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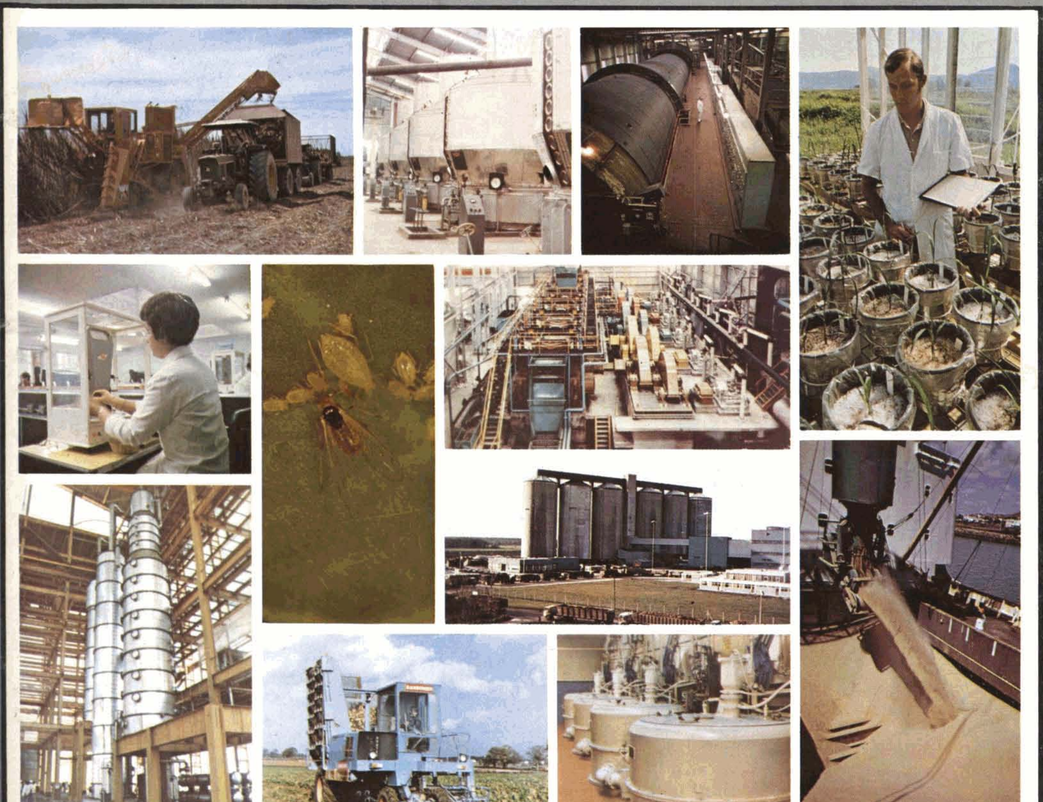

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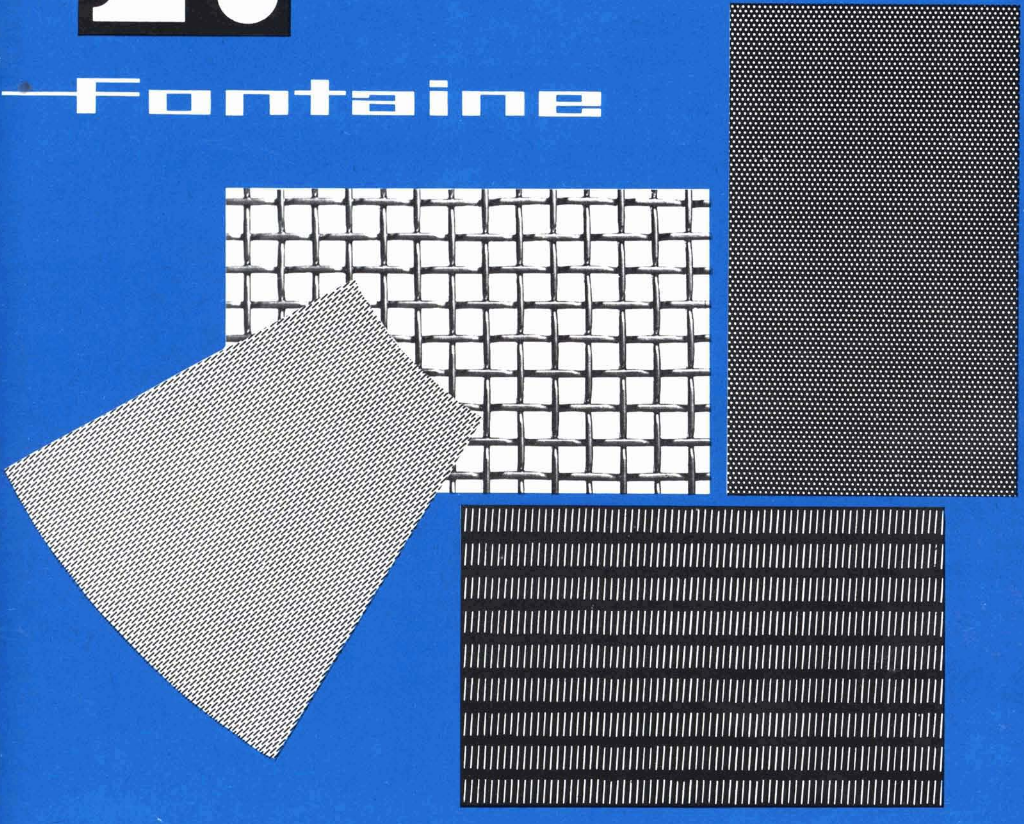

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NOTES AND COMMENTS

World sugar prices

The London Daily Price of raw sugar started the month of March at £255 per tonne and ended it at £226, varying between these extremes throughout the month except on March 12 when the price fell to £224. The LDP(W) started at £284 per tonne and after once reaching £285 fell to £260 at the end of the month, white sugar values showing a premium over raw sugar which varied between £25 and £42 but which for most of the month was between £28 and £32. There have been no major items of news to affect a rather quiet market and refiners are believed to be buying on a hand-to-mouth basis, partly because of the financial cost of holding stocks and partly in the self-fulfilling anticipation of lower prices. Strength towards the end of the month came from the small amounts of white sugar released by the EEC from its appreciable stocks.

International Sugar Agreement

With the fall in sugar prices, the ISA prevailing price (the average of the daily price over 15 days) entered the 13 – 23 cents/lb range of the agreement in the middle of March. No action is called for until the prevailing price drops for five market days below 21 cents/lb and there were indications that this might occur in April. At this point, importing members are obliged to restrict their imports from non-members to 75% of their average imports in the three highest years from 1973 to 1976. In practice this will have little effect, with the possible exception of EEC exports to the USSR; but the extent of Soviet purchases in the future remains uncertain as always, and sugar bought and shipped within 90 days of the restriction trigger point are excluded so that there is scope for avoidance of the limitation if this were desired.

Should the prevailing price fall bellow 17 cents/lb there would be a much more important effect; export quotas may then be imposed by the International Sugar Council (they must be imposed at 16 cents/lb).

Falling Japanese sugar requirements

The mutually-agreed cancellation of contracts for the supply of Philippines sugar to Japan has been reported, as has the reluctance of Japanese refiners to enter into long-term commitments. The reasons are clear in a reported statement by the Japanese Ministry of Agriculture[1]. The Ministry has revised downward the nation's requirements for the period October 1980/September 1981 to 2.04 million from 2.23 million tonnes estimated last September, following slow domestic consumption. The revised figure represents a reduction of 13.6% on the 2.36 million tonnes of raw sugar imported in 1979/80. Additionally some 135,000 tonnes of white sugar were imported in 1979/80.

Estimated consumption is set at 2.79 million tonnes, white value, down from the 2.89 million tonnes of 1979/80, while domestic production is estimated at 721,000 tonnes, white value, in 1980/81 against 711,000 tonnes last year. In the meantime, high fructose corn syrup production in Japan rose sharply to 360,000 tonnes during the period April-October 1980 from 290,000 tonnes in the same period of 1979.

Improved outlook for Indian sugar[2]

There has been a substantial improvement in the outlook for sugar production in India now pricing arrangements have changed so as to enable the factories to compete satisfactorily with the gur and khandsari manufacturers. Current indications range from 5.2 to 5.4 million tonnes, white value, compared with just under 3.9 million tonnes in 1979/80. A return to India's former status as an exporter will occur this year though the tonnage will fall far short of India's ISA basic export tonnage. The outlook for next season is said to be very good and with increased capacity and more cane available there have been suggestions that more than seven million tonnes may be achieved.

Morocco sugar expansion[3]

Prior to 1963, sugar production in Morocco was practically non-existent although, centuries ago, the Agadir region of Morocco, located in the southern part of the country, is supposed to have been one of the sources of supply of cane sugar to the Egyptian court. In the early 1960's a government policy emerged, designed to reduce Morocco's dependence on imported sugar by encouraging the development of domestic production. The government established guaranteed prices for beet growers, made credits available and set up projects.

The first beet sugar factory was completed in 1963 at Sidi Slimane and since then a further eight beet sugar factories (one of which can also process sugar cane) and a cane sugar factory have started operation. The nominal daily capacity is 35,200 tonnes of beet and 3,500 tonnes of cane but the factories operated at only some 70% of capacity in 1980. Consequently production of white sugar – 297,360 tonnes from beet and 33,173 tonnes from cane, a total of 330,533 tonnes – is considerably less than might have been obtained.

It is planned in 1981 to expand daily slicing capacity at Beni Mellal to 4,800 tonnes and to erect a beet sugar factory (Surag I) of 4,000 tonnes daily capacity in the Gharb region. In 1982 the daily capacity of Zaio factory is to be expanded to 3,500 tonnes and a new beet sugar factory is to be erected at Zemamra in the Doukkala region. A second factory in the Gharb region (Surag II) is to be erected with a 4,000 tonnes daily slice in 1983 and a cane sugar factory is to be built in the Loukkos region in 1984.

By 1985 beet sugar production is expected to rise to 434,000 tonnes while cane sugar output should reach 151,000 tonnes, giving a total of 585,000 tonnes or 77% of annual consumption expected in that year, against the 54% covered by domestic production in 1980.

World sugar balance, 1980/81

World Sugar Journal[4] and F. O. Licht GmbH[5] have both recently published estimates of the balance between world sugar production and distribution for 1980/81, together with comparative figures for a number of years previous. Both production and stock figures are calculated on different bases so the figures are not directly comparable; nevertheless, *World Sugar*

1 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 43.
2 C. Czarnikow Ltd., *Sugar Review*, 1981, (1526), 1.
3 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 45-49.
4 1981, **3**, (8), 10.
5 *International Sugar Rpt.*, 1981, **113**, 87.

Journal indicates that the production deficit for the period will be 2,367,000 tonnes, raw value (86,886,000 tonnes production *vs.* 89,253,000 tonnes consumption). while Licht estimates the deficit at 2,663000 tonnes (86,980,000 tonnes production *vs.* 89,643,000 tonnes consumption). In both cases, therefore, a substantial reduction in stocks is expected during the period, although the tightness is less than had been expected some months ago and prices are accordingly lower. Consumption in the developed countries appears to be lower than expected earlier, partly owing to substitution by HFCS but also to consumer resistance to high prices. Recent price levels of 20 – 30 cents/lb seem to reflect a new supply and demand balance and lower prices on greater availability could strengthen demand, correcting the imbalance and restoring the price.

The next major influence will probably be the news of plantings for the 1981/82 crops; Cuba and Brazil have announced expansion plans and, since the 1980/81 figures have been considerably influenced by adverse weather conditions in a number of areas, good weather throughout the world could provide several million tonnes of sugar more in 1981/82. However, the very high capital cost of enlarging crop areas and processing capacity, plus high interest charges on that capital, in conjunction with the insecurity of good returns on investment, are likely to inhibit large-scale expansion which would lead to the surpluses of 1976 – 1979, and the very low prices of that period seem unlikely to return.

Mexico sugar imports[1]

Official press reports from Cuba in March stated that 100,000 tonnes of refined sugar had been sold to Mexico and a similar tonnage was sold in February. Deliveries of Cuban sugar to Mexico amounted to some 400,000 tonnes in 1980. It has also been reported that 150,000 tonnes of US refined sugar has been acquired on a basis of raw sugar quotations plus a premium. It is remarkable how Mexico has recently emerged as a major importer when in the first half of the past decade it was an important supplier of sugar to the US market. Estimates vary but it seems probable that this year Mexico will need to import between 600,000 and 800,000 tonnes of sugar.

African sugar potential

A survey on potentialities and problems in a number of the countries of Africa has recently been published by Mr. A. Viton[2]. He notes that "Africa's production expansion has been remarkable, but it should be observed that the deficit has nevertheless increased steadily. Production (exclusive of Mauritius, Réunion and South Africa) has risen from less than 800,000 tonnes in 1955/57 to more than 2.8 million tonnes in 1975/77 and to 3.5 million tonnes in 1979/80. However, consumption has risen from 1.65 million tonnes to more than 4.2 million tonnes in 1975/77 and to about 5.6 million tonnes last year. As a result the continent's deficit (net imports) increased from 800,000 tonnes to 1.5 million tonnes in 1975/77 and to 2.1 million tonnes during 1979/80.

"All of these trends are likely to continue to 1985 at least. On the assumption that the price of sugar imports will average below 20 cents a pound and that current general economic and financial conditions will continue so the African countries will be able to pay for sugar supplied on this price assumption, consumption demand is likely to rise to 7.3 – 7.5 million tonnes, more than 1.5 million tonnes above that of 1980. On the other hand, it is difficult to see production increases of more than a million tonnes. Substantial production expansion will take place in Egypt, the Ivory Coast, Kenya and the Sudan, and by smaller amounts in eight or nine other countries, but on present expansion programs and policies the continent's output is not likely to exceed 4.3 – 4.5 million tonnes".

