India.

Research on sugar cane pests in Maharashtra. D. S. Ajri. *Sugar News* (India), 1977, **9**, (6/7), 75-77.—The pests discussed include the early shoot borer *Chilo infuscatellus*, the leafhopper *Pyrilla perpusilla*, the scale insect *Melanaspis glomerata* and the white grub *Holotrichia serrata*. Control measures are described for each pest.

Economics of insecticidal control of the sugar cane scale insect and mealy bugs in Gujarat. A. H. Shah, N. V. Vaghela, A. J. Patel and J. P. Bhatt. *Sugar News* (India), 1977, **9**, (6/7), 78-80.—Trials over a 3-year period on control of *Melanaspis glomerata* and *Saccharicoccus sacchari* showed that "Methidathion" was the most effective of four insecticides in terms of reduction of incidence of both pests and increase in cane yield by comparison with the untreated control. However, the cost of the chemical was not known, so that "Phosphamidon", the next most effective pesticide, is recommended as the best economically.

CANE BREEDING AND VARIETIES

Performance of Phil 65 and Phil 66 clonal selections in Luzon. E. V. Vergara, S. M. Villasanta and A. M. Galvez. *Proc. 24th Ann. Conv. Philippines Sugar Tech.*, 1976, 137-140.—Four hybrids from the Phil 65 series and four from the Phil 66 series were subjected to field trials in four areas of Luzon. Based on the results, Phil 6512, Phil 6520, Phil 6522, Phil 6612 and Phil 6614 are recommended for station release, all giving cane and sugar yields comparable to those of the standard recommended varieties for the areas, while Phil 6512 has a significantly higher sugar content.

Basic sugar cane breeding in subtropical Louisiana. P. H. Dunckelman and S. Nagatomi. *Sugar Bull.*, 1977, **55**, (23), 13-18.—Progress in the basic breeding programme at the US Sugarcane Field Laboratory, Houma, in 1976 is reported. By manipulation of basic and established breeding stocks under natural and artificial environments (using outdoor racks, a photo-period house and a breeding greenhouse), it was possible to make crosses that would otherwise have been impossible. From 143 parent canes of widely differing genetic constitution which were made available, 73 biparental crosses were made with air-layered (live-rooted) flowering stalks; only nine were unsuccessful, while the remaining 64 resulted in production of more than 100,000 viable true seeds, representing most of the lines considered necessary for upgrading of the varieties suitable for a subtropical environment. The number of crosses and estimated number of viable seeds for each of 29 new breeding lines are tabulated.

Sugar cane variety trials in Texas 1976-77 harvest season. S. A. Reeves. *Tech. Rpt. Texas Agric. Expt. Sta.*, 1977, (77-1), 57 pp.—Forty-seven tables are given of data obtained from 11 replicated cane varietal trials conducted during 1976-77 at 10 different locations in the Lower Rio Grande Valley of Texas, USA. Results indicated that N:Co 310 continues to be the outstanding variety, giving excellent yields of high-quality cane with optimum sugar yields when harvested after November. The next best variety, CP 65-357, matures earlier than N:Co 310, but also gives excellent cane and sugar yields. CP 61-37 matures after CP 65-357 but before N:Co 310 and also provides substantial yields. CP 57-614 and CP 56-59 gave disappointing performances despite promising results in earlier trials, the former variety maturing very early but not providing adequate yield, while the latter provides good yields of plant cane but not of ratoons. Of new varieties tested in 1976-77, the most promising early-maturing cane was L 61-49, which is notable for high sugar yields in October harvests; the yields are not as high as those of N:Co 310 but generally exceed those of L 62-96. CP 66-315 is a promising variety for high late-season sugar yields and is comparable to N:Co 310 in this respect.

Substrates for the pricking out of sugar cane seedlings. R. Cesnik, F. F. S. Oliveira and M. C. S. Mogueira. *Brasil Açuc.*, 1977, **90**, 227-232 (*Portuguese*).—The Planalsucar cane breeding programme involves germination of some 800,000 seedlings a year and requires some 200 tonnes of potting compound. Trials were made using a total of 91 combinations of different proportions of six ingredients: a latosol soil, filter cake which had been weathered for six months, stable manure, dried and milled bark of *Dimorphandra mollis* from which the tannin had been extracted, exhausted coffee grounds from which soluble coffee had been extracted and the grounds weathered for three years, and washed sand. The heights of the seedlings after 30 and 60 days for each combination are tabulated, and show that best results were obtained where the mixture included the stable manure, whereas inclusion of filter cake was to be avoided. The other constituents contributed to seedling development but in a less marked fashion.

The genetic improvement of sugar cane. Programme of work in the Tucumán Agricultural experiment Station. Current situation and prospects. J. Mariotti, C. Levi, J. Scandaliaris, P. C. Mendoza and C. G. Arevalo. *Bol. Estac. Exp. Agric. Tucumán*, 1977, (125), 13 pp. (*Spanish*).—The history of the development of sugar cane varieties in Argentina (the Tuc. and NA series, and the Fam. series from 1960) is briefly described, with the problems facing cane breeders at present, among these being the need to find a replacement for the declining NA 56079 which is the dominant variety in present use. New varieties are needed with resistance to red stripe, mosaic, smut, red rot, etc. The genetic base of the breeding programme is to be widened by importation of varieties from other countries and intensified studies made on the control of flowering by regulation of light and temperature in order to obtain suitable crosses. With the aid of Dr. R. D. Breaux of Houma, LA, USA, methods are being developed for early recognition of valuable potential in the seedlings. A study is being made of the behaviour of cane varieties, both local and imported, as well as of their phytosanitary characteristics in field and laboratory. A series of stations is being set up for growing of seed cane and multiplication of newly-released varieties.

Efficiency of visual evaluation in the clonal selection of sugar cane (*Saccharum* spp.). J. A. Mariott O. Giménez L., P. C. Mendoza, J. M. Osa and E. S. Oyarzabal. *Rev. Ind. Agric. Tucumán*, 1978, **53**, (2), 33-48 (*Spanish*).—The effectiveness of visual selection in cane has been examined and it has been shown that space and time effects are important. Repeatability of the visual score for "agronomic type" appears to be moderate to moderately high, depending on selector. There were differences among selectors as to criteria used and selection efficiency. It is important to make visual scores as objective and repeatable as possible, and a new scale from 0 to 9 is proposed, based on experience in Argentina. The weights to be given the various components in the scale are discussed.

Breeding for Fiji resistance. Anon. *Cane Growers' Quarterly Bull.*, 1977, **41**, 52.—Information is given on the cane breeding programme in southern Queensland aimed at producing varieties resistant to Fiji disease, which has spread rapidly in the area in question, particularly in the Bundaberg district.

CANE SUGAR MANUFACTURE

The use of stainless steel in sugar processing plants. E. Hale. *Sugar y Azúcar*, 1977, **72**, (11), 47-51. See *I.S.J.*, 1978, **80**, 21.

New concept in cane preparation. L. B. Rodriguez, E. G. Garcia and A. C. Alba. *Sugar y Azúcar*, 1977, **72**, (11), 55-59.—Information is given on the expansion programme at the authors' Philippine sugar factory which was in two phases: (1) basically, addition of a fourth mill to one of the two tandems to increase its throughput to 3000 t.c.d., and (2) replacement of a 2-roller unit with a 3-roller crusher in the same tandem, installation of new 1st and 2nd mills, and replacement of the shredder with a "Unigrator"[1], thereby raising the tandem throughput by a further 3000 t.c.d. A description is given of the "Unigrator", and comparison is made between weekly average hourly throughputs with the shredder in 1974/75 and with the "Unigrator" in 1975/76, showing an increase which in many instances was well above 25%. Moreover, the "Unigrator" gave a much higher Index of Displaceability and prepared cane density (kg.m^{-3}). The question of uniformity in determining cane preparation is discussed. Despite the advantages of the "Unigrator", extraction was not increased because of the need to reduce maceration by 30% in order to permit the evaporators to handle the extra juice resulting from the increased crushing rate. For the 1976/77 season, restoration of the normal maceration levels was planned, and an increase in extraction predicted at a target grinding rate of 8000 t.c.d.

Maintenance of a centrifugal. A. C. Chatterjee. *Maharashtra Sugar*, 1977, **3**, (1), 113-118.—The author outlines the design and operation of batch and continuous centrifugals and gives advice on their daily, weekly and off-season maintenance.

Occurrence of dextran in sugar cane. S. E. Ferrari and A. A. Rodella. *Brasil Açuc.*, 1977, **90**, 303-306 (*Portuguese*).—A study has been made of the occurrence of dextran at five sugar factories and at the Araras, São Paulo, experiment station of Planalsucar. Dextran was only found under abnormal conditions when several days had elapsed between burning of cane and crushing, while elongated crystals due to the presence of dextran were observed in only one factory.

The resazurine test for the determination of microbiological conditions in a milling tandem. M. T. Hernández, N. Quintero, N. Herrera and A. Shevchenko. *Centro Azúcar*, 1976, **3**, (1-3), 55-69 (*Spanish*).—The resazurine test is one in which the time for loss of colour of the dye by the reducing action of micro-organisms is a measure of the activity of the latter. It was applied to crusher and mixed juices under various conditions including without addition of a germicidal agent, shock addition of formalin at 2 hr and 4 hr intervals, addition of antiformin at 4 hr intervals, and heating to 70°C. It was concluded from the results that the test is an adequate index of hygienic conditions in a mill, and that the efficiency of a microbiological control agent can be estimated from the difference in colour destruction time between crusher and mixed juices.

Influence of various colloidal components of cane juice on the clarification process. M. Darias P. and J. Martín B. *Centro Azúcar*, 1976, **3**, (1-3), 71-83 (*Spanish*). The effects of peptone, pectin, pure dextran and commercial dextran and mixtures of peptone with the dextrans on clarification were determined by measurements of sedimentation rates, mud volume, viscosity, colour, etc. The "threshold of sedimentation" or concentration of colloid at which clarification began to be harmed was measured in each case and was, respectively, 0·4%, 0·1%, 0·4%, 0·2%, 0·4-0·6% and 0·2-0·4%.

A glimpse into the Colombian sugar industry. C. Alincastre. *Sugarland* (Philippines), 1977, **14**, (4), 18.—A brief survey is presented of cane agriculture in the Cauca Valley of Colombia (where cane is planted and/or harvested at any time of the year and where sufficient cane is grown to supply most of the export sugar) and a list is given of the 19 factories in operation in 1964 when the author was associated with one of the companies.

"Maxochlor" (a viscosity reducer). R. Sivaraman and S. C. Ray. *Maharashtra Sugar*, 1978, **3**, (4), 39-42. "Maxochlor" (75% calcium hypochlorite) has been found to have advantages over sodium hydrosulphite ("Blankit") in reducing massecuite viscosity in boiling, and these are listed. Addition of 2-2½ litres of "Maxochlor" per 25-30 tonnes of *C*-massecuite gave optimum results when 500 cm^3 was added during graining and the remainder introduced ½ hour before dropping. In *A*-massecuite boiling, the first dose should be added once seed is grained, and the second just before dropping. Treatment increased massecuite purity and reduced Brix by comparison with untreated controls.

Production of by-product power in the sugar industry to augment rural electrification. P. J. M. Rao. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.1-E.20.—Power production in India is surveyed and the question of supply of surplus sugar factory power to the public grid discussed, with references made to the adoption of such a scheme in Australia, Hawaii and Mauritius and descriptions of the systems and equipment used by certain Indian sugar factories.

A new design for a vapour line juice heater. M. Singh, V. V. Subbarao and S. J. Lagare. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.21-E.31.—Details are given of a tubular juice heater installed in the vapour line and receiving bled vapour from the 1st and 2nd effects of a quadruple-effect evaporator. Results of tests showed that the required 15-20°C temperature rise from 27-28°C was obtained in 14 passes, the overall heat transfer coefficient being estimated at 300 B.Th.U.ft^{-2}.hr^{-1}.°F^{-1} at a juice velocity of 6 ft.sec^{-1}. Further passes up to a total of 32 failed to effect any further increase in temperature.