Brazil sugar production increase[3]

The President of the Brazilian Sugar and Alcohol Institute said recently that Brazil could produce up to 8.8 million tonnes of sugar, raw value, in the 1981/82 crop year, compared with about 8.2 million tonnes in 1980/81 and 7.2 million tonnes in 1979/80. The rise in production would result from an increase in productivity, with sugar cane output likely to exceed 160 million tonnes in 1981/82 compared with 145 million tonnes in 1980/81 and 120 million tonnes in 1979/80. The area planted to sugar cane in Brazil is likely to increase only a small amount in 1981/82 from the 2.5 million hectares in 1980/81 and 2.4 million ha in 1979/80.

Alcohol production in the 1981/82 crop year will probably be between 46 and 48 million hectolitres, up from 39 million hl in 1980/81 and 36 million hl in 1979/80. The government is investing 2800 million cruzeiros in 1981 into research to increase productivity and to develop cane which is rich, pure and resistant to attack by disease and insects. Investment in research in 1980 was 1100 million cruzeiros.

The government aims to increase the level of domestic stocks, which are practically nil, so that exports of sugar in 1981 will be the same or only slightly more than 2.6 million tonnes exported in 1980. Alcohol exports in 1981 are likely to be between 1 and 2 million hl, down from last year's 3.3 million hl.

The prices for cane, sugar and alcohol in Brazil have been raised by between 18 and 21% from the end of January. The government is studying a price indexing plan, designed to boost productivity, under which prices paid to manufacturers and producers would be based on how close their output came to a national minimum average established by the government. The average production of alcohol in Brazil is 70 litres per tonne of cane and, under the plan, this could possibly rise to 80 litres per tonne. No minimum averages have yet been established.

US loan program hearings

Hearings have been taking place since the beginning of March before the Senate Agriculture Committee and the House Agriculture Sub-Committee at which growers and producers have been urging the incorporation of support measures for sugar into the 1981 Farm Bill, by adoption of a loan program similar to those of recent years. The US Cane Sugar Refiners Association have argued that no such support is necessary and this is undoubtedly true at the high price levels which have prevailed during the past 18 months.

However, if the price should decline appreciably, or if renegotiations of a new International Sugar Agreement in 1982 should fail, US domestic producers could be left in a vulnerable position without such support. Sugar users have said they favour protection for the domestic industry but prefer sugar to be given a comprehensive study in legislation separate from other farm programs.

1 C. Czarnikow Ltd., *Sugar Review*, 1981, (1536), 43.
2 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 103-109.
3 *ibid.*, 98-99.

Juice decalcification and its effect on molasses production

By J. F. T. OLDFIELD, M. SHORE, N. W. BROUGHTON and G. C. JONES

PART II

The total chloride content of the output from the column during each regeneration sequence was obtained by integrating to obtain the area under the curve for each stage, multiplying by the flow rate for that stage, and summing the three answers. The figures thereby obtained for each regeneration sequence are compared in Table V below with the corresponding total chloride input to the column from the brine regenerant, expressed as kiloequivalents of chloride. Since the stage times were measured to the nearest minute, the figures in the final column contain rounding errors of up to 3%.

Table V. Comparison of chloride in and out of columns during regeneration

Regeneration sequence	Chloride IN (keq)	Chloride OUT (keq) Regeneration	Wash	Rinse	Total Output	Output/Input (%)
1	44.9	23.2	16.5	12.5	52.2	116
2	49.8	24.9	21.8	1.8	48.5	98
3	44.9	25.4	19.7	0	45.1	100
4	44.9	26.6	17.4	1.2	45.2	101
5	44.9	23.8	16.5	0.6	40.9	91

In regeneration 1 the chloride balance estimated from the samples was poor. There was a substantial amount of chloride in the spent rinse, and hence the brine for the next regeneration, diluted with this spent rinse, was also slightly high in chloride content. Regenerations 2, 3 and 4 gave a good chloride balance in and out of the columns.

In regeneration 5, the measured chloride in the output was about 10% less than that in the input; it is suggested that this was because in this cycle there was probably, and unusually, a significant amount of chloride in the water draining from the column immediately after the wash stage and, as mentioned above, this drain water was not included in the balance. The principal cation associated with this unmeasured chloride would be sodium from the excess regenerant, rather than ions previously removed from the juice, as the results in the Appendix for the end of the wash and the beginning of the rinse stages of regeneration cycle 5 suggest. The error introduced into the estimation of the amounts of potassium, ammonium and calcium on the resin after exhaustion by the omission of the drain water analyses would therefore be expected to be much smaller than that created in the chloride balance by this omission in cycle 5.

It was therefore considered that regeneration cycles 2 to 5 would provide reliable data for calculating the overall exchange of juice cations during an exhaustion cycle. The sum of the quantity of each cation eluted during each of the three major stages of a regeneration would be expected to be very close to the total quantity of that cation which was exchanged on to the resin during the previous exhaustion.

Potassium, ammonium and calcium were measured on the samples from these four regeneration sequences by the methods referred to earlier. The results are quoted in the Appendix. For each individual sample, the sum of the measured cation contents was the stoichiometric equivalent of the chloride content, confirming that all cations present had been accounted for.

The cation concentrations during the four regenerations studied are given in Fig. 4, combined in a single diagram. The changes in concentration were rapid compared with the maximum practical sampling frequency, and therefore this method of representation gives a much more detailed picture than studying each regeneration separately.

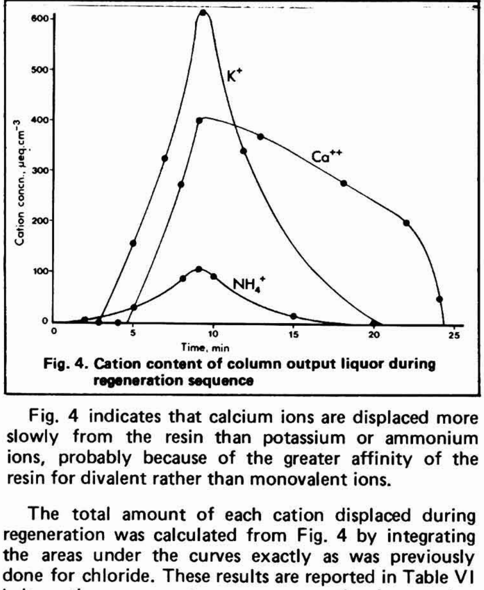

Fig. 4. Cation content of column output liquor during regeneration sequence

Fig. 4 indicates that calcium ions are displaced more slowly from the resin than potassium or ammonium ions, probably because of the greater affinity of the resin for divalent rather than monovalent ions.

The total amount of each cation displaced during regeneration was calculated from Fig. 4 by integrating the areas under the curves exactly as was previously done for chloride. These results are reported in Table VI below; they represent averages over the four cycles.

Table VI. Cations displaced during regeneration

Cation	keq	keq per m^3 resin	% of total keq
Potassium	4.98	0.55	41.5
Ammonium	0.78	0.09	6.5
Calcium	6.24	0.69	52.0
Total	12.00	1.33	100.0

The four regeneration cycles monitored covered three different columns with resin capacities in the range 1.45 – 1.63 keq per m^3. The average resin capacity was 1.51 keq per m^3 and so the results reported in Table VI correspond to an average of about 87% of the available capacity being utilized in exchange reactions in the complete exhaustion cycle, with calcium removal from the juice accounting for just over half of this use of capacity.

In Table VII, the result for each ion is compared with the corresponding mean value of the results given in Table III for the initial part of the exchange in four cycles.

Table VII. Cations adsorbed on resin during factory exhaustion

Cation	keq per m^3 adsorbed during initial part of cycle (27 bed volumes)	keq per m^3 adsorbed during complete cycle (270 bed volumes)
Potassium	0.69	0.55
Ammonium	0.06	0.09
Calcium	0.03	0.69
Total	0.78	1.33

These results indicate that, after the initial, and short, part of the exhaustion cycle, a further 0.66 keq calcium and 0.03 keq ammonium in juice were exchanged for 0.14 keq potassium and, by difference, 0.55 keq sodium from the resin for each m^3 of resin. It is therefore clear that calcium/sodium exchange was the predominant mechanism for decalcifying juice in this latter part of the cycle.

There are two reasons why calcium ions would be expected to exchange with the sodium ions on the resin in preference to exchanging with the potassium ions. Firstly, the high potassium content of the juice relative to the sodium content would alter the equilibrium of the exchange reactions in favour of adsorption of potassium ions onto the resin. Secondly, a potassium ion in solution can approach more closely to the negatively-charged sites of attachment on the cation exchange resin than can a sodium ion, because of the smaller hydrated ionic radius of the former[13], and hence will be held more strongly than a sodium ion in accordance with Coulomb's law of electrostatic forces.

The total calcium exchanged onto the resin in the complete exhaustion cycle in the factory was 0.69 keq per m^3 (i.e. 1.2 lb CaO/ft^3). Each cycle thus removed about 125 kg calcium which would otherwise very likely have formed lime scale.

Exchange reactions involving ammonium ions were of very little significance. Analysis of spent rinse samples indicated that only about 0.02 keq per m^3 resin of the ammonium ions on the resin prior to regeneration came from the factory general hot water used at the rinse stage, to give 0.07 keq per m^3 resin removed from the juice.

It is now possible to calculate the overall change in juice non-sugars occurring during the decalcification process. For every 0.69 kiloequivalents (13.83 kg) of calcium ions removed from juice, the plant also removed 0.55 kiloequivalents (21.51 kg) of potassium ions and 0.07 kiloequivalents (1.26 kg) of ammonium ions in exchange for 1.31 kiloequivalents (30.12 kg) of sodium ions. This corresponds to the net removal of 6.48 kg non-sugars from the juice by decalcification.

Without decalcification the ammonium ions would be lost as ammonia during evaporation and, as discussed earlier, it would be necessary to add at least the stoichiometric equivalent of soda-ash, i.e. 1.61 kg sodium, to maintain the acid-base balance. Omitting the effect of this ammonium/sodium exchange, the effective decrease in non-sugars as a result of ion exchange was 6.83 kg per 13.83 kg calcium removed.

At the time of the experiments, Wissington second carbonatation juice before decalcification was typically 13.5° Bx and 91.9% apparent purity. The typical cation composition by analysis and the non-sugars content calculated from the apparent purity are shown in Table VIII below. By decalcification, the typical calcium content was lowered from 28 to 7 mg per 100g apparent solids, which corresponds to a reduction in lime salts from 0.039 to 0.010g CaO per 100° Bx. Using this information and the results quoted in the previous paragraph, the concentrations of the other cations and of the non-sugars after decalcification were calculated, and are given in the Table for comparison with the untreated juice.

Table VIII. Juice composition before and after decalcification

Component	Before mg/litre	Before mg/100°Bx	After mg/100°Bx	Change mg/100°Bx
Potassium	1500	1053	1021	−32
Sodium	250	176	221	+45
Calcium	40	28	7	−21
Ammonia	110	77	75	− 2
Non-sugars	11533	8100	8090	−10

Table VIII indicates a reduction of 10 mg non-sugars per 100° Brix as a result of decalcification. To the nearest whole number, this estimated reduction is not altered by discounting the ammonium/sodium exchange. Such a decrease in non-sugars corresponds to an increase in juice purity of about 0.01 units.

From these data it is possible to estimate the change in the non-sugars composition of molasses as a result of decalcification. For molasses of 60% apparent purity and 83°Bx, there would be a decrease in molasses non-sugars of about 41 kg per 100 tonnes molasses.

These factory investigations have shown that decalcification of typical British Sugar second carbonatation juice results in a net decrease in juice non-sugars. As pointed out earlier in this paper, if all the calcium which is removed from the juice by the resin were exchanged for sodium alone, there would be a net increase in juice non-sugars. In the BMA-Gryllus process[14], there is neither a net increase nor a net decrease in juice non-sugars as a result of the ion exchange: the ions removed from the juice by ion-exchange before evaporation are replaced in thick juice by using the thick juice to regenerate the resin. Advocates of this process[15,16] have tended to compare it with a decalcification process in which only calcium/sodium exchange occurs, ignoring other exchange reactions, and they have thereby distorted the relative merits of the two processes.

Molasses formation

The observed change in juice non-sugars as a result of a typical decalcification process within British Sugar can be used to estimate the accompanying change in sugar in molasses. Most of the several approaches to this are based on the assumption that the molasses is exhausted. As this is generally not so within British Sugar, results obtained by applying such theories need to be treated with caution.

13 Stern & Amis: *Chem. Rev.*, 1959, **59**, 1-64.
14 Gryllus & Delavier: *Zeitsch. Zuckerind.*, 1975, **100**, 493-501.
15 Anon: *BMA Information*, 1977, (16), 27-29.
16 Ponant: *Sucr. Franç.*, 1979, **120**, 263-267.

The simplest approach to molasses formation, and one that is applicable to molasses which is not exhausted, is to assume that equal weights of all non-sugars have an approximately equal melassigenic effect. Thus, for molasses of 60% apparent purity, a change in non-sugars of 1 kg would be accompanied by a change in molasses sugar of 1.5 kg. Applying this to the results obtained for the Wissington plant, a net decrease in non-sugars of 41 kg per 100 tonnes molasses would reduce the sugar in molasses by 62 kg per 100 tonnes molasses. At 4% molasses on beet this would increase sugar production by 0.0025% on beet, or 250 kg per day at a factory slicing 10,000 tonnes/day.

Although it is not justified to use this method of calculation merely on the basis that molasses from juice with and without decalcification are both at the same purity, since the changes in non-sugars and in the associated sugar are too small to give a measurable change in molasses purity whatever their relative proportions, there are probably situations where it will give the correct result empirically. It may be regarded as estimating the magnitude of the two main effects by which non-sugars can be considered to influence the sugar content of molasses which is not exhausted, i.e. the effect on the solubility of sucrose and the effect on the rate of crystallization of sucrose.

The amount of sugar in molasses will be affected if decalcification causes any change in factors such as juice viscosity which affect the crystallization rate of sucrose. Calcium, sodium and potassium ions are known to affect juice viscosity[17,18]. Their salts, moreover, are known to inhibit the deposition of sucrose molecules in crystal lattice sites[19-22]. The replacement of calcium and potassium ions with sodium ions during decalcification would thus be expected to affect the crystallization rate, and hence the amount of sugar in molasses for a fixed crystallizer retention time. Present knowledge is perhaps inadequate to permit the magnitude of such effects to be separately estimated.

Some other considerations may also be pertinent to the question of the effect of decalcification on molasses sugar. Hartl[23] suggested that decalcification plants remove some nitrogenous organic non-sugars to give an increase in juice quality, while Smit[24] also suggested that other non-sugars besides the cations are removed and observed that the molasses sugar in ten factories studied showed an average decrease of 0.05% on beet after the installation of a decalcification plant.

The effect of non-sugars on the solubility of sucrose in molasses has been studied for many years, but the resultant methods of estimating the magnitude of the effect are valid only for exhausted molasses. The earliest theory was that of Dedek[25], who observed that exhausted molasses contains approximately one molecule of sucrose per atom of sodium or potassium, and suggested that some form of bonding might exist between them, keeping the sucrose in solution. Other cations, which did not form such 'bonds', would not be melassigenic. On this basis, decalcification would give rise to additional sugar in exhausted molasses, since exchange of sodium ions on the resin for any other ion in juice except potassium would increase the total sodium plus potassium content of molasses.

Carolan[26] extended this idea to include atoms of calcium, from analysis of exhausted molasses of high calcium content. In decalcification, 1 equivalent of calcium is replaced by 1 equivalent of a monovalent cation, i.e. each ion of calcium is replaced by two ions of sodium or potassium. On Dedek's theory, this exchange would increase the sucrose content of exhausted molasses by two molecules. On Carolan's theory, the sucrose content would only be increased by one molecule, and adoption of this modified theory would thus give a lower estimate of the effect of decalcification on the sugar content of molasses at exhaustion.

Nowadays, it is generally assumed that the correlation between the molar concentrations of cations and sucrose is largely empirical, and that other non-sugars also have melassigenic effects. Silin & Silina[27] determined the change in the weight of sucrose which was soluble in a standard molasses for unit change in the weight of each of a wide range of specific non-sugars: this ratio is termed the melassigenic coefficient. On the assumption that the cations exchanged during decalcification are present in molasses as chlorides (one of the most abundant anions in molasses), then the appropriate Silin melassigenic coefficients are 2.58 for NaCl, 2.48 for KCl and 0.56 for $CaCl_2$. Using these values, the ion exchange during decalcification recorded in Table VIII, with the exclusion of 2mg/100°Bx ammonium/sodium exchange, would give an estimated increase in molasses sugar at exhaustion of 397 kg per 100 tonnes molasses. At 4% molasses on beet, this would reduce sugar production by 0.016% on beet, or 1600 kg/day at a factory slicing 10,000 tonnes/ day.

Different estimates can, of course, be obtained according to the choice of anions, but chloride is among the more melassigenic of the anions in molasses[28].

The use of these melassigenic coefficients assumes that the amount of sugar held in exhausted molasses by a specific non-sugar is directly proportional to the amount of that non-sugar present. However, Vavrinecz[28] has presented extensive evidence that most non-sugars, including the chlorides of potassium, sodium and calcium, exert opposing effects on the solubility of sucrose in exhausted molasses at different concentrations: at low concentrations, the solubility is reduced by a small increase in the amount of these non-sugars, whereas at higher concentrations the solubility is increased.

These opposing effects on sucrose solubility can be allowed for by use of modified Wagnerowski equations for each non-sugar considered. Vavrinecz[28] obtained such equations for the chlorides of potassium, sodium and calcium from a study of the experimental data obtained by many previous investigators. Applying these equations to the change in non-sugars during decalcification given in Table VIII, but omitting the ammonium/ sodium exchange, gives an estimated increase in molasses sugar at exhaustion of 203 kg per 100 tonnes molasses. At 4% molasses on beet, this is equivalent to 0.0081% on beet, or 810 kg/day at a factory slicing 10,000 tonnes/ day.

17 Pieck, Houssiau & Vandewijer: *Sucr. Belge*, 1968, **87**, 319-326, 371-377.
18 Breitung: *Zeitsch. Zuckerind.*, 1956, **81**, 185-193, 254-260.
19 Schliephake, Zeichner, Orlowski & Schneider: *I.S.J.*, 1968, **70**, 131-134.
20 Mantovani: *Zucker*, 1967, **20**, 198-204.
21 Kharin & Dobromirova: *Izvest..V. U. Z., Pisch. Tekhnol.*, 1972, **1**, 134-137; *S.I.A.*, 1972, **34**, 152.
22 Kharin, Dobromirova & Kharin: *Sakhar. Prom.*, 1972, **46**, (9), 21-23; *S.I.A.*, 1973, **35**, 87.
23 *Zucker*, 1959, **12**, 534-542.
24 *Sucr. Belge*, 1962, **82**, 6-8.
25 *Z. Ver. deutsch. Zuckerind.*, 1927, **77**, 495.
26 Carolan: *Paper presented to the Irish Sugar Co. Tech. Conf.*, 1960.
27 *I.S.J.*, 1964, **66**, 255-258.
28 Vavrinecz: *Sugar Technol. Rev.*, 1978-9, **6**, 117-305.

Juice decalcification

Decalcification, of course, changes only the cation content of juice. To use either the Silin or the Vavrinecz approaches to estimating the resultant change in molasses sugar, an anion must be selected with which the cations might be thought to be in association. Other workers[17,29,30] have examined the melassigenic effects of individual cations by using molasses in which all the cations have been replaced by a single specific cation by ion exchange. Their findings might therefore be thought to be more appropriate for calculations of changes in molasses sugar which result from decalcification. Application of their results should be treated with caution, however, as the proportion of cations exchanged in decalcification is only a small part of the total and the melassigenic effect of cations on exhausted molasses is not necessarily directly proportional to their concentration.

Zagrodzki & Zaorska[7] used this technique to estimate the effect of decalcification on molasses formation. Their results were based on higher lime salts levels in juice than are normal within British Sugar and hence the amount of potassium exchanged relative to calcium was less than half that in Table VI. Substituting data from Table VIII into their calculations gives an estimated increase in sugar in exhausted molasses of approximately 166 kg per 100 tonnes molasses. This substitution is not strictly valid since their experiments were at a different non-sugar:water ratio but it indicates the order of magnitude of the change in molasses sugar calculated by this method for typical changes in juice cations by decalcification in British Sugar.

In conclusion, the many different methods of calculation all indicate that there is only a small change in the sugar content of molasses as a result of using decalcification. From the studies made during typical operations of a standard British Sugar decalcification plant, it can be calculated that the effect is within the likely range 0.06 tonnes decrease in molasses sugar to 0.20 tonnes increase in molasses sugar per 100 tonnes molasses – the upper of these two limits is, of course, only valid for exhausted molasses.

Magnesium exchange

Ion exchange of approximately half the cations in low green syrup for magnesium ions by the Quentin process[31,32] can be used to reduce the amount of sugar in molasses. It is worth considering whether use of magnesium ions rather than sodium ions as regenerant in a modified second carbonatation juice decalcification process would similarly lead to a reduction in the amount of sugar in molasses.

There are several ways in which magnesium exchange might affect the sugar content of molasses. First, such exchange decreases the weight of non-sugars in the juice. Second, the Quentin process reduces the viscosity of the mother liquor in final massecuite[17], giving an increase in crystallization rate. Third, magnesium ions have been shown to be less melassigenic in exhausted molasses than potassium, sodium or calcium ions[29,30]. As the proportion of cations exchanged in decalcification is much smaller than in the Quentin process, the benefits from these effects in a modified decalcification process using magnesium ions would likewise be expected to be smaller.

The magnesium salt normally used as an ion exchange regenerant for the Quentin process[31] is magnesium chloride, for which the current United Kingdom price is £9.00 per kiloequivalent. Regenerant costs could be reduced by the use of kieserite[32], agricultural grade hydrated magnesium sulphate, currently costing £4.80 per kiloequivalent (plus capital costs not exceeding £1 per kiloequivalent for additional handling plant.) By contrast, sodium chloride costs £1.99 per kiloequivalent and, therefore, the cost of regeneration with magnesium ions would be considerably more than with sodium ions, even though it would require fewer kiloequivalents of regenerant because of the greater affinity of the resin for divalent cations[1].

This affinity of the resin for multivalent ions might result in a less efficient exchange for juice cations than when using resin in the sodium form. This effect is reduced in the Quentin process by applying a juice with a high concentration of cations (low green syrup) to displace the equilibrium to favour the exchange.

In a laboratory experiment similar to those simulating decalcification described earlier in this paper, columns containing 10 cm^3 of Zerolit 525 resin were fully regenerated with excess magnesium chloride solution and then exhausted by a synthetic "juice" containing sucrose and the cations potassium, sodium and calcium (as chloride) in the concentrations used previously.

The output juice was collected in fractions and analysed. When the calcium content of the output juice was the same as that of the input juice, the column was regenerated and the spent regenerant collected and analysed.

The ions adsorbed onto the resin initially (calculated from analysis of the output juice for the first 100 bed volumes treated), and at exhaustion (calculated from analysis of the spent regenerant) are reported in Table IX below, as milliequivalents per cm^3 of resin.

Table IX. Cations adsorbed on resin (magnesium form)

Cation	meq. adsorbed initially (100 bed volumes)	meq. displaced at regeneration (1000 bed volumes)
Potassium	0.82	0.85
Sodium	0.16	0.16
Calcium	0.15	1.05
Total	1.13	2.06

The results indicate that after the initial displacement of magnesium ions from the resin by potassium ions, and to a lesser extent by sodium and calcium ions, the main reaction was calcium/magnesium exchange. It is probable that the absence of magnesium from the input juice made this exchange the most favourable for removal of calcium.

The experiment suggests that calcium, and some potassium, in second carbonatation juice would be exchanged for magnesium ions in a modified decalcification process. The sugar content of the resultant magnesium-rich molasses would be lower than that of the sodium-rich molasses from conventional decalcification: a comparison of the data in Tables VII and IX suggests that, for each kiloequivalent of calcium removed, the net effect of magnesium regeneration compared with sodium regeneration might be to remove an additional 1.96 kiloequivalents of sodium and to add an additional 1.96 kiloequivalents of magnesium to the juice.

29 Quentin: *Zucker.*, 1957, **10**, 408-415, 432-433.
30 Moebes: *Zeitsch. Zuckerind.*, 1957, **82**, 382-386.
31 Quentin: German Patent 974, 408 (1960).
32 Oldfield, Shore, Harvey, Gyte & Jones: *I.S.J.*, 1979, **81**, 103-108, 138-143.

The basic purpose of decalcifying juice, of course, is to prevent scale formation in later processing, and magnesium decalcification would probably be less suitable for this than conventional sodium decalcification. Although such magnesium salts as chloride and sulphate are rather more water soluble than the corresponding sodium salts, others such as carbonate and oxalate are very much less soluble. There might therefore be an increase in scaling of evaporators and white pans compared with conventionally decalcified juice. Moreover, this scale would not necessarily have the same properties, for example with respect to heat transfer, as the conventional calcium scale.

It is thus probable, for each kiloequivalent of calcium removed, that magnesium decalcification would reduce the sugar content of molasses compared with conventional decalcification but that the regenerant costs would be substantially higher and that scaling would be increased.

APPENDIX

Analytical Data for Wissington Factory Samples

(a) Composition of individual column output juices during four exhaustion cycles

Time from sweeten-on (hours.min)	Cation concentration ($\mu g.cm^{-3}$) — Cycle 1				Cycle 2			
	Na	K	Ca	NH_4	Na	K	Ca	NH_4
0.15	1125	0	10	0	1150	0	N.D.	N.D.
0.30	1075	0	N.D.	N.D.	1125	0	N.D.	N.D.
0.45	1125	0	N.D.	27	1100	0	N.D.	34
1.00	1025	0	9	N.D.	1125	0	N.D.	68
1.15	975	10	N.D.	107	925	50	N.D.	N.D.
1.30	475	850	N.D.	ND	400	1050	N.D.	N.D.
1.45	200	1450	3	102	200	1600	N.D.	N.D.
2.00	175	1450	N.D.	ND	190	1630	13	N.D.
2.15	180	1480	10	94	–	–	–	–
2.30	–	–	–	–	220	1610	N.D.	N.D.
2.45	198	1470	11	90	–	–	–	–
3.00	–	–	–	–	300	1575	N.D.	N.D.
3.15	213	1463	10	N.D.	–	–	–	–
4.00	–	–	–	–	330	1493	N.D.	N.D.
5.00	–	–	–	–	319	1500	11	N.D.
5.15	225	1525	9	N.D.	–	–	–	–
7.00	–	–	–	–	275	1538	11	N.D.
7.15	238	1500	9	N.D.	–	–	–	–
11.00	–	–	–	–	219	1513	8	N.D.
11.15	213	1688	10	N.D.	–	–	–	–
14.00	–	–	–	–	238	1538	11	N.D.
15.15	281	1588	9	N.D.	–	–	–	–
17.15	N.D.	N.D.	14	N.D.	–	–	–	–
18.15	N.D.	N.D.	31	N.D.	–	–	–	–
19.15	250	1613	46	N.D.	–	–	–	–
	Cycle 3				Cycle 4			
	Na	K	Ca	NH_4	Na	K	Ca	NH_4
0.15	–	–	–	–	1363	0	9	N.D.
0.30	1000	20	N.D.	35	1250	0	N.D.	71
0.45	1050	20	N.D.	53	775	175	N.D.	140
1.00	975	20	N.D.	N.D.	425	1525	N.D.	N.D.
1.15	750	400	9	N.D.	388	1625	10	N.D.
1.30	250	1450	N.D.	N.D.	400	1575	N.D.	N.D.
1.45	225	1550	N.D.	N.D.	425	1600	N.D.	N.D.
2.00	275	1575	N.D.	N.D.	425	1625	N.D.	N.D.
2.15	325	1525	6	N.D.	475	1625	10	N.D.
3.15	250	1325	8	N.D.	375	1550	10	N.D.
4.15	250	1400	N.D.	N.D.	400	1487	N.D.	N.D.
5.15	250	1550	7	N.D.	363	1575	7	N.D.
7.15	–	–	–	–	181	1563	11	N.D.
8.15	175	1475	6	N.D.	–	–	–	–
9.15	–	–	–	–	300	1600	8	N.D.
11.15	500	1525	N.D.	N.D.	325	1550	9	N.D.
14.15	220	1425	27	N.D.	–	–	–	–
15.15	–	–	–	–	263	1513	8	N.D.
19.15	–	–	–	–	238	1550	16	N.D.