[1] Ducasse: *I.S.J.*, 1975, **77**, 140-142.

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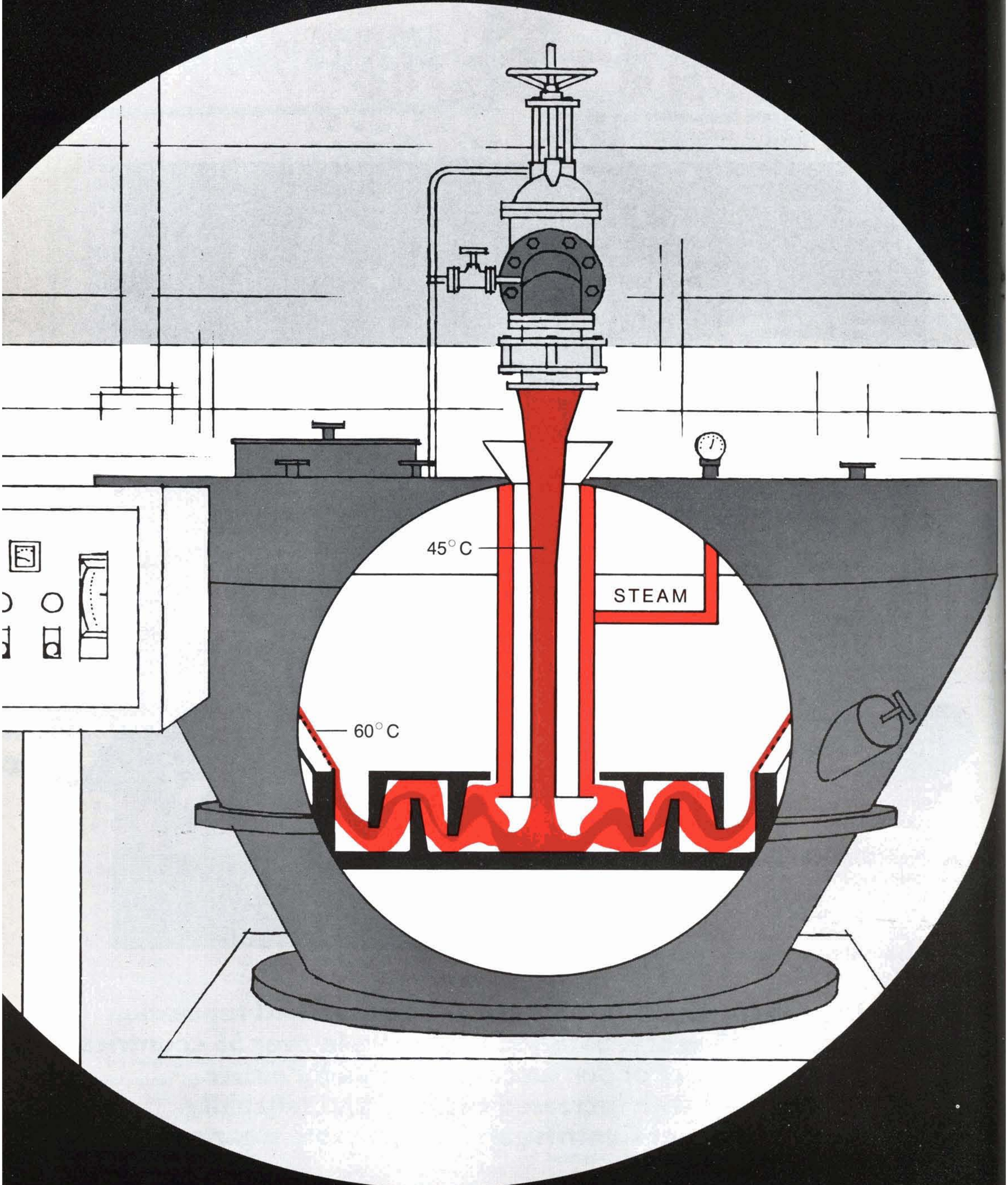

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Design features of continuous centrifugals. S. Pichaimuthu. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.33-E.36.—The salient design features of horizontal- and vertical-shaft continuous centrifugals are explained and their operational behaviour briefly discussed. In order to increase the time allowed for massecuite purging, the author suggests that the lower half of conical baskets should be parabolic.

Further trials of stationary knives for improving cane preparation. H. N. Gupta. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.37-E.41.—After promising results had been obtained in trials with reversed knives and stationary knives installed in the hood of the set[1], further tests were carried out to determine the effect on cane preparation of one and, subsequently, two sets of stationary knives in the hood of a knife set. Results showed that one stationary knife set increased the Preparation Index from 54% to 62·5%, while a second set raised it to 68·2%. No mill roller bearings had to be replaced, whereas previous to the use of the stationary knives 2-3 bearings had had to be replaced every season. Use of a third set of stationary knives had no substantial effect on preparation because of too high a clearance between them and the cane, while the spacing between the knife sets may also have been a contributory cause. Use of stationary knives caused practically no increase in motor load.

Use of magnetic separators in the sugar industry. D. B. Chinchwade. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.43-E.48.—The use of magnetic separators to remove tramp iron from sugar is briefly discussed. Investigations showed that bagged sugar after magnetic separator treatment still contained 2·9 $mg.kg^{-1}$ of iron, indicating the need for a more efficient separator and use of clean equipment. It is also suggested that the drum type should be complemented with another type.

An attempt at drying of bagasse. R. T. Khurd. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.49-E.51.—The moisture content of bagasse from a return carrier was reduced by 2·5-3% by blowing it out with a fan to which hot air was fed from the air heater of a boiler. The amount of bagasse thus treated was 8% of the total at the factory in question, and the method could only be tested for the last 10 days of the season. Further investigations are considered necessary.

Case study of frequent breakages of intermediate carrier head shafts. V. M. Murugkar and J. Lakshminarayan. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.53-E.60.—The authors examine possible causes of shear stress failure at the clutch end of intermediate carrier shafts at their sugar factory.

Low bearing oil pressure alarm in steam and diesel engines and automatic stopping device at low bearing oil pressure of diesel engines. M. K. Biswas and M. Singh. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.61-E.66.—A brief description with diagrams is given of an alarm and automatic stopping system for steam and diesel engines which is actuated when the bearing oil pressure is excessively low. The device has operated successfully at the authors' sugar factory.

Reclamation of mill turbine rotor shrouding and blades. B. P. Bargaje. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.67-E.72.—Failure of a rotor bearing in a Gutehoffnungshütte (GHH) cane mill turbine led to damage to the blades and shrouding. Because of difficulties in obtaining replacement parts, repairs were carried out by welding. Details are given of the repair work and of the economics, showing considerable savings on the cost of new imported parts.

Relevance of boiler feed water treatment in the sugar industry. K. S. Ramamani. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, E.73-E.80.—A representative of a chemicals firm describes the boiler feed-water treatment service and chemicals his company provides, and describes six case histories from sugar factories to show the benefits obtained by treatment.

The sulphi-carbonatation process. R. S. Dubey. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.1-M.4.—The sulphi-carbonatation process developed and patented by the author[2] is outlined and results obtained with the system at Purwodadi factory in Indonesia are briefly reported. Benefits of the scheme include a 50-60% lower lime consumption than in conventional double carbonatation, increase in non-sugar removal by comparison with double carbonatation, leading to improvement in juice, syrup and sugar colour, reduction in fuel consumption through improved evaporator operation, and the chance to increase factory throughput. Clarification gave a 1st carbonatation juice filtrability comparable to that in the normal process.

Filtrability and filtration of first carbonatation cane juice. Development of a new design of chemical reactor and a new low pressure filtration system. S. P. Mishra. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, M.33-M.56.—Details are given of a liming and gassing tank used for preliming and defeco-saturation at two factories. The vertical tank has a central CO_2 pipe to which the gas is fed from a lateral branch pipe; the gas passes down the pipe to a star-shaped distributor, the arms of which carry rows of slots on the underside. The bottom section of the CO_2 pipe and the distributor are surrounded by a frustro-conical baffle which forms a chimney; gassed juice, being of lower density than the juice outside the "chimney", flows up and replaces the heavier, ungassed juice, creating high circulation rates. Above the chimney is a rotary vane distributor to which is fed both raw juice and milk-of-lime. The new tank was used in conjunction with a low-pressure filtration system, in which juice was fed to plate-and-frame filters by gravity from an overhead tank. Benefits of the new system included greater utilization of available capacity, reduction in filter cake losses, production of higher quality sugar and savings in the form of reduced filter cloth consumption and decreased plate and frame damage by comparison with the earlier system.

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[1] Garg *et al.*: *I.S.J.*, 1978, **80**, 245.
[2] Dubey & Mavi: *ibid.*, 1957, **59**, 49.

BEET SUGAR MANUFACTURE

Incondensable gases in the sugar factory. I. G. Mantovani. *Ind. Sacc. Ital.*, 1977, **70**, 143-144. **II.** S. Basso. *ibid.*, 145-147. **III.** S. Sacchi. *ibid.*, 148. **IV.** F. Zama. *ibid.*, 148-149. V. L. Gulminelli. *ibid.*, 149 (*Italian*).

I. In the first of a series of lectures given at a special conference on the subject of incondensables, the author first shows how incondensables in vapour transferred from one evaporator effect to another considerably reduce its film heat transfer coefficient. Moreover, they can contribute to corrosion, particularly through the action of ammonia, which is present in considerable quantities when the juice has been subjected to excessive carbonatation (which also leads to high CO_2 contents in the incondensables as well as oxygen, nitrogen and a small amount of carbon monoxide). Incondensables act in two ways: they form a layer on the heating surface and thus prevent access of further vapour, although this effect is largely balanced by increasing the diffusion coefficients of vapour and gas; and, more seriously, incondensables reduce the partial pressure of the vapour and hence the temperature at which it condenses; this temperature difference can represent a considerable proportion of the temperature difference between the heating vapour and juice. Means of measuring and eliminating incondensables described in the literature are discussed.

II. Four theoretical schemes for withdrawal of incondensables from a quintuple-effect evaporator are examined for a factory having a daily beet slice of 3000 tonnes and where the quantity of juice and steam fed to the evaporator, the juice Brix and the quantity of vapour bled from the first four effects to the corresponding juice heaters are constant. The schemes, which are illustrated by flow diagrams, are: (1) where the incondensables from both evaporator and juice heaters are vented to the atmosphere or pass to the condenser; (2) where the evaporator incondensables in each effect are transferred to the juice space of the same effect, while the juice heater incondensables are treated as in (1); (3) where the evaporator incondensables are transferred to the vapour space of the next effect, while the juice heater incondensables are treated as in (1); and (4) where the evaporator incondensables are treated as in (2) while the juice heater incondensables are transferred to the vapour system of the next effect. It is shown that there is no advantage, as regards vapour recovery, in transferring the incondensables from one effect to the next, so that it is recommended to vent to the atmosphere or transfer to the condenser at suitable pressure (the lower the pressure, the easier it is to avoid excessive build-up of gases in the final effect vapour and hence in the bleed to the vacuum pans).

III. A brief description is given of the incondensables withdrawal system of a juice heater and evaporator manufactured by Fives-Cail Babcock and installed at the author's sugar factory. Some of the incondensables are withdrawn from the calandria near the bottom tube plate, and the rest from near the top tube plate. This mixture of vapour and incondensables, plus that from the upper part of the juice space, is passed through a collector to the preceding thin juice heater. The vapour-incondensables mixture from this heater is passed via a collector to two raw juice heaters, from which the Incondensables are transferred to the condenser for venting to the atmosphere.