N.D. = Not determined
– = No sample

Conclusions

When a decalcification plant is operating under representative conditions, the net effect during the exhaustion part of the cycle is the removal of both calcium and potassium ions from the juice and their replacement by sodium ions. Small quantities of ammonium ions are also removed.

Most of the removal of potassium occurs during the first two hours or so of each exhaustion, and in the remainder of the exhaustion sequence some of the potassium which has been removed is exchanged back into the juice for calcium ions. The observed exchanges can be explained in terms of the relative concentrations of the various cations in juice and the relative strengths with which they are bound to the negatively charged sites in the resin beads.

The net effect of a typical cycle is to remove about 41 kg cations per 100 tonnes molasses. Calcium removal amounts to some 86 kg per 100 tonnes molasses, potassium removal to 131 kg per 100 tonnes molasses and sodium addition to 176 kg per 100 tonnes molasses. The corresponding typical reduction in lime salts is from 0.039 to 0.010g CaO per 100°Bx.

According to which theory of molasses formation is preferred, this small net reduction in molasses non-sugars is estimated to cause a change in the sugar content of molasses ranging between an increase of 200 kg per 100 tonnes molasses and a decrease of 60 kg per 100 tonnes. The former estimate is derived from a theory which is strictly valid only for exhausted molasses, unlike the latter.

Although it would reduce the amount of sugar in molasses compared with conventional decalcification using a resin in the sodium form, decalcification with a resin in the magnesium form would be considerably more costly and would probably increase scaling.

Acknowledgements

The authors wish to thank the Management of Wissington factory for permission to monitor their plant, Mr. D. Sargent and Mr. N. Williams for assistance during that study, Mr. P. L. Howard for carrying out much of the laboratory work in this paper, and Dr. C. W. Harvey for his part in the earlier work described.

Summary

Some of the processes that take place during ion exchange decalcification of 2nd carbonatation juice,as practised in several British Sugar Corporation factories, are discussed and their probable effects on molasses production are examined.

La décalcification du jus et son effet sur la production de mélasse

Certains phénomènes chimiques qui ont lieu au cours de la décalcification par échange d'ions du jus de 2ème carbonatation, telle que pratiquée dans nombre d'usines de la British Sugar Corporation, sont discutés et leurs effets probables sur la production de mélasse sont examinés.

Saftentkalkung und deren Wirkung auf die Melasseerzeugung

Einige chemische Vorgänge bei der Entkalkung des zweiten Carbonatationssaftes durch Ionenaustausch, wie sie in vielen Fabriken der British Sugar Corporation praktiziert wird, werden diskutiert und ihre wahrscheinlichen Auswirkungen auf die Melasseerzeugung untersucht.

Descalcificación de jugo y su efecto sobre produccion de melaza

Algunos de los procesos químicos que ocurren durante la descalcificación por cambio de iones del jugo de la segunda carbonatación, como practicado en muchos de los ingenios de la British Sugar Corporation, se discuten y sus efectos probables sobre la producción de melaza se examinan.

(b) Composition of second carbonatation juice before decalcification

Samples were taken at approximately 4-hourly intervals over the period of 48 hours during which the columns were being monitored

Cation concentration (μg.cm^{-3})

Na	K	Ca	NH_4
230	1470	44	ND
ND	ND	60	ND
240	1420	58	ND
ND	ND	44	ND
230	1550	40	120
270	1570	38	ND
250	1520	36	102
370	1470	22	ND
170	1570	52	ND
330	1550	26	108
270	1500	34	ND
230	1510	36	ND
259	1513	41	110

ND = Not determined

(c) Composition of individual column output liquors during five regeneration sequences

Samples were taken at five-minute intervals, the number for each stage varying according to the stage time

Column Ion Concentration (μeq.cm^{-3})

Regen:	1	2					3					4					5				
Stage	Cl	C!	Na	K	Ca	NH_4	Cl	Na	K	Ca	NH_4	Cl	Na	K	Ca	NH_4	Cl	Na	K	Ca	NH_4
Regen-	0	0	0	1	0	6	0	1	2	0	ND	0	0	1	0	ND	9	1	2	1	ND
eration	1663	809	113	323	220	84	973	163	439	275	88	0	1	1	0	ND	318	39	154	30	35
"	2065	2128	1347	333	415	43	1821	1130	211	365	29	1568	348	615	405	104	1810	783	538	295	98
"	–	2326	2000	50	250	5	2022	1717	20	265	ND	2074	1217	256	370	32	2227	1478	50	245	16
	–	–	–	–	–	–	–	–	–	–	–	2056	1565	50	275	ND	–	–	–	–	–
Wash	2080	2326	2261	0	195	2	2074	1870	0	190	ND	2080	1739	0	200	ND	2080	1652	0	175	ND
"	2154	2275	2261	0	145	ND	2048	1913	0	135	ND	581	500	0	18	ND	2080	1739	0	130	ND
Drain	2142	47	70	0	0	ND	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Rinse	1961	202	26	0	0	ND	20	21	0	0	ND	190	22	0	0	ND	43	43	0	0	ND
"	12	1	1	0	0	ND	14	17	0	0	ND	3	7	0	0	ND	1	15	0	0	ND
"	2	1	5	0	0	ND	4	9	0	0	ND	1	7	0	0	ND	1	6	0	0	ND
"	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	6	0	0	ND

ND = Not determined
– = No sample

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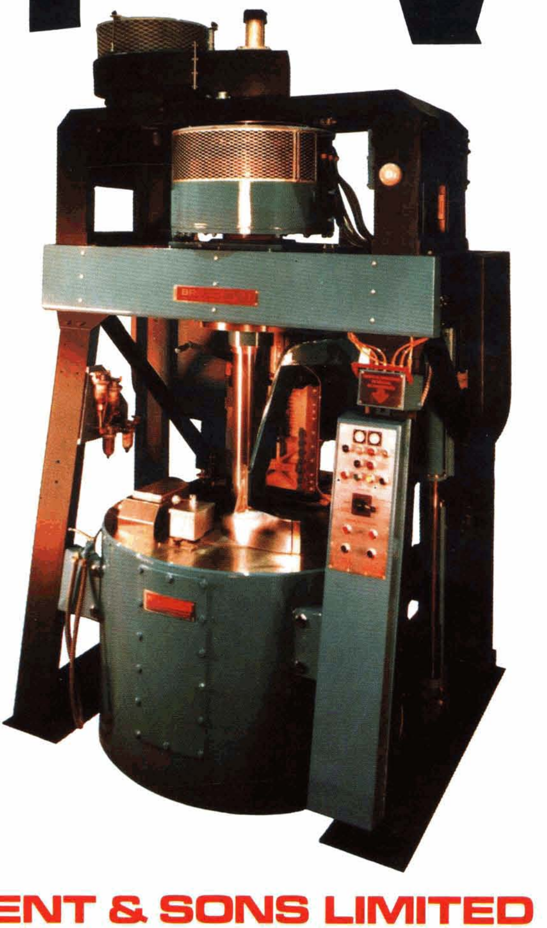

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Enzymic colour formation in sugar beet

Characterization of enzymes using catecholamines

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PART II

Temperature inactivation

In general, the temperature is important in two ways for enzymic reactions. By increasing the temperature, the rate of reaction increases. However, by increasing the temperature, the rate of inactivation of the enzyme also increases, giving a fall of activity. In the system we are dealing with, a third factor is of importance: the product formed (e.g. rednorepinephrine) disappears when a solution of the compound is kept at an increased temperature for some time.

Samples of a crude enzyme preparation have been heated to various temperatures for 15 min. Afterwards, the samples were incubated with a 250 ppm norepinephrine solution of pH 6.0 at 37°C for 60 min. The samples were then filtered, and the extinctions measured at 485 nm. The results are shown in Fig. 7. It must be concluded that, during the extraction of the sugar, the enzyme must exert a certain activity and convert some of the extracted catecholamines to the corresponding red compounds.

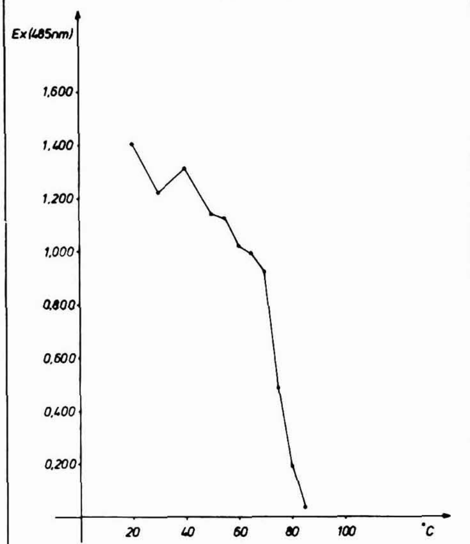

Fig. 7. Temperature inactivation of enzymic activity. Enzyme preparations were heated to various temperatures for 15 min. Afterwards the samples were mixed with a solution of norepinephrine and incubated at 37°C

Effect of pH on the enzymic activity

Samples of crude enzyme preparations have been mixed with norepinephrine, the samples adjusted to various pH values, and then incubated at 25°C for 30 min. An activity maximum was found at pH about 5-6. No enzymic activity was found when the pH of the solution was below 2.0. At about 7-8, a minimum was found in the enzymic activity—pH curve.

In the diffuser, the pH might depend on the microbial activity[13], but the pH normally found coincides with the maximum found for the enzyme.

Effect of substrate concentration on enzymic activity

Initial investigations of the importance of the substrate concentration in relation to the enzyme concentration have shown a complicated relationship.

Purified enzyme preparations have been incubated with norepinephrine at 25°C, and the absorption of the samples at 485 nm have been measured a number of times. Some results are shown in Fig. 8. An enzyme

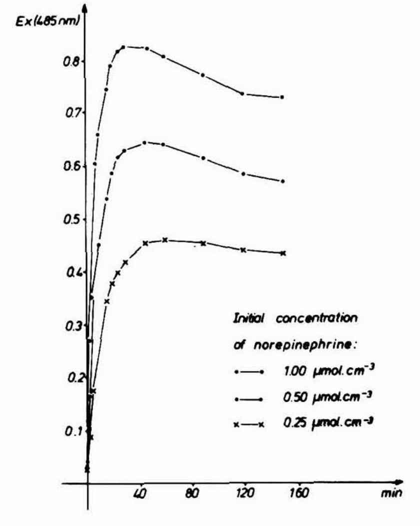

Fig. 8. Relationship between the concentration of rednorepinephrine measured as Ex(485 nm) and the time of incubation. A purified preparation of enzymes from stalk material was used in a constant concentration. Three levels of the concentration of norepinephrine were applied

[13] Winstrøm-Olsen *et al.*: Zuckerind., 1979 **104**, 1011-1018.

preparation of 40 mg was dissolved in 10 cm^3 0.02 M phosphate buffer. To each of the three cuvettes containing 2 cm^3 of norepinephrine solution, 1 cm^3 of the dissolved enzyme solution was added, giving solutions of 0.25, 0.50, and 1.00 $\mu mol.cm^{-3}$ of norepinephrine. 1.00 $\mu mol.cm^{-3}$ is the same as a 169.2 ppm solution. The absorption increases rapidly within the first 10 min. The maxima are reached after 30-40 min. In this range of concentrations, a doubling of the initial substrate concentration does not lead to a corresponding increase of products formed.

By analysing data obtained in experiments like these, it is in principle possible to estimate the Michaelis-Menten constant K_M and the maximum velocity V_{max}. However, a condition for doing this is knowledge of the relationship between the measured absorption of the solution and the substrate consumed. This will be discussed below.

INVESTIGATIONS OF THE PROPERTIES OF THE COMPOUNDS FORMED

Absorption at 485 nm versus substrate consumed

This section deals mainly with the compound named rednorepinephrine formed from norepinephrine since this compound has been studied to the greatest extent.

Figure 6 shows a chromatogram achieved after incubation of the highly purified enzyme eluted in a fraction from a Bio-Gel P-60 column (see Fig. 5). Similar chromatograms were recorded from other fractions. The estimated area is depicted in Fig. 9. It may be noticed that there is a linear relationship between the areas of the two compounds. The initial concentration of norepinephrine was 250 ppm. Hence, it can be estimated that a peak of 100,000 for rednorepinephrine corresponds to 111 ppm norepinephrine being consumed.

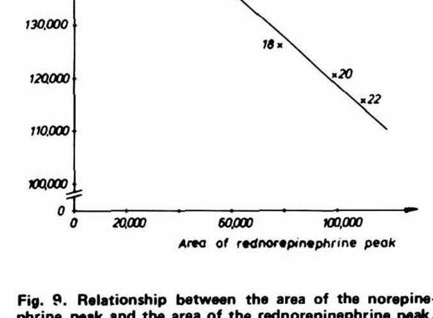

Fig. 9. Relationship between the area of the norepinephrine peak and the area of the rednorepinephrine peak. The area was printed by the HPLC-plotter. The figures indicate the number of fractions collected in the GPC-chromatogram, Fig. 5

Figure 10 shows the relationship between the colour of the sample measured in a 10 mm cuvette at 485 nm and the area of the rednorepinephrine peak estimated by the calculator connected with HPLC for the same samples as those used for the drawing of Fig. 9. The extinction measured is directly proportional to the area of rednorepinephrine.

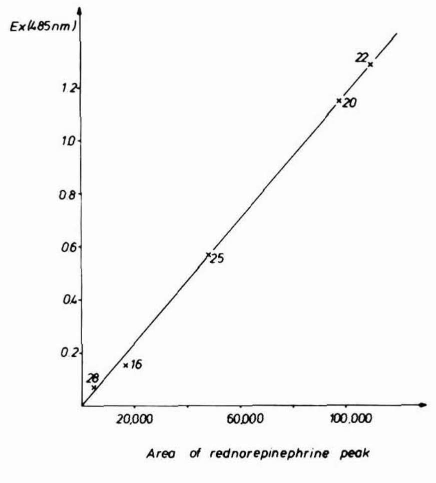

Fig. 10. Relationship between the colour of the sample measured at 485 nm and the area of the rednorepinephrine peak. The samples were the same as those in Fig. 9. For details see the text

It is estimated that an absorption of Ex(485 nm) = 1.00 corresponds to a conversion of 92 ppm norepinephrine to rednorepinephrine.

By using this figure and Fig. 8, it is possible to estimate K_M at about 1 mM and V_{max} at about 0.5 $mM.min^{-1}$ for the enzyme in question. Since the configuration of the red compound is unknown, it is for the time being impossible to estimate the molecular extinction coefficient.

Chemical properties of the red compounds formed

After incubation of a sample of catecholamine and enzyme and development of a strong, red-coloured solution, the sample was treated with alumina according to our procedure[1], leading to a concentrate containing only the original catecholamine. The compounds formed do not react like catechols, but they might also have been destroyed during the alumina purification.

Rednorepinephrine from 10 x 250 mm^3 samples subjected to HPLC have been isolated by collecting appropriate samples from HPLC and evaporating the liquid. A mass spectrum of the isolated substance showed no peaks of importance, indicating a substance which is very difficult to evaporate.

The red compounds formed can be reduced to colourless compounds by addition of sulphur dioxide in the form of $NaHSO_3$. An example is shown in Fig. 11. A crude enzyme preparation was used to develop the red colour from norepinephrine in a large sample. After filtration, samples of 20 cm^3 were withdrawn, and various amounts of $NaHSO_3$ were added. It is evident from Fig. 11 that the colour is removed by the addition.

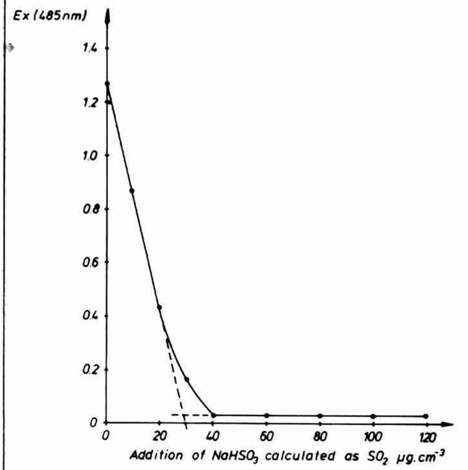

Fig. 11. Reduction of rednorepinephrineby sulphur deioxide

The initial absorption of 1.27 corresponds to 117 ppm or 0.69 µmol.cm^{-3} norepinephrine converted to the red compound. The intersection between the dotted lines corresponds to 0.45 µmol.cm^{-3}. Addition of 40 µg.cm^{-3} SO_2 is the lowest addition where the minimal absorption is found. This is equivalent to 0.63 µmol. cm^{-3} SO_2. We have concluded that for each mole of converted norepinephrine, less than one mole of SO_2 is used to reduce the formed red compound.

By reduction, the amount of norepinephrine is not altered. Analysing by HPLC shows that the peak from rednorepinephrine disappears on its reduction, but no new peak appears. The UV spectrum of the sample shows a new peak at about 340 nm.

diffuser, no free SO_2 can be detected in the raw juice end of the diffuser. Thus, the enzyme determines the colour of the raw juice to a certain degree.

Also, the action of the enzyme is noticeable on damaged beets, in which a high portion of cells has sometimes turned red. In addition, the top of the root is occasionally pink or red. The importance of the enzyme for the beet is unclear, but it could take part in a mechanism of defence against dry and warm weather.

The importance of the enzyme for the colour of 2nd carbonatation filtrate, thick juice, and white sugar is not known. In Table I, the colours of thick juice and white sugar from five factories for the past five years are listed. Clearly, there is a year-by-year variation in the colour level, as during the campaigns 1975 and 1976 the colours were rather high, while during the last three campaigns the colours were fairly low. Naturally, we do not hope to have another campaign with high colours, but during such a campaign valuable information about the importance of the enzyme system could be achieved.

During the present work, no unit for enzyme activity has been introduced. However, further work should aim at introducing a definition for such a unit. Further knowledge of the red compounds formed would be helpful.

In this paper, we have been dealing mainly with the oxidation of tyrosine and the conversion of catecholamines to red compounds. Apart from these studies, we have also investigated the enzymic actions on the various catecholamines mentioned in the introduction. However, during the last campaign these activities seemed to be lower than those mentioned.

The pigments of redbeet (*Beta vulgaris* v. *rubra*) are known as betalains[14]. This group of coloured compounds contains both red pigments, betacyanines, and yellow pigments, betaxanthines. They can be separated by HPLC[15]. Absorbance maxima are found in the 537-538 nm and 476-477 nm regions, respectively. The red colours have been isolated by gel filtration, giving commercial pigment preparations[16]. No relation between these compounds and the compounds studied in this paper has been established.

Table I. Colour in ICUMSA units for thick juice and white sugar from DDS factories

Campaign	Nakskov		Saxkjobing		Stege		Gorlev		Assens	
	Juice	Sugar	Juice	Sugar	Juice	Sugar	Juice	Sugar	Juice	Sugar
1975	1980	17	3420	29	2557	30	2580	36	2860	27
1976	2100	23	2804	30	2532	29	3400	32	3309	30
1977	1340	17	2730	25	2150	22	1930	24	1750	17
1978	1540	16	2730	26	2230	20	2100	22	1770	18
1979	1370	17	2150	23	1940	23	2230	25	1530	22

Discussion

The classification of the enzyme forming red compounds from catecholamines awaits further research. The exact composition of the red compounds remains to be found.

The enzyme metabolizing catecholamines has been easy to isolate from various sources of sugar beet material, and it is believed to take part in the reactions in the diffuser. Here, the temperature and pH are appropriate for the enzyme. In general, we have found that, although we are using SO_2 to acidify the water to the

Summary

During the 1978 campaign, it was established that catecholamines such as dopa and norepinephrine are of major importance in beet sugar manufacture. The present paper deals with the enzymic formation of the catecholamines and the enzymic conversion of these to coloured compounds. A simple procedure has been developed to isolate the enzymes in question from various fractions of the sugar beet, using ammonium sulphate to precipitate the enzymes as a crude preparation. From this, enzymes were purified by gel-permeation chromatography, using Bio-Gel P-6 and Bio-Gel P-60. An

14 Mabry & Dreiding: *Recent Adv. in Phytochem.*, 1968, **1**, 145-160.
15 Vincent & Scholz: *J. Agric. Food Chem.*, 1978, **26**, (4), 812-816.
16 Vergeront, Elbe & Amundson: *Process Biochem.*, 1980, **15**, (2), 2-6, 15.

enzyme capable of oxidizing tyrosine to dopa was found to be tightly bonded to insoluble material in the crude enzyme preparation. Apparently, the enzyme did not require copper as a co-factor. The enzyme preparations contained enzymic activity capable of converting catecholamines to red coloured compounds having absorption maxima at 485 nm which could be separated from the catecholamines by HPLC. Conversion of 92 ppm norepinephrine gives a solution with an absorption of 1.00 in a 10 mm cuvette at 485 nm. By addition of sulphur dioxide to a red coloured solution, a clear, colourless solution can be achieved.

The enzyme has a maximum activity at about pH 5-6 and, even at 70°C, retains some activity. Hence, during the extraction of sugar in the diffuser, the enzyme must exert a certain influence.

Formation enzymatique de coloration dans la betterave à sucre. Recherche et caractérisation d'enzymes en utilisant des catécholamines comme substrat en relation avec la formation de coloration en fabrication du sucre de betterave

Au cours de la campagne de 1978 il a été établi que les catécholamines telles que la dopa et la norépinéphrine sont d'une grande importance en fabrication du sucre de betterave. Le présent papier traite de la formation enzymatique des catécholamines et de leur conversion enzymatique en composés colorés. Un mode opératoire simple a été mis au point pour isoler les enzymes en question de diverses fractions de la betterave à sucre, en utilisant le sulfate d'ammonium pour précipiter les enzymes comme préparation brute. A partir de là les enzymes ont été purifiées par chromatographie à percolation sur gel en utilisant du Bio-Gel P-6 et du Bio-Gel P-60. On a trouvé qu'une enzyme capable d'oxyder la tyrosine en dopa était étroitement liée au matériau insoluble dans la préparation d'enzyme brute. Apparemment l'enzyme n'exigeait pas le cuivre comme cofacteur. Les préparations enzymatiques manifestaient une activité enzymatique capable de convertir les catécholamines en composés de coloration rouge dont les maxima d'absorption étaient situés à 485 nm et qui pouvaient être séparés des catécholamines par chromatographie liquide sous haute pression. La conversion de 92 ppm de norépinéphrine fournit une solution dont l'absorption est de l,00 en cuvette de 10 mm à 485 nm. Par addition d'anhydride sulfureux à une solution de couleur rouge on peut obtenir une solution claire, incolore. L'enzyme a un maximum d'activité à pH 5-6 environ et même à 70°C elle a encore une certaine activité. Dès lors cette enzyme doit exercer une certaine influence au cours de l'extraction du sucre dans le diffuseur.

Enzymatische Farbbildung in Zuckerrüben. Untersuchung und Charakterisierung der catecholaminspezifischen Enzyme im Verhaltnis zur Farbbildung bei der Rübenzuckerherstellung

Während der Kampagne 1978 wurde festgestellt, daß Catecholamine, wie Dopa oder Norepinephrine, von großer Bedeutung bei der Rübenzuckerherstellung sind. Die vorliegende Arbeit behandelt die enzymatische Bildung von Catecholaminen und die enzymatische Umwandlung dieser in farbige Verbindungen. Ein einfaches Verfahren wurde entwickelt, um die in Frage kommenden Enzyme aus den verschiedenen Fraktionen der Zuckerrübe zu isolieren. Durch Ammoniumsulfatfällung wurde ein Rohextrakt der Enzyme hergestellt. Sodann wurden die Enzyme durch Gel-Permeationschromatographie mit Hilfe von Bio-Gel P-6 und Bio-Gel P-60 gereinigt. Ein Enzym, das Tyrosin zu Dopa oxidieren vermag, befindet sich in der unlöslichen Fraktion des Rohextrakts. Wahrscheinlich benötigt dieses Enzym kein Kupfer als Co-Faktor. Die Präparationen enthielten eine enzymatische Aktivität, die fähig war, Catecholamine in rot-gefärbte Verbindungen mit einem Absorptionsmaximum bei 485 nm zu überführen. Diese konnten durch Hochdruckflüssigkeitschromatographie (HPLC) abgetrennt werden. Nach Umwandlung von 92 ppm Norepinephrin erhält man bei 10 mm Schichtdicke bei 485 nm eine Absorption von 1. Durch Zugabe von Schwefeldioxid zu der rotgefärbten Lösung kann eine klare, farblose Lösung erhalten werden. Dieses Enzym hat sein Aktivitätsmaximum bei pH=5-6 und selbst bei 70°C wurde noch eine Aktivität festgestellt. Daher muß dieses Enzym während der Extraktion von Zucker im Extrakteur einen gewissen Einfluß ausüben.

Formación enzimática de color in remolacha azucarera. Investigación y caracterización de enzimas usando catecolaminas como sustrato respecto de la formación de color en la fabricación de azúcar de remolacha

Durante la campaña 1978, se ha establecido que catecolaminas, por ejemplo dopa y norepinefrina, estan de mayor importancia en la fabricación de azúcar de remolacha. El presente papel trata de la formación enzimática de las catecolaminas y su conversión enzimática a compuestos colorados. Se ha desarrollado una técnica sencilla para isolar las enzimas en cuestión de varias fracciones de la remolacha, empleando sulfato de amonio para precipitar las enzimas en la forma de una preparación cruda. De ésta, enzimas se purifican por cromatografía gel-permeación, usando Bio-Gel P-6 y Bio-Gel P-60. Una enzima capaz de oxidar tirosina a dopa se ha demostrado como liado estrechamente a materia insoluble en la preparación de enzima cruda. La enzima no parece requerir cobre como un co-factor. Las preparaciones de enzima contuvieron actividad enzimática capaz de convertir catecolaminas en compuestos rojos que tienen maximas de absorción a 485 nm y que pueden separarse de las catecolaminas por CLAP. Conversión de 92 ppm de norepinefrina da una solución con un adsorción de 1.00 en una célula de 100 mm a 485 nm. Por adición de dióxido de azufre a un solución roja, se obtiene una solución clara y sin color. La enzima tiene un máxima de actividad a pH acerca de 5-6 y, aun a 70°C, retiene una cierta actividad. Por consiguiente, durante la extracción de azúcar en el difusor, la enzima tiene que ejercer una cierta influencia.

Hungary beet sugar production, 1980/81[1]. — Sugar beet production in Hungary in the 1980/81 crop totalled 3.93 million tonnes, grown on an area of 102,000 hectares. Average sugar content was 15.46% and sugar outturn 481,523 tonnes, raw value. The area planted to beet for the 1981/82 crop is expected to rise to 120,000 hectares.