IV. The question of withdrawing as much of the in condensables as possible from heaters and evaporators with minimum vapour loss is briefly discussed. While it is admitted that it is impossible to prevent loss of some vapour, the author suggests a valve, the opening of which is time-controlled so as to minimize heat loss. While he considers the scheme described in III as logical and efficient with regard to heat economy, he wonders whether there is a certain reduction in the heat transfer coefficient of the evaporator. The question of the system for trapping the incondensables is also discussed, and the opinion expressed that the form and layout of the vessels will affect the efficiency, a vertical vessel having a large height:diameter ratio being better than a horizontal vessel or a vacuum pan calandria of high width:depth ratio.

V. At Cecina factory, the evaporator effects are in coupled pairs, and vapour fed towards the top of the space in one vessel passes down against a rising juice stream and then passes to the other effect, which it enters at a point below the upper tube plate. The result is a higher vapour circulation rate than in conventional evaporators, leading to a high heat transfer coefficient and less risk of accumulation of incondensable gases.

Effect of juice treatment with lime before 2nd carbonatation on raw juice purification results. A. P. Lapin, K. P. Zakharov and V. Z. Semenenko. *Sakhar. Prom.*, 1978, (2), 27-34 (*Russian*).—In laboratory and factory experiments, treatment of juice with lime (0·6% CaO on weight of beet or 20-30% of the total amount of lime used in purification) for 5-6 minutes prior to 2nd carbonatation improved juice quality (by comparison with conventional processing) in terms of reduction in lime salts, colloids, reducing matter and thick juice colour in evaporation. The amount of lime added before 2nd carbonatation should be kept at the lower limit of the range mentioned above when raw juice has a high amide and reducing matter content and the lime salts content in purified juice is high.

Development of dryer/coolers for white sugar. A. F. Zaborsin, V. I. Kruglovenko, Ya. Ya. Lazhe and L. A. Orlov. *Sakhar. Prom.*, 1978, (2), 34-37 (*Russian*).—Investigations of three Soviet types of white sugar cooler/dryer are reported, *viz.* a single-chamber fluidized bed unit, a fluidized bed unit with vibratory means, and a twin-chamber dryer/classifier having a continuous tumbler as well as many features of a fluidized bed dryer. The general performances of all three are discussed, and their advantages and disadvantages indicated. While they are better than the conventional drum dryer, they still do not cool the sugar sufficiently, i.e. to 25-22°C, except when the ambient temperature is very low. However, fluidized bed drying and cooling is regarded as the most promising method, particularly where vibratory means are provided as in one Soviet factory.

NEW BOOKS

An outline of expansion plans in the world sugar industry. II. H. Ahlfeld. 99 pp; 20·5×29·4 cm. F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany.) 1978.

The changed circumstances of world sugar markets and prices have provoked a re-examination by F. O. Licht of their survey of expansion plans made three years ago. The results of this new survey are recorded, country-by-country, giving the official policies of the Governments and authorities concerned. In summary, nearly all the expansion plans initiated during the pre-1976 sugar shortage are being continued, although some may experience considerable delays. Depressed world market prices will probably lead to lower utilization of installed capacity, and projects on which construction has not started, or which are still in the planning stage, are being postponed in many countries. Because of the world-wide surplus, new projects which were not already on the drawing board in 1975 are being considered only in exceptional cases.

Annual report 1976. 115 pp; 16·6×22·3 cm. (Estación Experimental Agrícola de Tucumán, San Miguel de Tucumán, Argentina.) 1977.

This booklet, Miscellaneous Publication No. 62 of the Station, is a record of activities both social and technical. It includes a brief account of the work of the various departments, much of it being concerned with sugar cane, although the station carries out research on several other crops. The activities of the sub-stations, meteorological information and publications are also recorded.

Zuckerwirtschaftliches Taschenbuch (Sugar economic pocket book) **1978/79.** K. Dankowski, R. Barth and G. Bruhns. 265 pp; 10×15 cm. (Verlag Dr. Albert Bartens, Lückhoffstr. 16, D-1000 Berlin 38, Germany.) 1978. Price: DM 28.-.

The 25th edition of this pocket book is a worthy successor to the collection of data first compiled by the sugar statisticians Dr. Albert Bartens and Dr. Hans Mosolff. Only the first section contains tables of statistics (world, European and West German) covering many aspects of sugar production, consumption and trading. Headings are in English, French and German. The second section gives (in German) an outline of the International Sugar Agreement and provides information on the various sugar markets, contracts and price formulae, while EEC sugar regulations are set out in some detail, being summarized also in English and French. The third section gives addresses of international and EEC sugar and associated organizations, followed by addresses of organizations and sugar companies and factories in each of the EEC member-countries. The West German sugar industry is treated in somewhat greater detail in a separate sub-section. In addition to the 69 tables of statistics, the book contains 6 graphs and 3 maps. It is a handy volume for those readers interested in the EEC sugar industries—it fits easily into a pocket, not being at all bulky, and the layout and printing lend themselves well to the purpose of providing easily accessible information. An English-French-German glossary of EEC trade terms is included.

Sugar cane production in South Africa. 44 pp; 22×28 cm. (The Experiment Station of the South African Sugar Association, P.O. Mount Edgecombe, South Africa 4300.) 1977.

This is Bulletin No. 1 (revised) of the SASA Experiment Station. It outlines cane cultivation in South Africa under a large number of headings, each aspect therefore being dealt with at most in only a few pages, but adequately so. The sections are: location, topography and climate; farm planning; programme planning; soils; nutrition; varieties; production of seed cane; drainage; land preparation; planting; irrigation; weeds; pests; diseases; harvesting; ratoon management; yields; payment; services available to cane growers; and structure of the South African sugar industry. A list is given of extension officers, and a short bibliography of recommended Experiment Station publications is appended. Subject headings within each section are clearly shown in a tinted left-hand margin, and the material is accompanied by many illustrations. The printing is very good, and there can be no doubt that the work is invaluable to those readers interested in the South African cane industry.

Hedging raw cane sugar on the futures market. E. P. Roy, K. Wegenhoft and L. Carville. 76 pp; 21·5×28 cm. (Department of Agricultural Economics and Agribusiness, Louisiana State University, Baton Rouge, LA 70803, USA.) 1977.

This report deals with hedging of raw sugar in terms of the producers of sugar cane and the operators of raw sugar factories. The basics of hedging are discussed, including the subject of "basis" (the difference between cash and futures prices). Costs of producing sugar cane and raw sugar are estimated so as to arrive at possible target prices for hedging purposes. Examples of hedging for the producers of sugar cane and of raw sugar are presented and these results compared with unhedged positions. Several other factors related to hedging of raw sugar are examined and an extensive bibliography is included.

F. O. Licht's international sugar economic yearbook and directory 1978. 485 + 56 pp; 22×30 cm. (F. O. Licht GmbH, P.O. Box 1220, D-2418 Ratzeburg, Germany.) 1978. Price: DM 85.-.

The latest edition of this well-known directory is packed with useful information on the world beet and cane sugar industries, all but a small part of it given in both English and German; the small part that is only in German concerns West German organizations. In the first main section, details are given of international sugar organizations, laws, the International Sugar Agreement and the Hong Kong Commodity Exchange. The second and third main sections carry information on organizations and sugar companies in all the beet- and cane-growing countries of the world; by far the most important material in this section are the names and addresses (where it has been possible to give them) of factories plus details of processing capacities and, in some instances, actual processing data for a number of years. Three articles appear in the next section: on world sugar prices (by G. B. Hagelberg), on plant protection for sugar beet (by W. R. Schäufele) and on the development of the US sugar policy (by T. C. Earley). A review is then presented of sugar machinery manufacturers by H. J. Delavier, after which there is a Buyers' Guide of companies manufacturing beet agricultural machinery plus a summary of beet agricultural practices for which the various implements are used (prepared by H. Schafmayer). A similar Buyers' Guide is given for cane agricultural machinery manufacturers, with information presented by B. J. Cochran and M. Giamalva. Reports from various companies involved in sugar machinery manufacture are presented, followed by a corresponding Buyers' Guide. A 56-page supplement containing world sugar statistics is to be found in a pocket at the back of the book. The directory is clearly printed and the information generally well laid out. The work still represents very good value for money, and readers looking for a guide to the world sugar industry could not find it in a better form.

Tätigkeitsbericht (Report on activities) **1977/78.** 34 pp; 17×24 cm. (Zuckerforschungsinstitut, Zaunergasse 1-3, A-1030 Vienna, Austria.) 1978.

Up to 1975/56, the Austrian Sugar Research Institute published annual reports which contained considerable numbers of papers based on work conducted at the Institute. It was then decided, however, to publish more concise reports outlining the investigations carried out in each of the three main departments (agriculture, technology and medicine). The nature of the experiments, the names of the investigators and the results obtained are given. Lists are given of articles published and papers presented by Institute workers during 1977/78, and details are given of Institute staff.

Annual review 1977-78. 19 pp; 21×26 cm. (Sugar Research Limited, Mackay, Queensland, Australia.) 1978.

The latest report from the Sugar Research Institute (set up in 1949 by 26 Queensland sugar factories) summarizes research carried out by the Systems Research, Engineering and Chemistry & Chemical Engineering sections on various aspects of cane sugar factory operations, and provides details of articles and papers prepared by Institute personnel as well as a list of Institute staff and changes.

Experiment Station annual report 1977-78. 86 pp; 21×30 cm. (Experiment Station of the South African Sugar Association, Mount Edgecombe, Natal, South Africa.) 1978.

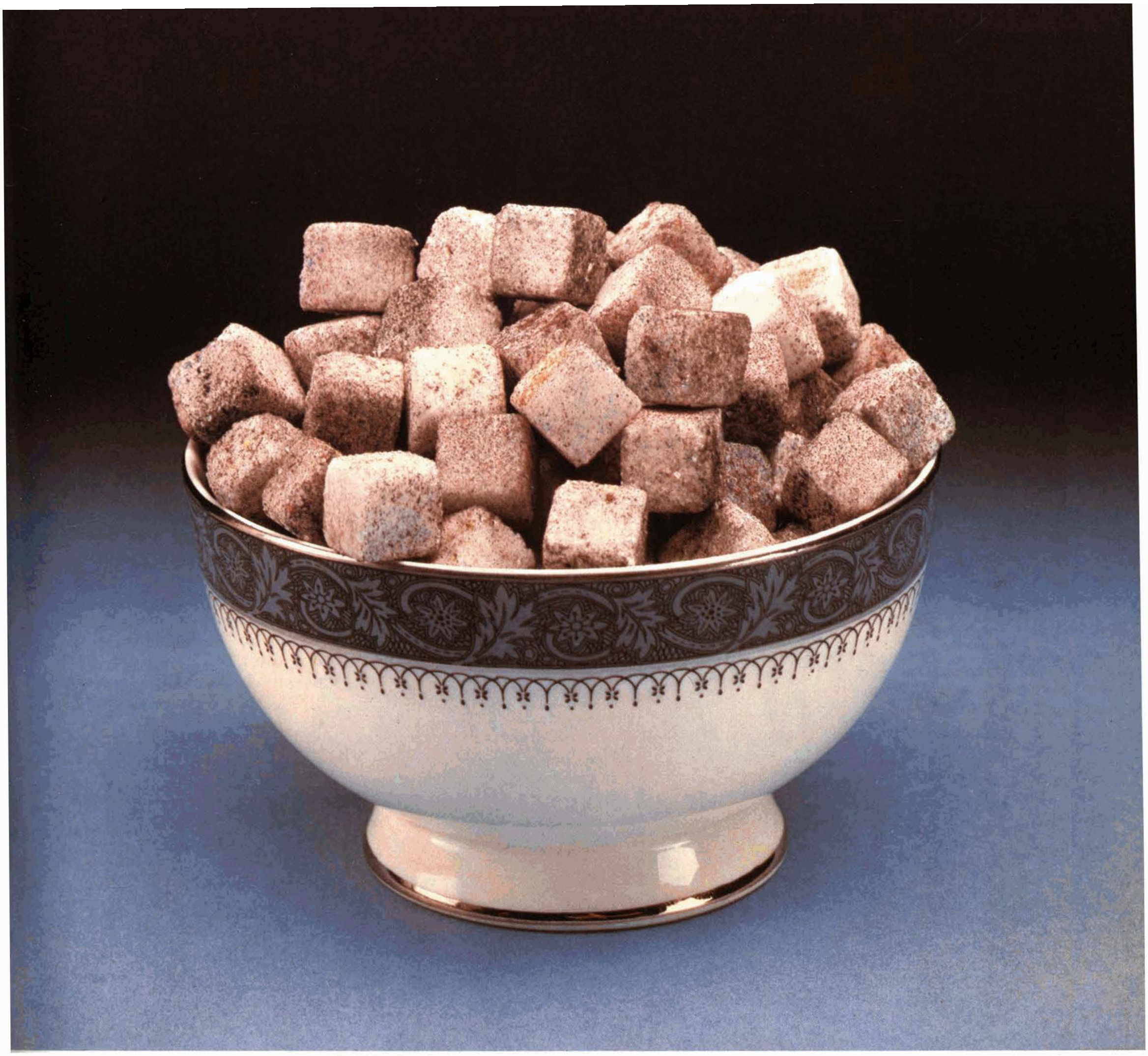
The main experiment station at Mount Edgecombe was established in 1925 and comprises some 70 hectares; it serves as the headquarters for all research, advisory, extension and training services as well as an extensive sugar cane breeding programme. While laboratory investigations are undertaken only at the main station, varietal selection and agronomic studies can be carried out under a wider range of soil and climatic conditions at four field stations and two smaller environment sites, providing a total of 500 ha, of which 175 ha are under irrigation. In addition, 950 ha of land in the area of La Mercy airport have been leased from the State for use in development of mechanization and conservation studies. The latest report carries details of research carried out in 1977-78 and includes a section describing the work of the Extension Division in the form of individual summaries for different cane-growing areas. The other divisions are represented by reports on mechanization, agronomy, soil and fertilizers, land and water management, plant breeding, pathology, etc. The report is well printed with numerous illustrations and gives a broad insight into the working of one of the world's leading cane research organizations.

The industrial utilization of sugar and mill by-products (a literature survey). M. J. Kort. 195 pp; 21×29 cm. (Sugar Milling Research Institute, University of Natal, King George V Ave., Durban 4001, South Africa.) 1978.

This, the 16th report in the series, gives a survey of the literature on by-products from sugar manufacture (factory and distillery waste water, filter cake, wax, molasses, bagasse and various chemicals from cane by-products), livestock feeding on sugar factory waste products as well as sucro-chemicals and spent bone char, industrial uses of refined sugar (both food and non-food uses are covered), recent developments in sucro-chemistry, nutrition and toxicology, and other sweeteners (natural and synthetic). A total of 1776 references are given, each section being followed by its appropriate references. Of these, 401 are concerned with by-products utilization and 213 with their use as animal fodder. There are 229 references to the industrial uses of refined sugar, but no new major discovery has been made, while no new directions of research have appeared in sucro-chemistry, for which 245 references are given. Nutrition and toxicology are represented by 252 references, while 436 references are given to the section on other sweeteners, for which an alphabetical index is also provided. It will come as no surprise to the reader that greatest attention in this field has been focused on dextrose and high fructose corn syrup manufacture. The survey is an excellent work for which the author is to be congratulated.

Sugar year book 1977. 378 pp; 10×14 cm. (International Sugar Organization, 28 Haymarket, London, England SW1Y 4SP.) 1978. Price: £5.00.

The 31st issue of this book contains statistics for 124 countries plus French Overseas Territories and the EEC. The statistics relate to centrifugal sugar only and are submitted by member-countries of the International Sugar Agreement under the rules of the Agreement and, in the case of non-members, are supplied by the governments of the countries or are extracted from statistical publications or estimated. Except where otherwise stated, the tables are on a calendar year basis and all figures are expressed in tonnes. The values are given, wherever possible, in terms of 96° pol raw sugar, although, where the information is available, trade figures are broken down into raw and refined (or plantation white or factory white) sugar as well as the raw sugar equivalent totals. Where the quality of the sugar cannot be determined, the term "tel quel" is used. The data refer to production, imports, exports and consumption, the usual range of years being 1971-77. World tables are also given, and include the London Daily Price for raw sugar as well as refined sugar retail prices in certain countries. The clear type and good layout of the tables makes for very easy reference.



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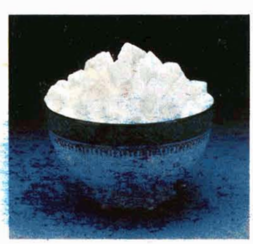

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LABORATORY STUDIES

Direct gas chromatographic analysis of molasses and fermented mash. E. Rosado and H. Batiz. *J. Agric.* (Univ. Puerto Rico), 1976, **60**, (4), 585-591; through *S.I.A.*, 1978, **40**, Abs. 78-101.—A Hewlett-Packard 5750 gas chromatograph, which had a glass pre-column and a stainless steel column both containing 5% "Carbowax 20M" and 60/80 mesh "Chromosorb W", was modified by fitting an external dismountable injection trap. The column was tested for the direct analysis of fermented mash, as produced in rum manufacture, from Puerto Rican cane molasses. 34 peaks were detected, of which 14 were identified as: acetaldehyde; acetal; ethyl, methyl, *iso*amyl and furfuryl acetates; ethyl, *n*-propyl, *iso*butyl, butyl, *iso*amyl, amyl and furfuryl alcohols; and furfuraldehyde.

The reactivity of glucose and fructose in the carbonylamino reaction in technical sugar juices. E. Reinefeld, K. M. Bliesener and M. Kunz. *Zuckerind.*, 1978, **103**, 20-28 (*German*).—Investigations are reported into the change in the relative concentrations of dextrose and levulose in model solutions simulating factory products from thin juice to molasses. In buffered weakly acid, neutral or weakly basic aqueous solutions exposed to a temperature of 100°C levulose was degraded more rapidly than was dextrose. Lysine added as example of a basic amino-acid reacted more strongly with the hexoses than did acid glutamic acid (which showed only weak reaction) or neutral leucine (which reacted more strongly than did glutamic acid). Again, the levulose concentration fell more rapidly than did that of dextrose, and sugar degradation was on a considerable scale, although the amino-acids did not markedly accelerate the fall in monosaccharide concentration. On the other hand, in solutions of high sucrose concentration, lysine affected the dextrose concentration more than the levulose; in all cases, levulose was, however, more sensitive than dextrose in alkaline solution of varying concentration. In thin and thick juice, carbonyl compounds are first formed from the hexoses; some then react with the amino-acids present to form melanoidins, while the others are rearranged to their corresponding acids. While in weakly alkaline aqueous solution the reactions were not governed by the base used (lysine or dilute NaOH), in non-aqueous solutions the above-mentioned products were not formed from the invert sugars in the presence of lysine. In highly concentrated solutions containing little water (e.g. run-offs) there is a condensation reaction between the monosaccharides and amino-acids (without formation of intermediate products), and hexose-amino acids are formed by Amadori or Heyns rearrangements, dextrose conversion being more rapid than that of levulose. In glycerine solution, the concentration of the carbonyl and amino components was equimolar, in contrast to the more rapid fall in concentration of total hexose than of the amino-acid in dilute aqueous solutions. Hexose conversion in aqueous solution in the presence of lysine was found to be of a complex nature and followed no simple rate law. Two schemes of hexose reaction paths are described.

Influence of technical dextran on sugar crystal growth habit. L. Carrazana, A. P. Koziavkin and C. Pérez. *Centro Azúcar,* 1976, **3**, (1-3), 41-53 (*Spanish*). The effects of dextran on sugar solution viscosity and refractive index were studied and also its effects on sugar crystals growing in a mother liquor. The refractive index was altered so as to indicate a Brix higher by 0·1 for 0·5% dextran, 0·2 for 1·0% and 0·3 for 2·0%. Viscosity was increased markedly by the dextran but Cuban native dextran did not affect the axis ratios as has been reported for other dextrans.

Tables of the degree of supersaturation as a function of temperature, dry substance and purity of the charge in a pan. L. Carrazana R. *Centro Azúcar,* 1976, **3**, (1-3), 85-88 (*Spanish*).—The tables are presented with an indication of their use in deciding the proper seeding point, corresponding to a required supersaturation, from conditions in a pan.

First expressed juice in the evaluation of sugar cane. V. H. Chiappino. *La Ind. Azuc.*, 1978, **84**, 366-368 (*Spanish*).—The author considers the use of first expressed juice purity, multiplied by the Java ratio, to be the best method of determining sugar cane quality by reason of the simplicity of the method and its precision, which is limited only by the accuracy of the analytical determinations and weighings made.

Occurrence of D-mannitol in sugar beet. J. Caplovic and F. Rendos. *Listy Cukr.*, 1978, **94**, 9-11 (*Czech*). While D-mannitol occurs widely in plants, and has been found in sugar cane, particularly after deterioration caused by frost, it had not been found in beet until it was detected as an impurity in L-arabinose extracted from dried beet pulp by a method developed by the Sugar Research Institute in Bratislava, Czechoslovakia. The pulp was from beet which had undergone marked deterioration, and it was concluded that the mannitol was already present in the beet before processing. Details are given of isolation of D-mannitol by fractional crystallization and of its hexaacetate preparation.

The pressure of vapour above aqueous sucrose solutions. V. I. Tuzhilkin and I. N. Kaganov. *Sakhar. Prom.*, 1978, (2), 52-54 (*Russian*).—The thermodynamics of massecuite boiling are discussed, particularly the pressure of the saturated vapour formed. Values of this pressure for sucrose solutions of various concentrations as well as saturated solution and pure water were calculated by a series of equations from ebullioometric measurements of solution temperature and curves plotted of vapour pressure *vs.* temperature. From the equation $\ln p = -\frac{\Delta H}{RT} + \text{const}$, where p is pressure, ΔH is the change in heat content (enthalpy) accompanying the change from liquid to vapour, R is the universal gas constant and T is absolute temperature, linearity was established for the relationship $\ln p$ *vs.* $(1/T) \times 10^3$, the straight lines for the solutions being parallel and having an angle of slope representing the heat content. However, calculation of ΔH from the equation $\Delta H = -\frac{(\Delta \log p)\ 4{\cdot}576}{\Delta\ (1/T)\ 10^3}$, where ΔH has a value characterized by the angle of slope of the curves, revealed a discrepancy between the heat content for sucrose solution and for water which was due to the differential of heat of dilution or heat of solution of amorphous sucrose, i.e. with no allowance made for the energy necessary for destruction of the crystal lattice. However, heats of dilution can be represented as a function of concentration: $-5{\cdot}6 \times 10^3\ N^2$, where N is the molar concentration of sucrose.

Adaptation of the Kroonen & Vader technique for the analysis of multi-component minerals in products derived from cane. G. Núñez T. and C. Díaz de A. *Revista Icidca*, 1976, **10**, (3), 36-44 (*Spanish*).—The title technique[1] using an emission spectrograph has been applied to measurement of ash constituents in cane molasses and yeasts. It is very simple and no serious difficulties have been encountered.