Two new sugar factories for Yugoslavia[2]. — Czechoslovakia is to supply equipment for two new sugar factories to be built in Sabac and Pozarevac, in Yugoslavia. A third of the secondary equipment will be be supplied by local firms.

Syria sugar expansion[3]. — It is proposed that the beet area be expanded by 4,500 hectares, mainly in the Euphrates Valley, to permit production of more sugar to meet domestic consumption and reduce imports which amounted to more than 200,000 tonnes in 1979/80 and cost $49.5 million. Four new sugar factories were set up during the Fourth Five-Year Plan period (1976/80).

1 *World Sugar J.*, 1981, **3**, (8), 32.
2 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 117.
3 *World Sugar J.*, 1981, **3**, (8), 34.


ALEX
STEWART

SUGAR CANE AGRONOMY

Studies on the soil moisture regimes in sugar cane under shallow water table conditions of north India. S. K. Saini, P. P. Singh and K. Kumar. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, Ag.123–Ag.133. Field experiments showed that, with a shallow water table ($\leqslant$ 2 m), irrigating the cane at 35% depletion of available soil moisture was optimum as regards yield, which fell dramatically after 40% depletion. The economically optimum number of irrigations to maintain maximum yield was nine.

Soil conservation. Anon. *Australian Canegrower,* 1979, **1**, (7), 67. – Soil erosion by rain under Queensland conditions is discussed. Of the three forms mentioned, gully erosion is considered the potentially most serious type, while sheet erosion (uniform removal of soil in layers that occurs on all sloping cane land) is not an obvious problem and often goes unnoticed; rill erosion is the removal of soil in small defined channels which can be eliminated by normal tillage. Valuable topsoil is removed, leading to an inevitable decline in soil fertility and silting of other farm areas. Erosion prevention is necessary for a continuing prosperity of the cane industry, particularly on sloping land, where the problem eventually makes cane growing uneconomical and causes the land to be abandoned.

Euphorbia **– a problem for Bundaberg growers.** P. A. Jones. *Cane Growers' Quarterly Bull.,* 1979, **43**, 34–35. – *Euphorbia cyathophora* and *E. heterophylla* are annual weeds capable of growing to more than 4 m in height. They have spread in one area of the Bundaberg district of Queensland during the past 3-4 years and will compete actively with cane if not eliminated by mechanical cultivation in young plant or ratoon crops. Herbicidal trials in 1978-79 showed that all the chemicals failed to give satisfactory control, although greatest success was achieved with younger weeds before their main stems became woody.

Renewed interest in pre-emergent weed control. T. G. Willcox. *Cane Growers' Quarterly Bull.,* 1979, **43**, 36–38. – Details are given of 2,4–D (sodium salt), MCPA, Trifluralin and Diuron pre-emergence herbicides and advice is offered on the best means of application to obtain maximum results.

Trifluralin – a viable control for Guinea grass. P. K. Makepeace. *Cane Growers' Quarterly Bull.,* 1979, **43**, 38. – Brief mention is made of the value of Trifluralin against *Panicum maximum,* a serious weed in Queensland cane fields.

Johnson grass – control measures are effective. I. T. Freshwater. *Cane Growers' Quarterly Bull.,* 1979, **43**, 39–40. – Control measures for the eradication of *Sorghum halepense* were devised by the BSES in 1964–68. The methods were adopted on two farms, where the weed was eliminated within 18 months and has not reappeared since. The methods are outlined for those growers who still have the weed on their farms or may have it in the future.

Phragmites **– a real reed problem.** L. K. Izatt. *Cane Growers' Quarterly Bull.,* 1979, **43**, 40–41. – The common reed *(Phragmites australis)* is a major weed that has continued to spread in southern Queensland despite widespread use of herbicides. It has an extensive root system which promotes regeneration, and total eradication will require many years of vigilance to ensure that any isolated regrowth is destroyed as it occurs. However, it can be controlled by normal cultivation, and recommended measures are described, as is chemical control with Dalapon and Glyphosate.

Soil conservation still needed. G. R. Cullen. *Cane Growers' Quarterly Bull.,* 1979, **43**, 42–44. – Abnormally heavy rainfall early in 1979 caused considerable erosion on farms where there were no soil conservation programs. It is stressed that erosion can be a recurring problem on most slopes greater than 2%; by means of photographs, the author discusses the problem and shows how it can be overcome.

Improvement in cane yield and quality for higher sugar production in Maharashtra. D. G. Hapase. *Maharashtra Sugar,* 1979, **4**, (10), 51–52, 54, 56, 58. – Problems facing cane agronomists in Maharashtra are discussed and results of various experiments covering a wide range of topics are reported. Advice is offered on water management, planting, plant protection and harvesting on a maturity basis.

Post-harvest deterioration of sugar cane under different storage conditions. J. Kapur and R. S. Kanwar. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1) A.43–A.50. – Investigations to establish a suitable cane storage method by which post-harvest deterioration could be minimized showed that covering the cut cane with trash and sprinkling with water reduced sugar losses from 0.73% to 0.23% per day over a 6-day period. Even covering with trash, but not sprinkling, reduced losses to 0.42% per day, while keeping the cane in the shade, but uncovered, reduced losses to 0.44%; merely sprinkling with water reduced losses to 0.50%.

Studies on the effects of *Azotobacter* **on establishment of sugar cane seedlings.** P. G. Patil, A. V. Bendigeri and D. G. Hapase. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 7 pp. – In a field experiment, smearing of the root zone of single-budded setts with *Azotobacter* culture, followed by dipping of the seedling roots in a suspension of the culture, promoted establishment of the seedlings and increased yield by comparison with the control.

Effect of some chemicals on ripening of sugar cane. G. Hunsigi, N. Dwarakinath and C. Channaiah. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 6 pp. – Ripening experiments with Polaris and sodium metasilicate showed that treatment brought no benefits in the Mandya region, where natural ripening conditions are good, whereas it increased the sugar content in a coastal area characterized by high temperature and high humidity. Polaris appeared to be better than the metasilicate, while varietal differences in response were also found.

Bladex Plus on sugar cane: first year commercialization. J. H. Everitt. *S. African Sugar J.*, 1979, **63**, 473-474. – Tests are reported in which Bladex Plus herbicide at 9 $l.ha^{-1}$ plus 0.05% Tronic adjuvant gave effective control of a number of grasses, broad-leaf weeds and (when used as post-emergence treatment) *Cyperus esculentus* (nut grass).

Indirect method for determining the moment of cane maturity. Use of the percentage of potassium oxide in leaf sheath ash. Y. Lines, R. de Armas, J. Pardo and O. Recio. *ATAC*, 1978, **37**, (6), 35-43 (*Spanish*). – Measurements of K_2O % ash were made for cane grown in 27 different fields under different conditions and were found to follow a common curve with time, achieving a maximum 6-7 months before maturity. The age of the cane at this maximum and the age at maturity were related, with a high positive correlation, and a regression equation for both variables permits the calculation of maturity age from the age when the K_2O reaches its maximum.

A study on the moisture-inversion and temperature-inversion relationship with a quick method. T.T. Yang and T. S. Hsieh. *Taiwan Sugar*, 1979, **26**, 162–164. – A rapid method of determining cane stalk deterioration in terms of increase in the reducing sugars content was used, in which the stalk was cut into pieces to increase the area of water evaporation and thereby accelerate moisture loss. The pieces were then exposed to varying temperatures. The results showed that maximum deterioration under the effect of weight loss occurred at 20% loss, and thereafter remained constant up to 30% weight loss; it fell at varying rate with reduction in weight loss. Under the effect of temperature, deterioration was minimum at 5-15°C, after which it rose to a maximum at 40°C, thereafter falling with temperature rise to 45°C. The mechanism of stalk deterioration is discussed.

Studies on sugar cane irrigation. XV. Drying-off effect during the ripening stage on the sugar yield of autumn-planted cane. S. J. Yang, Y. T. Chang and P. L. Wang. *Rpt. Taiwan Sugar Research Inst.*, 1979, (85), 13-29 (*Chinese*). – Investigations showed that recoverable sugar in cane was inversely proportional to the leaf sheath moisture and soil moisture content in the root zone and fell with increase in the frequency of irrigation during the ripening period, particularly on a clay loam, the intervals between irrigations being based on Class A Pan evaporation. The results suggest that the soil moisture content should be controlled immediately after the end of the rainy season so as to promote ripening, and that irrigation should be stopped 30 days before harvest on a light-texture soil of medium water table height, and 40 days before harvest on a fine-texture soil, while the leaf sheath moisture should be below 72%. However, green leaf counts should be made and leaf sheath moisture determined periodically to prevent excessive desiccation.

Studies on sugar cane irrigation. XVI. Effect of irrigation frequency on evapotranspiration and cane yield between autumn-planted and ratoon canes. Y. T. Chang and S. J. Yang. *Rpt. Taiwan Sugar Research Inst.*, 1979, (85), 31–40 (*Chinese*). – The effects of irrigation frequency on actual evapotranspiration rate (Et), water uptake and cane yield were studied. Significant differences were found between the values of Et, Et:Ep ratios (where Ep is Class A Pan evaporation) and the patterns of water uptake for plant and ratoon cane; Et for plant cane was about double that for ratoon cane in the peak water consumption period, with a statistical linear correlation between Et and Ep in both crops, while the water was taken up at a more uniform rate and from lower in the soil with the plant cane than with the ratoon crop. Cane growth was more sensitive to moisture stress in the plant crop, although the growth rate was higher than in the ratoons under the same stress conditions. The differences in final yield between treatments was small and statistically non-significant.

Evaluation of the effect of cane ripeners on sugar cane maturity. S. S. Patil, A. V. Bendigeri, D. G. Hapase and A. P. Jadhav. *Maharashtra Sugar*, 1979, **5**, (2), 41-44. The effects of Cycocel and Polaris ripeners on cane and sugar yield and sugar content were determined with Co 740 variety. Both ripeners, applied 8 weeks before harvest at the rate of 4 kg (in 1000 litres of water) per ha, increased sugar content and yield by comparison with the control, but not cane yield; Polaris proved better than Cycocel.

Effect of Agromin and Nuspartin on the yield and juice quality of sugar cane. J. P. Sharma. *Maharashtra Sugar*, 1979, **5**, (2), 45-46, 48. – Agromin was applied to Co 1148 cane as foliar spray in three doses each of 1.25 $kg.ha^{-1}$ 45, 66 and 87 days after planting, while Nuspartin was applied in two doses of 5 $kg.ha^{-1}$ 90 and 115 days after planting. The results of application of both chemicals (containing trace elements) 300 and 360 days after planting are reported. It was found that at the earlier date, both increased Brix, purity and expected sugar recovery by comparison with the control, whereas at the later date the position was reversed.

Studies on scheduling irrigations for suru sugar cane on the basis of evaporation. B. A. Lakhdive, B. G. Bathkal, V. N. Deshmukh and S. H. Daterao. *Indian Sugar*, 1979, **29**, 325-328. – Irrigation scheduling on the basis of cumulative evaporation (CE) was studied; comparison of the results showed that optimum was a CE of 50 mm (the minimum tested), at which 31, 37 and 38 irrigations were applied in the three years of tests. Under these conditions, cane yield was maximum as a result of increased number of millable canes, plant height and girth. Average differences between varieties were not significant.

Influence of spent wash (distillery waste) on growth and chemical composition of immature sugar cane (*Saccharum officinarum* L.) cultivar Co 740. H. N. Jagadale and N. K. Savant. *Indian Sugar*, 1979, **29**, 433-440. – Vinasse was centrifuged, treated with cation exchange resin and then concentrated by evaporation on a hot water bath before use in sand culture tests in which it was added at 250, 500, 1000, 1500 and 2000 ppm to sand cultures in which cane cuttings were planted. It was found that 250 ppm vinasse increased growth parameters by comparison with the control, after which there was a reduction in the values of all parameters with increase in vinasse concentration.

Controlling cane maturity. H. L. Kulkarni. *Indian Sugar*, 1979, **29**, 443-445. – Cane harvest scheduling on the basis of maturity, and control of ripening through varietal selection, fertilization and moisture control (by reduction or stoppage of irrigation), are discussed.

An analysis of some aspects of sugar cane research and production in Cuba. D. W. Davis. *Sugar y Azúcar,* 1980, **75**, (2), 43, 46-47. – A survey is presented of cane research and breeding in Cuba, with mention of weeds, diseases and other problems.

Cyclic changeover for agronomy field trials. K. C. Leverington and D. M. Hogarth. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. – Where a property such as the recoverable sugar content in cane varies during a harvest period, the date of harvest of the crop can have an effect on next year's, as can residual effects of under- or over-fertilization. An account is given of the design of trials in Australia to determine these effects; the cyclic designs provide an efficient method which permits measurement of the effects using a minimum of plots.

The influence of plant season and age at harvest on the productivity of the three sugar cane varieties at Mumias, Kenya. P. P. M. Mutanda, J. M. S. Makatiani, J. L. Lamasia and G. L. James. *Paper presented to the 17th Congr. ISSCT,* 1980, 16 pp. – Under the conditions at Mumias in Kenya, the amount and seasonal distribution of rainfall received by the crop is the main natural factor affecting cane productivity, quality and rate of sugar accumulation. The data presented indicate that the optimum age for harvesting of April-planted cane is 84 weeks; cane planted in June should not be harvested before 84 weeks but thereafter sugar productivity is maintained until 100 weeks from planting. Sugar production in October-planted cane increases steadily from 68 to 100 weeks. Considering the varieties separately, N:Co 376 sugar productivity peaks at 84 weeks but those of Co 421 and Co 775 are very much less well defined, thus allowing greater flexibility in their harvest age. No optimum harvest age is indicated by the first ratoon crops, so permitting greater harvesting flexibility than with plant cane. N:Co 376 is preferred to the other two varieties for April and June plantings while Co 421 has the highest cane productivity after October planting. There is no significant advantage to any variety in ratoons, the greater weight of Co 421 cane being offset by its lower juice quality.

Intercropping of first ratoon sugar cane with rice in Mauritius. A. R. Pillay. *Paper presented to the 17th Congr. ISSCT,* 1980, 8 pp. – When intercropped as upland rice in inter-rows of cane planted at the conventional row spacing of 150 cm, rice varieties used in flooded paddies of Mauritius showed very low yields (owing to the short growth period before shading by the growing cane) and had no significant effect on sugar yields. Short-cycle rice varieties planted between double rows of cane (grown at alternate spacings of 227 cm and 97 cm) gave yields up to 1.6 tonnes. ha^{-1} under irrigated conditions and up to 0.9 tonnes. ha^{-1} under rain-fed conditions.

Germination response of sugar cane cultivars to soil moisture and temperature. S. J. Yang and J. B. Chen. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. Germination of four cane varieties was studied using four soil moisture potentials (-0.3, -3, -15 bar and saturation) at a constant air temperature of 28°C, and then at constant soil moisture potential of -0.3 bar and temperatures of 18°, 22°, 26° and 30°C. The optimum conditions were -0.3 bar and 30°C, respectively. The rate and total germination declined with decreasing soil moisture potential but germination was nil at saturation because of the lack of oxygen. The rate of germination was slower at lower temperatures although the final germination total was less affected. The four varieties studied showed a different response to environmental stress. Conditions to be achieved to promote germination are listed.

Sugar cane stalk distribution in two row spacings. S. F. Shih and G. J. Gascho. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. – Cane was grown at spacings of 50 cm and 150 cm in Florida and its stalk population, length and height monitored monthly. Maximum population at 50 cm was reached in May (417,000/ha), fell to 387,000 in June, 184,000 in July, 122,000 in August and to 79,000 by November. With 150 cm spacing, the stalk population was 145,000/ha in May and rose to 197,000 in June but thereafter fell to 140,000 in July, 95,000 in August and 70,000 by November. Stalks in cane planted at 50 cm spacings were more erect – taller by 39% and longer by 10% – than those with 150 cm planting. A Log Pearson Type III distribution simulated monthly stalk length population well and its distribution analysis may be used to modify estimation of stalk length, to choose a proper sample size within each stalk length interval, to avoid using samples with extreme values, and to study cane growth dynamics.

Studies on the effects of various nitrogen and irrigation levels on the yield of sugar cane varieties BL 4 and L 116. S. D. Fasihi, K. B. Malik and J. O. Reuss. *Paper presented to the 17th Congr. ISSCT,* 1980, 11 pp. – An account is given of trials using two varieties, five levels of N (between 0 and 224 kg ha^{-1}) and five irrigation levels (between 0.6 and 1.4 times pan evaporation). The different N levels did not improve tillering without adequate irrigation, and additional water had little effect at low N dosage. With adequate N and water, respectively, additional water and N produced higher yields but at additional cost, and the two varieties responded differently. Use of 112 kg N per ha and irrigation equivalent to pan evaporation appeared to be a good combination for both varieties.

Johnson grass (*Sorghum halepense*) control and sugar cane tolerance of pre-emergence treatments with Hexazinone. R. W. Millhollon. *Paper presented to the 17th Congr. ISSCT,* 1980, 12 pp. – Field trials were used to compare Hexazinone [3-cyclohexyl-6-dimethylamino-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione] with Terbacil as standard herbicide. An autumn application at 1.1 kg. ha^{-1} effectively controlled winter weeds on both silt loam and clay soils while a double autumn-spring application of 1.1 + 1.1 kg.ha^{-1} on silt loam or double these amounts on clay was required to control Johnson grass. The tolerance of cane to Hexazinone depended on its concentration, soil type and cane variety and the herbicide is generally more toxic to cane then Terbacil.

Disseminules of *Cyperus rotundus* L. in sugar cane (*Saccharum* spp.) stalks and rootstock. R. A. Arevalo and O. O. S. Bacchi. *Paper presented to the 17th Congr. ISSCT,* 1980, 7 pp. – An illustrated report is given of the finding of cane stalks and roots which had been invaded by rhizomes of *C. rotundus* which then formed tubers. It was observed that, when the cane bud was developing, the disseminule of the weed was dormant while, when the latter was developing a shoot, the cane stalk was dormant. The plants produced from both cane and weed were normal.

CANE PESTS AND DISEASES

A brief note on the research work done on sugar cane rust by the Plant Pathology Section, Sugarcane Research Station (Padegaon). D. G. Hapase, M. B. Bachchhav, V. V. Shingte and S. S. Lambhate. *Maharashtra Sugar,* 1979, **4**, (11), 21–23. – Screening trials involving 101 varieties are reported, and tests on control of the disease organism, *Puccinia erianthi,* described. Four sprayings of Ferbam (0.75% concentration) plus nickel sulphate (0.5%) at 21-day intervals starting from appearance of the disease reduced infection by 37.5% and increased yield of Co 475 cane (a susceptible variety) by 7.65 tonnes. ha^{-1} compared with the control.

Screening sugar cane clones for resistance to smut in Maharashtra. D. G. Hapase and M. B. Bachchhav. *Maharashtra Sugar,* 1979, **5**, (2), 19-22. – Screening trials at Padegaon cane research station are reported, and the performances of given varieties indicated. Inoculation techniques are compared, whereby it is shown that some varieties differed in their response with different methods.

Studies on productivity in sugar cane variety Co 740 infected by mosaic virus. L. N. Ghorpade and G. V. Joshi. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 10 pp. – The effect of mosaic on growth, sugars and starch content, enzyme activity and yield was investigated in the case of Co 740, which is highly susceptible to the disease. Results, which are discussed, demonstrated the severity of mosaic as a cause of significant deterioration and losses.

Quantitative and qualitative losses caused by smut and grassy shoot diseases of sugar cane. M. B. Bachchhav, P. G. Patil, D. G. Hapase and T. K. Ghure. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 5 pp. – The adverse effects of the title diseases were demonstrated in trials in which germination and growth were poor and the sugar content reduced by comparison with healthy and apparently healthy cane.

Quantitative losses due to internodal borers in sugar cane. A. S. Patil, B. P. Gajare, D. G. Hapase and S. V. Kale. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 9 pp. – The reductions in height, girth and weight of four cane varieties infested with *Chilotraea infuscatellus* and *Sesamia inferens* were determined and results are tabulated.

Effectiveness of the parasite *Trichogramma fasciatum* **Perkins in control of the pest** *Diatraea saccharalis* **Fab. and** *Mocis* **spp.** R. Alvarez, A. Fuentes, Z. Peres and E. Lopez. *ATAC,* 1978, **37**, (6), 58–64 (*Spanish*). – Tests with a number of eggs of lepidopterous insects showed that greatest parasitism by *T. fasciatum* was shown by *D. saccharalis* and *Mocis* spp., which are the major pests of cane in Cuba. Less parasitism was shown in eggs of *Spodoptera frugiperda,* but this is a minor pest. The parasite can be raised for mass release using eggs of *Sitrotoga cerealella* but it is necessary to effect parasitism on *Mocis* spp., since on this pest the parasitic aggressiveness is not lost.

Assessment of sugar cane varietal reaction to smut – a new approach. K. K. Prasadarao, M. N. Sarma, Y. Satyanarayana and M. A. Rao. *Sugarcane Pathologists' Newsletter,* 1979, (23), 1–7. – A positive and significant correlation was established between the number of days before manifestation of the first smut whip and the percentage of clumps remaining healthy; this relationship was used as basis for determining the reaction of specific varieties to the disease. Adjustment for the seasonal effect, whereby reaction of any one variety may fluctuate quite widely from one year to another, is made by deducting the mean number of days before smut manifestation for all seasons from the total for a season and dividing the balance by the number of varieties tested, after which this value is added to or subtracted from the observed value for a variety in a particular season. Since the appearance of whips during the first 120 days of growth (the formative phase) would indicate that a variety was highly susceptible, while it is also desirable to have a variety with a minimum of 95% of the clumps remaining healthy after inoculation, varieties were classified under two groups, viz. those having values above and below 11,400 (= 120 x 95). Insertion of the values for the two parameters in the two groups led to establishment of a discriminant function, from which varieties could be classed as susceptible, intermediate or resistant.

Screening of sugar cane clones for field resistance to leaf scald disease in India. K. S. Waraitch. *Sugarcane Pathologists' Newsletter,* 1979, (23), 8–10. – Results of screening tests are reported. Under field conditions, 150 varieties proved resistant to leaf scald in 1976–79; these included CoJ 67, released for general cultivation in Punjab in 1976 and having good ratooning properties and a high sugar content.

Reaction of noble canes, foreign and local varieties to gumming disease in Mauritius. C. Ricaud, J. C. Autrey and S. Sullivan. *Sugarcane Pathologists' Newsletter,* 1979, (23), 11–14. – The reactions of Mauritian, foreign and noble cane varieties to gumming disease were determined by the method described earlier[1], and the ratings are tabulated.

Fiji disease ratings of foreign and commercial varieties in Queensland. D. M. Hogarth and C. C. Ryan. *Sugarcane Pathologists' Newsletter,* 1979, (23), 15-16. – The reactions of a large number of varieties to Fiji disease were determined by planting the trial canes between rows of infected cane. The ratings are tabulated.

Sugar cane smut in Java. H. Handojo. *Sugarcane Pathologists' Newsletter,* 1979, (23), 24. – Brief mention is made of the discovery in 1979 of smut on cane in Indonesia, where the disease had not been observed for some 50 years. Since all infected stools were immediately destroyed once the disease was detected, it is not known which particular varieties were involved.

[1] Ricaud: *I.S.J.,* 1972, **74**, 174.

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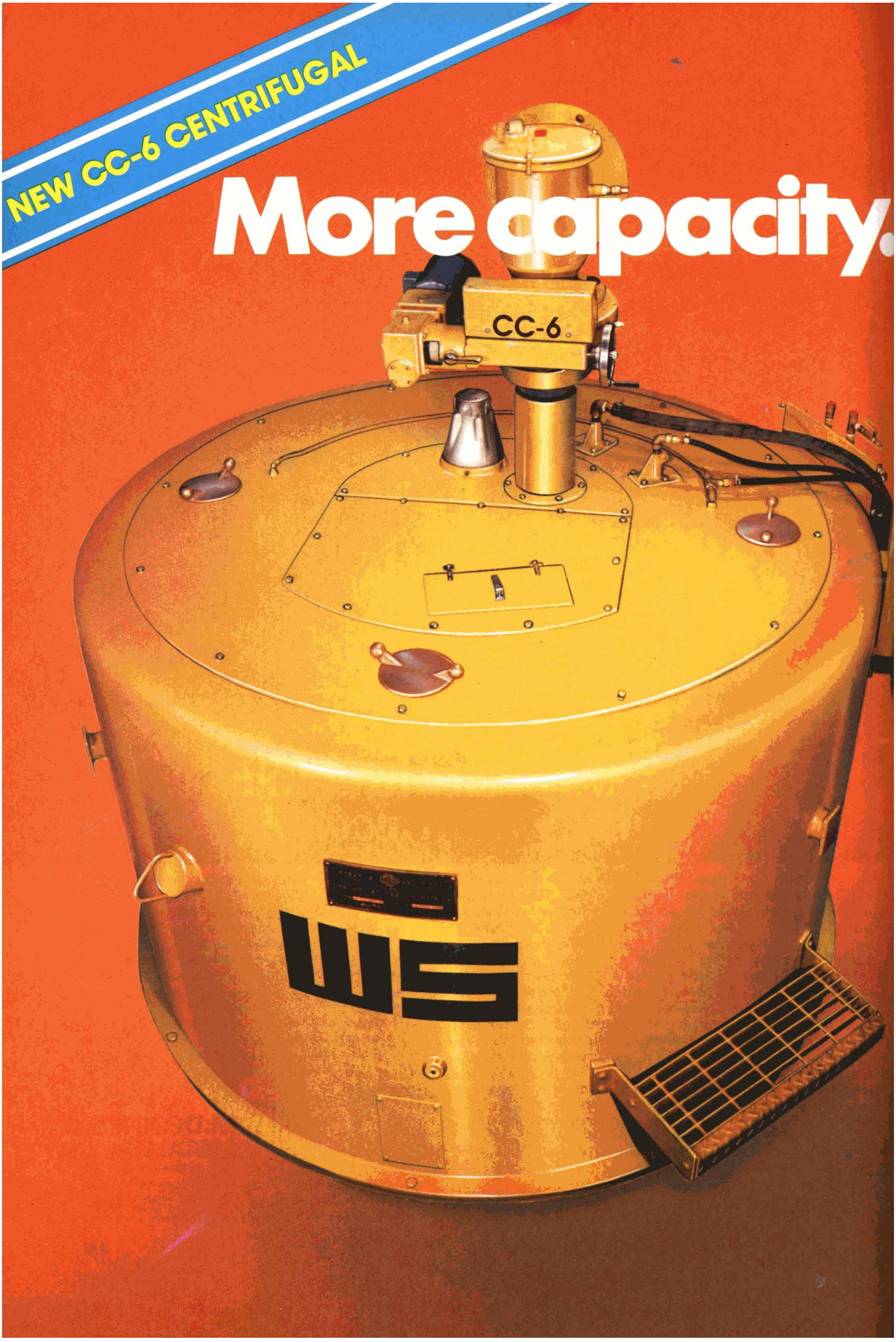
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CANE BREEDING AND VARIETIES

Sugar cane variety recommendations for Louisiana for 1979. L. L. McCormick. *Sugar Bull.*, 1979, **57**, (22), 10-13. – Of the varieties recommended for the 1979 planting season, three are recommended as major ones for general planting in all areas: CP 65-357, CP 70-321 and CP 70-330. However, it is stated that all recommended varieties are susceptible to ratoon stunting disease and should be heat treated, while the reaction of varieties to rust (present in Louisiana) and smut (a potential threat) is uncertain, so that farmers should plant a limited area of as many recommended varieties as possible. The characteristics of the more important commercial varieties are listed as well as planting recommendations according to soil and area. The 1979 varietal distribution in Louisiana is tabulated, showing the considerable increase in the planting of CP 65-357, while CP 61-37 has shown a marked fall.