Growth of single sucrose crystals from seed formed from fragments of prefixed orientation. G. Mantovani, C. A. Accorsi and G. Vaccari. *Ind. Sacc. Ital.*, 1977, **70**, 137-142 (*Italian*).—Crystal fragments of required crystallographic orientation were obtained by cutting crystals with a strand of synthetic fibre kept moist with distilled water. The fragments were then used as seed for growing single sucrose crystals in pure solution under controlled conditions, with or without addition of raffinose, dextran C and KCl, respectively. The effects of the impurities on crystal habit were thus determined. Photomicrographs demonstrate the effects. The action of raffinose confirmed earlier findings[2,3], *viz.* that growth of face 110 (extremity +b) is inhibited; the morphology of the crystal growth is a result of introduction of a raffinose molecule at the end where the crystal structure is best suited to receive it. As previously found, the intrusion of the raffinose molecule may be temporary; subsequent desorption of the same molecule may then take place, leading to retardation of sucrose crystal growth. This hypothesis is in accord with the findings of VanHook & Beall[4]. The experiment did little to explain the mechanism of the action exercised by dextran (elongation of the *c* axis), although it is suggested that it affects the mobility of the sucrose molecule; this may require the presence of yet another impurity having a synergistic effect[5]. Contrary to expectation, KCl did not have the dramatic effect on the *d* face that other authors have found.

Preparation and gas chromatography of highly volatile trifluoracetylated carbohydrates using N-methylhexafluorodiacetamide. J. E. Sullivan and L. R. Schewe. *J. Chromatogr. Sci.*, 1977, **15**, (6), 196-197; through *Anal. Abs.*, 1978, **34**, Abs. 2F13.—Mono- to tetrasaccharides are trifluoroacetylated by this reagent to produce derivatives suitable for gas-liquid chromatography. A glass column (6 ft × 3·9 mm) filled with 10% of OV-17 on "Chromosorb W HP" (80 to 100 mesh) is preferred; N is used as carrier gas (60 $cm^3.min^{-1}$), with flame ionization detection. By temperature programming (75° to 225°C at 10° per min), 13 compounds can be determined in 15 min. The procedure is applicable to the analysis of sugar syrups, processed foods and agricultural products.

Rapid gas chromatographic determination of sucrose as its trimethylsilyl ether on an open-tubular column. D. Nurok and T. J. Reardon. *Carbohydr. Res.*, 1977, **56**, (1), 165-167; through *Anal. Abs.*, 1978, **34**, Abs. 2F14.—Trimethylsilyl derivatives were prepared by treating 11 mg of an aqueous sucrose solution, containing trehalose as internal standard, with a 4:1 mixture of trimethylsilylimidazole and pyridine in a 1-cm^3 "Reacti-Vial" with a PTFE-faced liner. After 10 min (but within approx. 48 hr), the derivatives were analysed on a stainless steel column (40 m × 0·5 mm) coated with OV-17 and operated at 255°C, with H as carrier gas and a flame ionization detector. The gas-liquid chromatographic analysis took approx. 1 min. The coefficient of variation was <0·1% for 50% aqueous solution containing equimolar amounts of the two sugars (9 determinations on each of 5 preparations), but was slightly higher for impure solution, e.g. molasses.

A new formula for C-massecuite curing efficiency. N. V. Soundrarajan, M. K. Thippeswamy and N. Krishnamurthy. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, C.1-C.6.—A formula is derived for calculation of low-grade massecuite curing efficiency, expressed as quantity of non-sugars in *C*-sugar % *C*-massecuite Brix. The curing efficiency is given by $\frac{(Pm - Pe)\ (1 - Ps) \times 100}{(Ps - Pe)}$, where Pm is *C*-massecuite purity, Ps is *C*-sugar purity and Pe is final molasses purity. Use of the formula is illustrated and its advantages indicated.

A scheme for quantitative estimation of moisture, inorganic ions and total organic non-sugars in cane juice products. T. K. K. Menon and V. C. Nair. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, C.7-C.15.—The Dean & Stark distillation method was applied to moisture determination in molasses and massecuite and values were then compared with results obtained using the Karl Fischer method, showing close agreement. For reasons of simplicity and time consumption, the Dean & Stark method is preferred for routine analysis. An ion exchange method described in the literature was applied to inorganic anion and cation determination, while sucrose and reducing sugars were determined by the Lane & Eynon method; the total organic non-sugars were then established by subtraction. Comparison is made between the results of the ion exchange method and of the conventional ashing method. Advantages of the former method are discussed.

Colorimetric method of determination of sulphur dioxide in sulphite and sugar. M. Prasad, J. K. Srivastava and S. K. Upadhyay. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, C.17-C.27.—SO_2 was determined in white sugar on the basis of the colour change it caused in hydroquinone, which was maximum at 350 nm. The 5% hydroquinone solution used was acidified with 1M HCl (3 cm^3 acid to 2 cm^3 hydroquinone) and made up with distilled water in a 50-cm^3 flask. A calibration graph was obtained by observing the intensity of the colour change (from slight pink to yellowish) when known volumes of sulphite were added. The method gave values down to 2·3 ppm. Comparison is made with iodometric values and with known quantities of SO_2.

[1] Kroonen & Vader: "Line interference in emission spectrographic analysis" (Elsevier, Amsterdam). 1963.
[2] Mantovani *et al.*: *I.S.J.*, 1968, **70**, 121.
[3] Schneider: *ibid.*, 1974, **76**, 153.
[4] *ibid.*, 1977, **79**, 114.
[5] Kelly & Mak: *ibid.*, 264.

BY-PRODUCTS

Observations on the distribution of vinasse or distillery liquor in the State of São Paulo. F. Brieger. *Brasil Açuc.*, 1977, **90**, 307-314 (*Portuguese*).—The history of the recognition of the nutritional value of vinasse, its composition and factors affecting this, and the literature on its use as fertilizer in Brazil are surveyed, as are its effects on the soil and methods of its distribution. The economics of the Santal system for carriage in a 15-m^3 road tanker, from which the vinasse is sprayed onto the soil at a rate of 35 m^3.ha^{-1} over 180 days (7714 ha), are calculated; with an expected increase in cane yield of 20% above the standard ratoon crop of 54 tonnes.ha^{-1}, a net return of 9,479,125·58 cruzeiros is expected for an outlay of 3,241,974·41 cruzeiros. The return will vary with the variety, and the higher K content in the juice will be more melassigenic than that from cane grown in untreated soil. The figures presented, however, indicate that the practice warrants trials in various parts of Brazil.

Food waste fermentation. L. E. Slater. *Food Eng. Int.*, 1976, **1**, (10), 27-37; through *S.I.A.*, 1978, **40**, Abs. 78-52. Advantages of producing single cell protein by fermentation of food wastes are summarized. Processes of this type developed by four firms using different substrates are described; they include the production of glutamic acid and bacterial biomass from beet molasses by Orsan S.A. Production of lysine is also planned.

Importance of cane tops as a source of forage. F. Geoffroy and M. Vivier. *Nouvelles Agron. Antilles et Guyane*, 1975, **1**, (1), 46-55; through *S.I.A.*, 1978, **40**, 78-77. The nutritive value of cane tops from the three main varieties in Guadeloupe and Martinique and the quantities available were investigated. The dry solids content was high (30-35%), and increased by 5% on burning. The crude protein content was very low (<5%), and decreased on burning. The *in vitro* digestibility was on average 60%, but varied with the length of the growth period, area, and whether the cane was burnt or not.

Effect of various steps of purification on ash content and ash constitution of cellulose. II. Cellulose prepared from sugar cane bagasse. S. Shahine, S. el-Shorbani and M. el-Sadani. *J. Appl. Chem. Biotechnol.*, 1977, **27**, (11), 608-610; through *S.I.A.*, 1978, **40**, Abs. 78-79.—Depithed Egyptian bagasse was subjected to two purification schemes, one involving pre-hydrolysis with H_2SO_4, alkaline pulping and either double bleaching with hypochlorite or hypochlorite-chlorite bleaching, and the other involving prehydrolysis with water, nitric acid pulping and hypochlorite-chlorite bleaching. After each purification step, samples were analysed for total ash, SiO_2, Ca, Fe and Mn; values are tabulated. The first scheme decreased the ash content to a greater extent, and gave a pulp which contained 95·8% α-cellulose and had a 90% degree of whiteness.

Optimum drum volumes in pulp drying and the resultant drum feed temperature. H. Huber. *Zuckerind.*, 1978, **103**, 36-40 (*German*).—Lower Saxony (where the greatest concentration of West German sugar factories is to be found) has brought in a regulation to minimize atmospheric pollution whereby the temperature at the entrance to a pulp drum dryer must not exceed 725°C. The author shows, by means of calculations, that the specific heat consumption in a pulp dryer rises considerably when the drum charge falls below 70% of the nominal value. From a relationship established between inlet and outlet temperature as a function of drum charge, it is shown in graph form that an inlet temperature of 725°C corresponds to a drum charge which is only 56% of the rated. It is calculated that, for a factory of 6000 tonnes.day^{-1} beet slice, the amount of water to be evaporated from the pulp at a lower inlet temperature of 725° as opposed to about 820°C for 70% charge would be such as to require double the normal drum volume as well as increasing the fuel consumption. However, addition of boiler flue gas to the dryer furnace gas is calculated to effect a saving in fuel which increases with fall in dryer charge (to 16·81% at 60% charge compared with 10·02% at 100% charge); the corresponding "cost efficiency" is shown to be 94·50% at 60% compared with 90·20% at 100% charge. At an optimum relationship between boiler performance and pulp drying efficiency it is shown that a relationship also exists between steam and drying economy, and from this an optimum drum volumetric capacity is calculated as function of the inlet temperature, whereby fuel consumption is reduced and water evaporation increased.

Analysis of optimum flows for maximum production in a plant for continuous production of biomass. P. Hernández S., P. García G., I. Vega R. and N. Reitor A. *Centro Azúcar*, 1976, (1-3), 15-25 (*Spanish*).—A linear programming method has been applied to maximizing production of yeast by cultivation on a molasses wort in a continuous operation and the stages (primary separation and evaporation) which govern the overall process identified.

Submerged culture propagation of mushroom (*Volvariella volvacea*) mycelium using distillery slops and blackstrap molasses. J. T. Aguinaldo. *Sugar News* (Philippines), 1977, **53**, 270-274.—Details are given of an experiment on propagation of *V. volvacea* mycelium (rich in protein and vitamin B and therefore suitable for use as animal fodder or, if purified, for human consumption) on vinasse made up to a required Brix by addition of cane molasses. Maximum yield was 0·559 g mycelium per g total fermentable substance in a 9°Bx mixture (22·80 g per litre of slops) to which urea, KH_2PO_4 and $MgHPO_4$ were added before inoculation with the culture.

An overview of by-products utilization in the cane sugar industry. J. M. Paturau. *Maharashtra Sugar*, 1978, **3**, (4), 9-16.—The potential of bagasse and molasses as raw material for by-products of varying types is discussed, and an indication given of manufacturing costs of the individual products, which are classified according to simplicity of processing. Factors which need to be considered in deciding on one or other use of bagasse and molasses are examined, including the minimum quantities of raw material required.

PATENTS

UNITED STATES

Cane harvester topper. D. J. Brassette and R. A. Duncan, *assrs.* Thomson International Company, of Thibodaux, LA, USA. **3,934,391.** 25th July 1974; 27th January 1976.

Method for automatic sugar syrup production. D. R. White, of Western Springs, IL, USA. **3,939,005.** 5th July 1974; 17th February 1976.—See US Patent 3,901,724[1].

Preparing levulose (from dextrose). D. J. Lartigue and H. H. Weetall, *assrs.* Corning Glass Works, of Corning, NY, USA. **3,939,041.** 31st May 1974; 17th February 1976.—Levulose is prepared from an aqueous dextrose solution by reacting it under incubation conditions with cross-linked bacterial cells of a *Streptomyces* micro-organism which have isomerase activity, these cells being the product of reaction of a suspension of individual cells with an aqueous solution containing 4–20 mg of tetrazotized benzidine per g of cells.

Production of citric acid by submerged fermentation. H. Hustede and H. Rudy, *assrs.* Joh. A. Benckiser GmbH, of Ludwigshafen, Germany. (*A*) **3,940,315.** 2nd November 1971; 24th February 1976. (*B*) **3,941,656.** 2nd November 1971; 2nd March 1976.

(*A*) Spores of a citric acid-producing micro-organism (*Aspergillus niger, A. wentii* or *Penicillium citrinum*) are treated in a carbohydrate-containing (molasses) growth medium free of unbound cyanide ions by adding [0·25–1·5 g/litre (0·75–1 g/litre)] ferro- or ferricyanide ions (0·5–3 g/litre of potassium ferrocyanide) during the physiologically intensive development period which occurs during the transition period between the spore-swelling stage and the spore germination stage (7–10 hours after inoculation) (when the pH falls by 0·5-1 unit) and forming mycelial pellets from them. The pellets formed are characterized by a pH development curve essentially free of a lag period. Citric acid is produced by introducing a pellet into a carbohydrate-containing medium (molasses) and carrying out submerged aerobic fermentation. A pH drop of at least 1·5 (at least 2) units occurs in 24 hours after inoculation. The concentration of ferro- or ferricyanide ions is maintained at a minimum of about 0·2 g/litre during the fermentation. Aeration does not exceed 0·4 vol/vol of medium per minute.

(*B*) To a carbohydrate-containing (beet or cane molasses) medium, not later than its sterilization, is added sufficient ferrocyanide ions (as potassium ferrocyanide) to form complexes with one-third to two-thirds of the total complexable substances and assimilable heavy metals present. A second quantity of ferrocyanide ions is added after sterilization of the medium (half before inoculation and half afterwards), sufficient to form complexes with the remaining complexable substances and heavy metals but not enough to block the respiration of the micro-organism, i.e. sufficient to give a level of at least 0·4 g/litre during fermentation. Total ferrocyanide usage is 0·05–4 g/litre. The medium is inoculated with *Aspergillus niger* to produce citric acid during its growth in the medium.

Liquid animal fodder supplement. J. F. Wilson and R. S. Parish, *assrs.* Phillips Petroleum Company, of Bartlesville, OK, USA. **3,940,494.** 29th July 1974; 24th February 1976.—The supplement consists of 24·2–35·0% w/w urea, 26·6–38·6% w/w of molasses solids, 8·6–15·8% w/w of ammonium phosphate and 25·4–27·9% water, the supplement having a crystallization temperature below 36°F and a viscosity sufficiently low that it may be pumped at temperatures below 36°F.

Sucrose hydroxyalkyl ethers. D. Maassen, R. Nast, H. Bormann, H. Piechota and K. J. Kraft, *assrs.* Bayer AG, of Leverkusen, Germany. **3,941,769.** 9th August 1973; 2nd March 1976.—100 parts of sucrose is alkoxyalkylated with 800–2000 parts of ethylene oxide, propylene oxide or 1,2-butylene oxide (or a mixture of these) at 85–130°C and at a pressure of 1·3–5·0 atmospheres, in the presence of 2–5 parts of water, 3–15 (2–20) parts of a low mol.wt. (60-250) (water-soluble) higher alcohol, monoamine or polyamine having a m.p. below 100°C, 40-150 parts of an aromatic hydrocarbon solvent (benzene, toluene, ethyl benzene, xylene or chlorobenzene) and 1–5 parts of an alkali metal hydroxide (2–3 parts of KOH), the mixture being made up initially at 20–100°C.

Cane harvester billet elevator. D. J. Quick, of Bundaberg, Queensland, Australia, *assr.* Massey-Ferguson Services N.V. **3,942,307.** 16th October 1974; 9th March 1976.

Cane planter. P. Populin, L. Populin and G. Scalia, of Home Hill, Australia. **3,943,862.** 4th October 1974; 16th March 1976.

Cane harvester. D. A. Scott and J. C. Hudson, *assrs.* F. W. McConnel Ltd. **3,945,177.** 24th July 1974; 23rd March 1976.

Field operated cane cleaner. L. G. Fowler, of Belle Glade, FL, USA, *assr.* Sugar Cane Growers Cooperative of Florida. **3,946,875.** 26th August 1974; 30th March 1976.

Cane planter. C. V. Allain, of Franklin, LA, USA. **3,946,899.** 7th February 1975; 30th March 1976.

Cane harvesters. D. J. Quick, of Bundaberg, Queensland, Australia, *assr.* Massey-Ferguson Services N.V. (*A*) **3,950,924.** 4th October 1974; 20th April 1976. (*B*) **3,952,482.** 4th October 1974; 27th April 1976.

[1] *I.S.J.*, 1978, **80**, 316.

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 95p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).

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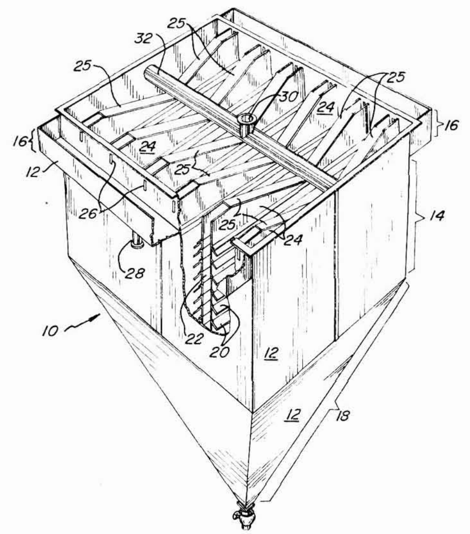
Clarifier. M. Bosnjak, of Englewood, CO, USA. **3,951,818.** 9th December 1974; 20th April 1976.

The clarifier 10 comprises a rectangular tank 12 with an upper separation portion 14, a pyramidal sump portion 18 and a weir or overflow portion 16 on two opposite sides of the tank. Within portion 14 are a series of separation elements 20 constructed of linked segments 22, each supported by horizontal rods running from one side of the tank to the other, as do the elements. The bottom of the element is closed so that the interior of the elements is separated from the bulk of the space within separation portion 14 apart from a series of perforations just under the apex of the angle of the deflector part of the segments.

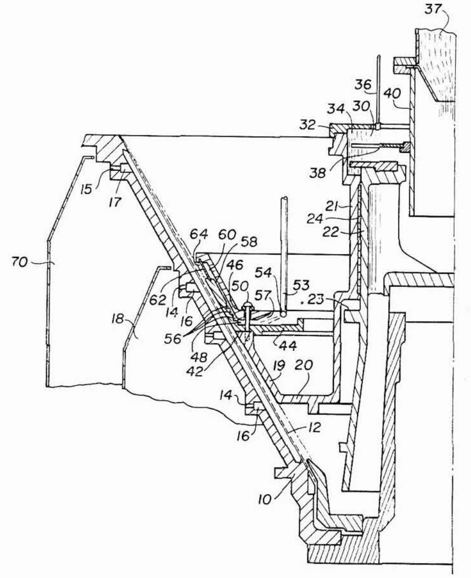


At the top of each segment is a plate 24 running across the width of the clarifier and having a notch in each closed by plate 25, so forming a channel connecting with the interior of the separation elements and, through slots 26 in the tank walls, to overflow portion 16. An inlet for muddy juice 30 is connected to a distribution pipe 32 through which the juice flows into tank 12. Solid particles are directed by the deflector plates on segments 22 into the vertical channels between elements 20 and they sink into the sump 18 from which they are removed as a mud through the bottom valve. Clear juice passes through the perforations in segments 22 and rises within the elements 20, passing eventually through slots 26 into overflow portion 16 and so through pipe 28 to process. The clarifier requires only a short retention time since it provides a high separation surface:volume ratio and steady laminar flow. It is also simple and cheap to construct and easy to clean.

Continuous centrifugal. H. Schaper, of Braunschweig, Germany, *assr.* Braunschweigische Maschinenbauanstalt. **3,955,754.** 16th October 1974; 11th May 1976.—The conical basket of the continuous centrifugal is provided with two screens, the inner having larger perforations than the outer and the conical angle being different if required. Larger crystals are trapped by the inner screen and pass radially to its periphery where they are discharged. Smaller crystals pass with molasses to the second screen where they are separated and also pass radially to the periphery for discharge and mixing with the larger crystals, while molasses passes outwards through the second screen to a collecting chamber. Separation of the crystals in two layers, under conditions appropriate to each, increases the capacity of the machine.

Continuous centrifugal. A. Mercier, of La Madeleine, France, *assr.* Fives-Cail Babcock. **3,956,135.** 2nd October 1974; 11th May 1976.

The generally conventional cone-type continuous centrifugal is provided with a closure plate 20 mounted on a sleeve 21 which surrounds the bearing 22 of the centrifugal, a bushing 24 of PTFE or similar material being interposed. The plate 20 carries a frustroconical periphery 19 which is parallel to the screen 12 and rests on the layer of sugar partly by its own weight and partly by the suction effect of the centrifugal removal of air from the lower part of the basket. The sleeve may rotate with shaft 22 by friction between the cone section 19 and the sugar or it may be keyed to the shaft. Massecuite is delivered by feed pipe 40 for distribution to the bottom of the basket 10, while water is supplied by pipe 36 to the chamber 30 between sleeve 21 and bearing 22 to maintain a liquid seal around pipe 40 and so prevent air entering the bottom portion of the basket.



The cone section 19 carries two further telescoped cone sections 44, 46 which are spaced slightly apart to form a channel 58 by means of which wash water from pipe 53 entering chamber 57 is carried to chamber 60 and passes through the perforations in a screen plate 62 onto the sugar layer in a narrow band which is unaffected by air currents and so purges the sugar more efficiently since it does not bounce off the sugar and is not carried upwards to be discharged over the basket rim with the crystals.

World sugar production 1978/79[1]

	1978/79	1977/78	1976/77
BEET SUGAR		tonnes, raw value	
Belgium/Luxembourg	853,000	791,000	732,000
Denmark	446,000	566,000	415,000
France	4,002,000	4,268,000	2,974,000
Germany, West	2,951,000	3,076,000	2,735,000
Holland	1,022,000	905,000	945,000
Ireland	210,000	182,000	189,000
Italy	1,630,000	1,355,000	1,747,000
UK	1,141,000	1,033,000	755,000
Total EEC	*12,255,000*	*12,176,000*	*10,492,000*
Austria	354,000	495,000	416,000
Finland	102,000	70,000	77,000
Greece	354,000	294,000	386,000
Spain	1,174,000	1,198,000	1,407,000
Sweden	326,000	344,000	302,000
Switzerland	103,000	85,000	83,000
Turkey	1,278,000	1,082,000	1,284,000
Yugoslavia	763,000	766,000	650,000
Total West Europe	*16,709,000*	*16,510,000*	*15,097,000*
Albania	20,000	15,000	20,000
Bulgaria	250,000	210,000	240,000
Czechoslovakia	710,000	939,000	620,000
Germany, East	730,000	780,000	560,000
Hungary	540,000	486,000	400,000
Poland	1,850,000	1,850,000	1,800,000
Rumania	700,000	775,000	610,000
USSR	8,800,000	8,825,000	7,350,000
Total East Europe	*13,600,000*	*13,880,000*	*11,600,000*
Total Europe	*30,309,000*	*30,390,000*	*26,697,000*
Afghanistan	15,000	12,000	15,000
Algeria	15,000	10,000	10,000
Azores	11,000	7,000	7,000
Canada	126,000	139,000	163,000
Chile	95,000	132,000	315,000
China	1,000,000	980,000	860,000
Iran	533,000	580,000	666,000
Iraq	13,000	13,000	11,000
Israel	14,000	37,000	39,000
Japan	390,000	365,000	339,000
Lebanon	11,000	14,000	15,000
Morocco	320,000	243,000	337,000
Pakistan	33,000	31,000	37,000
Syria	35,000	30,000	24,000
Tunisia	8,000	12,000	9,000
Uruguay	60,000	49,000	66,000
USA	3,039,000	2,844,000	3,534,000
Total Other Continents	*5,718,000*	*5,498,000*	*6,447,000*
Total Beet Sugar	36,027,000	35,888,000	33,144,000
CANE SUGAR			
Spain	20,000	15,000	22,000
Total Europe	*20,000*	*15,000*	*22,000*
Barbados	120,000	104,000	124,000
Belize	108,000	118,000	96,000
Costa Rica	217,000	192,000	195,000
Cuba	7,100,000	7,350,000	6,607,000
Dominican Republic	1,300,000	1,150,000	1,275,000
Guadeloupe	100,000	81,000	91,000
Guatemala	450,000	410,000	527,000
Haiti	65,000	61,000	48,000
Honduras	205,000	129,000	107,000
Jamaica	340,000	306,000	297,000
Martinique	13,000	14,000	16,000
Mexico	3,200,000	3,049,000	2,670,000
Nicaragua	225,000	261,000	224,000
Panama	238,000	187,000	172,000
Puerto Rico	159,000	183,000	243,000
St. Kitts	35,000	41,000	43,000
El Salvador	296,000	293,000	340,000
Trinidad	170,000	148,000	178,000
USA—Hawaii*	952,000	988,000	938,000
Mainland	1,460,000	1,497,000	1,519,000
Total N. & C. America	*16,753,000*	*16,562,000*	*15,710,000*
Argentina	1,370,000	1,666,000	1,559,000
Bolivia	270,000	281,000	272,000
Brazil	7,600,000	8,757,000	7,598,000
Colombia*	1,100,000	1,000,000	853,000
Ecuador	320,000	295,000	301,000
Guyana*	379,000	368,000	253,000
Paraguay	77,000	71,000	57,000
Peru*	820,000	895,000	926,000
Surinam	10,000	9,000	5,000
Uruguay	40,000	53,000	21,000
Venezuela	440,000	402,000	450,000
Total S. America	*12,426,000*	*13,797,000*	*12,295,000*
Angola	65,000	59,000	47,000
Cameroun	47,000	36,000	33,000
Chad	20,000	15,000	15,000
Congo	20,000	16,000	33,000
Egypt	680,000	623,000	626,000
Ethiopia	170,000	159,000	135,000
Ghana	19,000	15,000	13,000
Ivory Coast	58,000	33,000	32,000
Kenya	248,000	221,000	182,000
Liberia	10,000	9,000	1,000
Madagascar	115,000	116,000	114,000
Madeira	1,000	1,000	2,000
Malawi	136,000	93,000	87,000
Mali	16,000	15,000	15,000
Mauritius	695,000	705,000	731,000
Morocco	40,000	18,000	8,000
Mozambique	150,000	190,000	220,000
Nigeria	34,000	27,000	36,000
Réunion	257,000	249,000	249,000
Rhodesia	250,000	290,000	270,000
Senegal	30,000	30,000	35,000
Somalia	30,000	20,000	32,000
South Africa	2,135,000	2,244,000	2,198,000
Sudan	190,000	150,000	151,000
Swaziland	255,000	237,000	220,000
Tanzania	130,000	100,000	113,000
Uganda	12,000	16,000	23,000
Upper Volta	32,000	30,000	22,000
Zaire	41,000	45,000	46,000
Zambia	110,000	75,000	85,000
Total Africa	*5,996,000*	*5,837,000*	*5,774,000*
Bangladesh	185,000	194,000	152,000
Burma	42,000	39,000	32,000
China*	2,950,000	2,920,000	2,570,000
India	6,300,000	7,000,000	5,250,000
Indonesia	1,492,000	1,264,000	1,033,000
Iran	150,000	108,000	80,000
Iraq	20,000	20,000	15,000
Japan	300,000	281,000	228,000
Malaysia	90,000	80,000	50,000
Nepal	29,000	28,000	17,000
Pakistan	795,000	866,000	746,000
Philippines	2,200,000	2,397,000	2,750,000
Sri Lanka	29,000	25,000	25,000
Taiwan	848,000	767,000	1,123,000
Thailand	2,140,000	1,624,000	2,282,000
Vietnam	25,000	33,000	25,000
Total Asia	*17,595,000*	*17,646,000*	*16,378,000*
Australia	3,000,000	3,440,000	3,390,000
Fiji	343,000	376,000	307,000
Total Oceania	*3,343,000*	*3,816,000*	*3,697,000*
Total Cane Sugar	56,133,000	57,673,000	53,876,000
Total Beet Sugar	36,027,000	35,888,000	33,144,000
Total World Sugar	92,160,000	93,561,000	87,020,000

* 1979, 1978, 1977 calendar years.

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (35), 1–7.

BREVITIES

Spanish sugar factory closures[4].—After closure of the Adra cane sugar factory in Almeria, the cane sugar industry of Spain is reduced to six factories having a total capacity of 3450 t.c.d., the smallest in Almuñécar, Granada, having a crushing capacity of 250 t.c.d. and the largest, in Torre del Mar, a capacity of 1300 t.c.d. The sugar factories at Málaga and Salobreña process 1000 tonnes of beet per day but also crush 1300 and 1000 tonnes of cane per day, respectively. With the closure of the 850 tonnes/day Burgos beet sugar factory in the northern Spain Province of the same name, by Sociedad Industrial Castellana (part of the Ebro Group), the beet sugar sector in Spain is reduced to 33 sugar factories having a daily slice in 1977/78 of about 78,000 tonnes.

Iran sugar industry structure[1].—According to a USDA report there are 33 beet sugar factories in Iran, of which 5 are owned by the Central Government, 3 by Provincial Governments, 4 are under Army supervision, and the remaining 21 are privately owned. The rated capacities total about 800,000 tonnes per year. Two additional factories are under construction. The two cane sugar factories run by the Government have a rated sugar production capacity of 350,000 tonnes per year. The beet sugar factories are currently facing a crisis of supply, however, with some operating for as little as 50 days. Consequently Iran has stopped production of raw sugar and all is now as white sugar. Iran uses about 100,000 tonnes of sugar per month, about half as cube sugar and half as granulated white sugar. The USDA, on the basis of the estimates below, believes that in 1978/79 Iran will import more sugar than is produced. The figures refer to the national crop year, March 21 to March 20.

	1976/77	1977/78	1978/79
		hectares	
Beet area planted	200,000	165,000	153,000
Cane area planted	8,800	11,000	15,000
		tonnes, raw value	
Initial stock	577,000	312,000	230,000
Production: Beet sugar	613,000	534,000	490,000
Cane sugar	74,000	99,000	140,000
Imports	258,000	495,000	718,000
	1,522,000	1,440,000	1,588,000
Domestic consumption	1,200,000	1,200,000	1,200,000
Exports	10,000	10,000	10,000
Final stocks	312,000	230,000	378,000

Southdown Sugars Inc. closure.—Southdown Sugars Inc. of Louisiana, formerly owner of four raw sugar factories and a sugar refinery, has decided to cease operation of all its production units, as well as its subsidiary, Cane Tech Sugar Consultants[2], with effect from December 31, 1978.

US 1977 sugar crop loan period extension.—Most of the outstanding 1977-crop loans which, under the sugar price support regulations, mature 11 months after the loans were made, were due to mature between November 30, 1978 and March 31, 1979. Owing to the lack of market opportunities within this period, processors with sugar under loan to the Commodity Credit Corporation indicated that they would not be able to redeem and market the sugar. As a consequence, the US Department of Agriculture announced on November 24 that the maturity period would be extended to September 30. At the time of the announcement the sugar under loan amounted to about 350,000 short tons of cane sugar and 128,000 tons of beet sugar.

Zambia sugar export plans frustrated[3].—The Zambian Government has postponed plans to export sugar, owing to a shortage of sugar in the country caused by high rainfall and delays in the 1978/79 cane harvest. Instead, the Zambian Sugar Company is to develop a stockpile to prevent further shortages from recurring. It is also to expand production and, to this end, has signed an agreement with the West German Government for a loan to finance its new production plans. The EEC Commission has meanwhile recommended that the Zambian request to join the Sugar Protocol of the Lomé Convention should be rejected, partly based on its doubt whether Zambia can maintain an annual 13,000 tonnes of sugar exports to the EEC and also on the observation that Zambia has an export quota of 70,000 tonnes a year for the free market under the International Sugar Agreement.

Bangladesh sugar industry modernization[5].—The Industry Ministry in Bangladesh has prepared a Tk 270 million plan to develop and modernize the sugar industry in the next two years. It is proposed to set up a sugar refinery, the Thakurgaon and Deshbandu sugar mills are to be balanced and modernized, and mills at Rajshahi and other places are to be expanded. Among other projects, a second distillery with a capacity of 1,000,000 gallons per year is planned. With Australian assistance, model farms are to be established in North Bengal, cultivating high-yielding varieties. Renwick & Co., an engineering workshop under the Food and Sugar Mills Corporation, will be modernized to produce spare parts for the sugar industry, so cutting down on imports, The sugar industry has currently a rated capacity of 179,000 tonnes of sugar a year and 170,118 tonnes, tel quel, were produced in the July 1977/June 1978 season against 138,707 tonnes in 1976/77. The cane area was expanded from 357,000 acres in 1976/77 to 379,000 acres in 1977/78 and cane production rose from 6,401,000 to 6,590,000 tonnes.

Queensland cane transport by rail[6].—A $A 4 million rail system is to be built in North Queensland to haul sugar cane to Invicta Mill at Giru, south of Townsville. Financed by cane grower levy, its 46-km track will replace a road transport system linking the mill with Clare and the Millaroo and Dalbeg areas. Invicta Mill will provide the rolling stock and maintain the line.

New Indonesian sugar factory[7].—A new sugar factory is to be built in the Sambas regency of West Kalimantan and is expected to be in operation by the middle of 1979. It will be located in Sekura village, on a 5 ha site in a 600 ha cane plantation. Estimated daily production capacity is about 200 tons of sugar. Construction will be undertaken by PT Boma Stork of Pasuruan, under the supervision of the Indonesian Ministry of Agriculture. All the required finance will come from Presidential aid.

Yeast plants in Cuba[8].—A French-designed plant to produce animal fodder yeast has come on stream at a sugar factory in Ciego de Avila. The plant, the first of ten in a programme of the sugar ministry, cost 10 million pesos (US $13·5 million) and has a design capacity of 40 tonnes per day. Four more such plants were due to come on stream in 1978. The aim of the programme, devised in conjunction with the Instituto Cubano de Investigación de Derivados de la Caña de Azúcar (ICIDCA), is to convert the sugar industry's by-products into protein foodstuff for the rapidly expanding livestock sector.

Japan refining capacity[9].—According to reports from Japan it is generally believed that the sugar refining industry is 20% in excess of the refining capacity needed for domestic consumption. The Refiners' Association has therefore suggested that member refineries establish a fund by imposing a 1500 yen per ton levy on raw sugar melted which will be paid to those who scrap their refineries; this has not been agreed by all members, however, several preferring free competition[10].

[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (34), 19–20.
[2] *I.S.J.*, 1978, **80**, 94.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110** (31), 26.
[4] *Zuckerind.*, 1978, **103**, 988.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (33), 20.
[6] *Queensland Newsletter*, 15th November 1978.
[7] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (32), 20.
[8] *Latin America Econ. Rpt.*,; through *Westway Newsletter*, 1978, (60), 12.
[9] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (32), 20.
[10] *ibid.*, (33), 19.

BREVITIES

Nicaragua sugar production 1977/78[1].—Sugar production in Nicaragua in the 1977/78 campaign amounted to 212,143 tonnes, white value, of which 115,000 tonnes is for domestic consumption. 1978/79 production is estimated at some 215,000 tonnes.

Poland sugar industry expansion[2].—In an attempt to enlarge and modernize its sugar industry, the Polish authorities have allocated 2200 million zloty for investment and 180 million zloty for modernization. Construction of new beet sugar factories is continuing and in 1979 a new factory is expected to go into production in the Rzeszow Province with, in two years' time, two more in Ciechanow and Glinojeck Provinces. Additional factories are planned for the 1980's. The beet purchasing points are also being enlarged or new ones built.

Storm damage to Philippines sugar crop[3].—The Philippine Sugar Commission has stated that, owing to damage caused by storms in the sugar-growing areas of the country, the estimated 1978/79 sugar production was reduced from 2·34 to 2·1 million tonnes, tel quel, a reduction of 10%.

White sugar silo for Egypt[4].—An ABR Engineering storage silo for white sugar, with a capacity of 65,000 tonnes, is to be built at the Kafr el Cheikh sugar factory in Egypt. This new factory, with an annual production capacity of 100,000 tonnes, ordered from Fives-Cail Babcock, has selected the ABR Engineering silo to store its white sugar production because of its ability to provide the most suitable storage conditions, with a waterproof steel shell, insulation, and heating and ventilation by a closed-circuit air conditioning system. All sugar handling operations, including complete stock removal, will be fully automatic. Despite its very advanced technical features, operating costs of the silo, both in terms of power consumption and labour, are very low.

Cane smut in St. Kitts[5].—Cane smut disease, which is now rampant among cane planted in St. Kitts, could wipe out 70% of the island's sugar crop by 1980, according to an agronomist of the Government National Agricultural Corporation.

Thailand sugar situation[6].—With expansion of the industry, Thailand has increased exports from less than 100,000 tonnes as recently as 1970 to 1·7 million tonnes in 1977. Under the International Sugar Agreement, Thailand's 1978 export quota was set at 1,020,000 tonnes; however, no significant sugar surplus problems are anticipated because drought conditions reduced the size of the 1977/78 crop and raw sugar output was cut by 15–20% from the 1976/77 level of 2·3 million tonnes, while domestic requirements are 550,000–600,000 tonnes. In addition, Thailand is to build up stocks of 81,500 tonnes under the Agreement in 1978 and 1979 and a further 40,750 tonnes in 1980.

Bagasse board plant closure in South Africa[7].—The Hulett Group's particle board factory, which traded under the name Hulsakane Ltd. and which was placed "in mothballs" in 1975, has now been sold to another company. The plant was established in 1972 at a cost of R5,000,000 and located next to Hulett's Amatikulu sugar factory, for the manufacture of particle board from bagasse. It was the world's largest bagasse board plant but, owing to a decline in demand, Huletts stopped board production in February 1975 and veneering and other operations later that year. An investigation was held recently into the possibility of restarting production, but particle board demand is still low and it was decided not to reopen the plant. Hulett's will continue to retain the fibre preparation plant at Amatikulu.

Venezuela sugar imports[8].—Venezuela is designated an exporting member of the International Sugar Agreement although it is as ong ago as 1973 since any sizeable shipments were made from that country. Factories are understood to be operating at less than 50% of capacity, partly owing to lack of cane supplies, which reflects competition from other crops and an inadequate supply of labour. In the circumstances it has become increasingly necessary for recourse to be made to imports. Under a trade agreement signed in 1977, it was agreed that the Dominican Republic would deliver 110,000 tonnes of sugar to Venezuela each year for three years at a price which would be related to the internal price in Venezuela. At that time it was mentioned that the net return to the Dominican Republic would work out at between 9·80 and 10·00 cents per pound. The agreement gave to the Dominican Republic the option of meeting up to 50% of any additional requirements by Venezuela in excess of the 100,000 tonnes. It has been reported that supplies for a 12-month period in 1978/79 had been raised to 300,000 tonnes, of which 40,000 tonnes were for the last quarter of 1978 and 260,000 tonnes in 1979. It is not clear whether this will cover all of Venezuela's requirements in 1979; in 1978, in addition to the supplies from the Dominican Republic, Venezuela also purchased sugar from Brazil.

New cane rust disease in Puerto Rico[9].—According to the US Department of Agriculture, a rust fungus disease new to US sugar cane fields has been found in Puerto Rico. The USDA Animal and Plant Health Inspection Service officials expect to use existing emergency regulations to prevent spread of the disease to the Continental US and Hawaii.

Colombia sugar expansion[10].—Consumption of centrifugal sugar in Colombia increased from 771,461 tonnes in 1975/56 to 844,247 tonnes in 1976/77 and 911,225 tonnes in 1977/78, representing, in relative terms, increases of 7·93% and 9·43% per annum, respectively. A parallel increase has also been observed in the consumption of non-centrifugal sugar (panela). The Government's long-term sugar policy is to encourage production to meet increasing domestic demand and also to return to the country's former role as a regular exporter of sugar to earn foreign exchange. Production of panela is also receiving support for expansion in order to avoid reallocation of cane for panela production. Should production of centrifugal sugar prove insufficient to meet requirements, imports will again be permitted, as in 1977/78 when Colombia imported 99,767 tonnes of sugar from Argentina, Cuba, Ecuador, the EEC and Peru.

PERSONAL NOTES

Dr. Don J. Heinz has been elected Vice President and Director of the Experiment Station of the Hawaiian Sugar Planters' Association. He is a native of Idaho, attended Utah State University, where he received degrees of Bachelor of Science and Master of Science, and was granted the Doctor of Philosophy degree by Michigan State University in 1961. Dr. Heinz joined the staff of the HSPA Experiment Station as an Associate Plant Breeder in 1961. He was appointed Head of the Department of Genetics and Pathology in 1966 and was appointed Assistant Director of the Experiment Station in 1977. He succeeds **Robert L. Cushing,** who retired as HSPA Experiment Station Director on December 31, 1978. Dr. Cushing will continue to serve the Association part-time as Vice President-Administration and Secretary.

As a consequence of the closing down of Southdown Sugars Inc. and their subsidiary, Cane Tech Sugar Consultants, **Dr. J. C. P. Chen,** formerly Technical Director of the company, and a principal of the Cane Tech firm, is entering private consultancy on an individual basis. His wide experience in raw sugar manufacture, refining and by-products utilization will be available to clients on a full-time or part-time engagement. His address is 417 Westview Drive, Houma, LA 70360, USA.

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1 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (31), 25.
2 *World Sugar J.*, 1978, **1**, (5), 26.
3 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (31), 27.
4 *S. African Sugar J.*, 1978, **62**, 521.
5 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (32), 15.
6 *USDA Sugar & Sweetener Rpt.*, 1978, **3**, (11), 15.
7 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (32), 17.
8 C. Czarnikow Ltd., *Sugar Review*, 1978, (1416), 228.
9 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (36), 17.
10 *World Sugar J.*, 1978, **1**, (6), 27.

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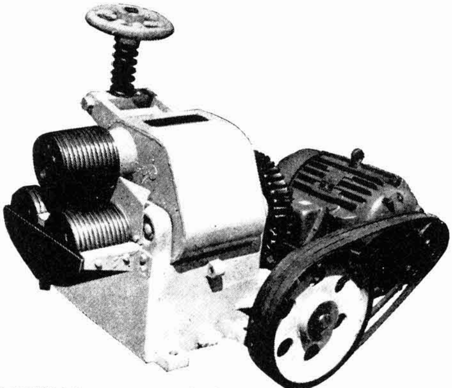

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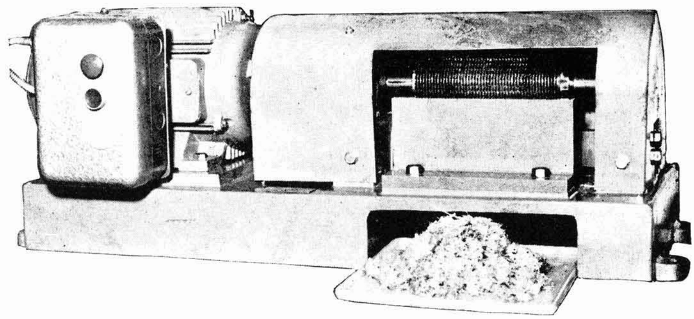

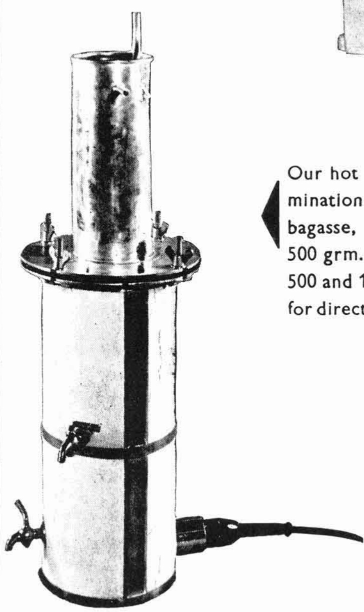

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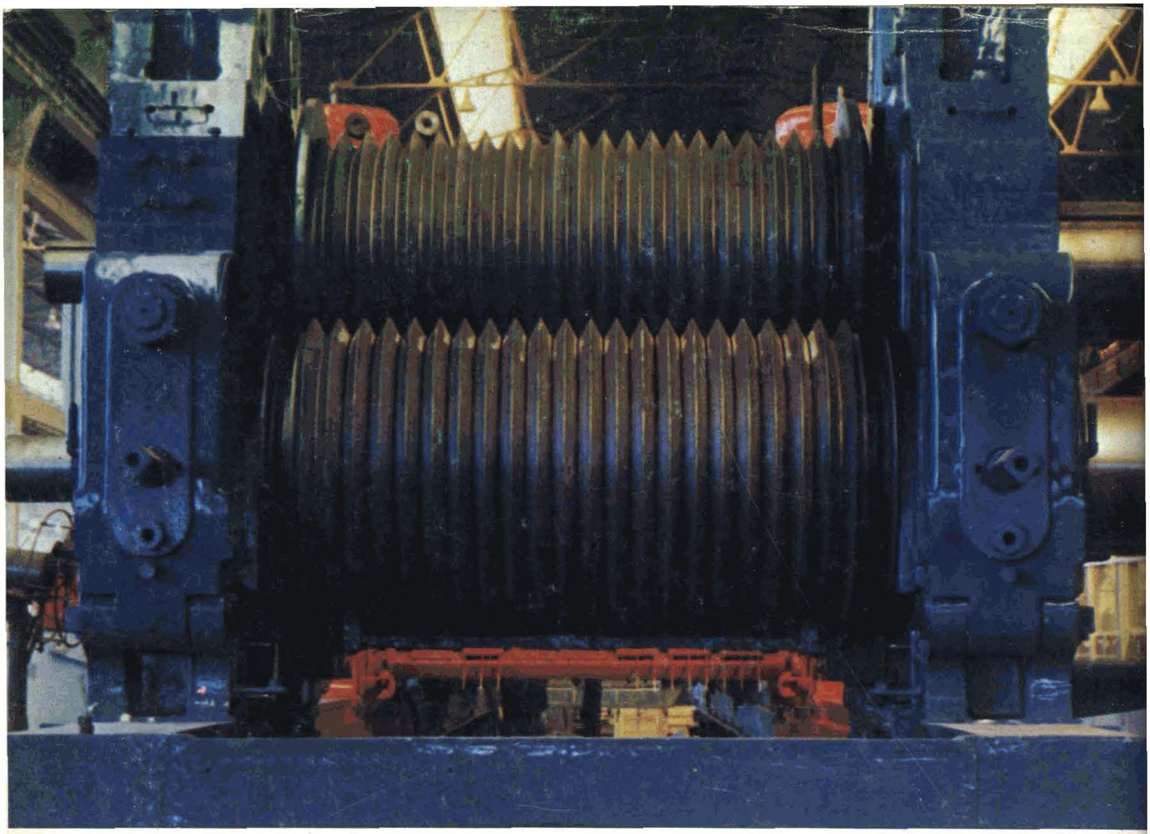

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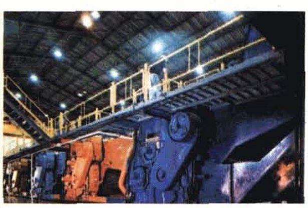

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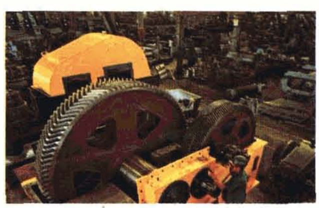

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