Advancement of new basic sugar cane breeding lines. P. H. Dunckelman. *Sugar Bull.*, 1979, **57**, (22), 16-19. Cane breeding work during the 1978/79 season at Houma is reported, including details of parental material, flowering and crossing, and true seed production; 114 bi-parental crosses were made. Of more than 440,000 viable true seeds produced, 226,000 came from a line (*Saccharum spontaneum* L. US 56-15-8) that is already producing canes having commercial potential.

Cane varieties. BSES program maintains sugar industry productivity. M. Hogarth. *Australian Canegrower*, 1979, **1**, (7), 43-45. – The accelerated program incorporated in the selection system at Bundaberg to speed-up release of Fiji disease-resistant varieties allowed suitable varieties to be moved through the main system in such a way that about six years of testing were eliminated. The program has produced four resistant varieties which have been released early despite lack of knowledge on their agronomic characteristics and milling qualities and on resistance to other diseases. The program is discussed, as are the criteria used to select varieties under normal circumstances. The question of introducing more varieties from outside Australia that are resistant to particular diseases is examined, and the possibility of maintaining a reserve bank of varieties considered. The balance between plant breeding and mill processing research is discussed, and particular mention made of fibre, starch and ash contents. It is pointed out that, if the milling criteria were rigidly applied, many varieties would not be released, and one of the highest-yielding varieties ever grown in Queensland, N:Co 310, would have been discarded. Average fibre contents in hybrid varieties have been steadily increasing but, with the need for more bagasse as fuel, the tendency may be to favour high fibre contents, selection for which is easier than for low-fibre varieties. While selection for low ash contents would be possible, it is stressed that ash is also related to soil type, water salinity and rate of application of K fertilizers.

Comparative study of six sugar cane cultivars in their first two crops in Tumán. C. Lapoint T. and O. Cifuentes I. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6**, 1-20 (*Spanish*). – Cane and sugar yields were determined from plant and first ratoon crops of six cane varieties (H 50-7209, H 32-8560, H 39-5803, H 37-1933, Lar 52-604 and PCG 12-745) harvested at 611 and 402 days, respectively, from part of the Tumán sugar factory area. The first of the varieties gave the highest cane yield for both crops, but the first two were equal in respect of sugar yield.

Behaviour of some biometric characteristics of six sugar cane cultivars. C. Lapoint T. *Saccharum* (Publ. Cient. Inst. Central Invest. Azuc., Peru), 1978, **6**, 86-117 (*Spanish*). – The lower yields of ratoon cane compared with plant cane are not dependent on soil, climate or variety but are the consequence of biological characteristics, i.e. smaller plant populations, shorter stalks and lower weight per unit length of stalk. There is a varietal difference between the proportion of the area in which ratoon growth does not occur; in those varieties studied, H 50-7209 had the highest proportion of re-growth, while the greatest loss was observed with H 39-5803 and Lar 52-604. H 50-7209 also showed the greatest tillering capacity as well as rate of growth. From observations throughout the two crops on six varieties there were found to be three stages in stalk population development and two in stalk elongation.

Yield performance of two promising VMC hybrids. A.T. Barredo and F.C. Barredo. *Sugar News* (Philippines), 1979, **56**, 178-183. – The yields obtained in trials with VMC 67-315 and VMC 71-238 are reported. Both are high-yielding varieties, but the former is susceptible to leaf scorch, while the latter variety is resistant to both this and smut.

Sugar cane variety tests in Florida 1978-79 harvest season. E. R. Rice. *Science and Education Administration* (USDA), 1979, 16 pp. – Varietal tests at eight sites representing four soil types are reported. The 29 varieties were compared with CP 63-588, the leading commercial variety in Florida, in terms of cane and sugar yield. Outstanding performances were given by CP 72-1210, CP 72-1312, CP 73-1172, CP 73-1547 and CP 74-1241. Tabulated results refer to plant and 1st and 2nd ratoon crops.

Comparative studies in different sugar cane varieties. P. M. Gokhale and J. D. Nimbalkar. *Maharashtra Sugar*, 1979, **4**, (9), 37-38, 40-41. – Growth pattern and mineral uptake studies were conducted on four Co varieties under field conditions, and results are discussed.

Assessment of TS-1, a thick cane mutant. H. K. S. Rao, R.S. Sachan and M. Singh. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, Ag.23-Ag.27. – The growth and juice quality parameters of TS-1, a cane mutant obtained by irradiation of budded setts of Co 419[1], have been found to be superior to those of unirradiated Co 419. Some details of the mutant are given.

Sugar cane improvement in India. J. T. Rao. *Maharashtra Sugar*, 1979, **4**, (10), 13, 15, 17, 19, 21. – After brief descriptions of the five species of the *Saccharum* genus, the author describes cane breeding work conducted at Coimbatore and indicates how genetic improvement has benefited the Indian sugar industry.

[1] Rao *et al*.: *I.S.J.*, 1979, **81**, 117.

SUGAR BEET AGRONOMY

The optimum number of replications in field experiments. M. Cagatay. *Seker,* 1979, **29**, (111), 36-43 (*Turkish*). Experiments showed that for field trials at only one site at least six, but preferably eight, replications are required, whereas for trials at more than one location, the minimum requirement is four replications and the preferable number six.

Phytotoxicity of incorporated cover crops to sugar beet seedlings. L. F. Elliott, D. E. Miller and A. W. Richards. *Plant Disease Reporter,* 1979, **63**, 882–886. Some of the stand loss in a beet crop grown in an area of the USA subject to soil erosion by wind was attributed to the phytotoxic effect of decomposing winter wheat and oat cover crops incorporated in the soil for erosion prevention. It is recommended to keep the cover crop residue out of the beet rows.

Soil management and the sugar beet crop. G. Spoor. *British Sugar Beet Rev.,* 1979, **47**, (4), 23–24. – In a study of soil structural damage as a result of field operations, the author advocates better use of the natural weathering and drying processes and thus reduction of the number of tillage operations and wheelings. Spring operations can be significantly reduced by leaving a level surface of appropriate clod size in autumn which will weather during winter into a condition requiring only light harrowing and levelling before drilling. Firm "tramlines" to carry harvesting equipment should be established after primary tillage rather than after drilling, while subsoiling operations will be of greater benefit to the subsequent crop if they are postponed until after harvesting and soil preparation.

Strip tillage. A possibility for sugar beet. M. Nuttall. *British Sugar Beet Rev.,* 1979, **47**, (4), 25–26. – Strip tillage, whereby the beets (in a 3-year rotation of cereals-cereals-beet) were drilled directly into cereal stubble after application of pre-emergence herbicide, was tested in two years. Sugar yield per ha rose with increased N application up to 200 kg N per ha (the maximum applied), at which level it was slightly below the yield obtained by conventional soil treatment (ploughing plus seedbed preparation by shallow harrowing in two passes) in 1977 and slightly above it in 1978. In the conventional method, 120 $kg.ha^{-1}$ N was the most economical rate. Strip tillage led to increased root fanginess which, however, did not appear to have much effect on yield and occurred at a lower level than after ploughing. Advantages of strip tillage include improvements in soil structure and accumulation of organic matter (from the plant residues) in the surface layers, which is of benefit to subsequent cereal crops. It may also be of advantage on very light soils as a means of preventing blowing. The question of suitable equipment for strip tillage is discussed.

Electro-thermal weed and bolter control. M. Diprose and N.Turner. *British Sugar Beet Rev.,* 1979, **47**, (4), 31–32. – After success was achieved in the use of electric current to kill bolters, a tractor-mounted test machine was built in which the key components were a generator, transformer (to raise the voltage to 8000 V) and an electrode. Results obtained were sufficiently encouraging to justify further work. Desirable characteristics of a suitable machine are listed.

A sugar beet system for the 1980's. C. Howard. *British Sugar Beet Rev.,* 1979, **47**, (4), 34–35. – A system of beet growing is described in which the crop is produced in 4-row beds with inter-bed spacing to allow a 4-row harvester to pass over the beds and follow the same tracks (1.8 m apart) as equipment used for potatoes grown in 900-mm rows. A description is given of a prototype harvester built to customer specifications to allow for increased beet lifting per unit area. The system has resulted in an approx. 7.5% increase in harvested beet, while other advantages include the absence of need to change wheels and the increased harvesting rate.

Energy consumption and possible ways of reducing it in the case of sugar beet production. H. Steinkamp. *Die Zuckerrübe,* 1979, **28**, (6), 18-23 (*German*). – The energy consumption in West German agriculture is discussed, and beet agriculture examined more closely in this respect. Highest energy consumption occurs in tillage and seedbed preparation as well as harvesting, while transport to the factory may also add appreciably to the total consumption. The energy used for preparation of spray chemicals and fertilizers must also be taken into consideration. It is admitted that at present there is no recognizable way of making any dramatic reduction in energy consumption in beet agriculture.

No more ploughing in sugar beet? K. Baeumer. *Die Zuckerrübe,* 1979, **28**, (6), 24–25 (*German*). – The minimum tillage system of beet agriculture, in which the beet is drilled in a mulch formed from a previous cereal crop, is discussed and reference made to trials in which problems occurred in connexion with changes in the structure of the untilled soil, so that the yield with conventional ploughing and seedbed preparation was greater. Another problem mentioned is the possible penetration of the beet row by the residual cereals. On the other hand, the system does reduce mudding and compaction, and thus facilitates movement of the harvesting equipment.

The sugar content of high-topped sugar beet roots. E. Schellerová *et al.* *Listy Cukr.,* 1979, **95**, 265–267 (*Czech*). – Investigations of mechanically harvested beet showed that 32.6% had been topped above the normal level and had an average sugar content which was 0.24 units lower than for correctly topped beets. The tops, having a weight representing 3.9% of the untopped beets, contained much more ash and α-amino-N than did the topped beets.

Possible means of improving field emergence. W. C. von Kessel. *Die Zuckerrübe,* 1980, **29**, (1), 8–10, 12 (*German*). – Factors of importance in establishing a high emergence rate with uniform spacing between plants are discussed, including application of plant protection chemicals and fertilizer at correct time intervals and proper use of drills. The latest developments in drilling equipment are described.

BEET PESTS AND DISEASES

3-year tests on soil disinfection for control of the beet cyst nematode *Heterodera schachtii*. W. C. von Kessel. *Die Zuckerrübe*, 1979, **28**, (4), 8-12 *(German)*. – Trials are reported on soil application of various nematicides as a means of controlling *H. schachtii* and raising beet yield. Most successful treatment was application of Telone I at 175 litres.ha^{-1}, Telon II at 150 litres.ha^{-1} or Shell DD at 250 litres.ha^{-1}. Treatment must be carried out before each beet crop, since soil sterilization does not have a lasting effect on nematodes, and the soil must be well prepared before nematicide application.

Creating epiphytotics of *Rhizoctonia* root rot and evaluating for resistance to *Rhizoctonia solani* in sugar beet field plots. E. G. Ruppel, C. L. Schneider, R. L. Hecker and G. J. Hogaboam. *Plant Disease Reporter*, 1979, **63**, 518-522. – A modified granulator was used to apply *R. solani* inoculum to rows of beet at two locations in the USA. By this means, uniform epiphytotics of root rot were initiated. Details are given to the equipment, inoculum preparation, field rates and disease evaluation at the two sites. The methods were effective as a means of evaluating varietal resistance to the fungus.

The effect of oil sprays on aphid transmission of turnip mosaic, beet yellows, bean common mosaic and bean yellow mosaic viruses. G. D. A. Walkey and M. C. Dance. *Plant Disease Reporter*, 1979, **63**, 877–881. While mineral oil diluted to 1, 2.5 or 5% (v/v) in distilled water and sprayed onto leaves of sugar beet (among other plants) controlled transmission of beet yellows virus by *Myzus persicae* in glasshouse experiments, 1% dilutions failed to control virus transmission when applied in field tests, while the other dilutions induced moderate to severe phytotoxicity.

Ecology of the green peach aphid as a vector of beet western yellows virus of sugar beets. G. Tamaki, L. Fox and B. A. Butt. *Tech. Bull.* (U.S. Dept. Agric.), 1979, (1599), 16 pp. – The green peach aphid (GPA), *Myzus persicae*, is the most important and efficient vector of beet western yellows virus (BWYV), which is more prevalent than beet yellows virus (BYV) in the USA and infects weed hosts that serve as important virus sources, although BYV has been found to cause greater yield losses in studies carried out in California. Three-year investigations were carried out in the state of Washington at four sites representative of typical overwintering areas for the GPA. In the period, the earliest collection of winged viruliferous GPA was on May 6, and peak levels occurred in June and July. In 1975 some 75% of the indicator plants at each site were infected with BWYV from the third week of June; infection was cyclic at two sites (including an area of drainage ditches) but continued at a high level throughout the summer at the other two locations. It is concluded that the first two of the currently recommended pesticide applications could be eliminated in most years and spraying delayed until end-May or early June; only after a mild winter and when substantial numbers of GPA over-winter in drainage ditches close to a beet field is early treatment necessary.

The effect of a three-year rotation and monoculture on sugar beet damage by root-parasitic fungi. W. Steudel. *Zuckerind.*, 1979, **104**, 840–844 (*German*). – Sugar yield losses caused by root-parasitic fungi, particularly *Aphanomyces cochlioides*, were determined in experiments in which beet was grown in a 3-year rotation (beet-cereals-cereals) and as monoculture; partial soil disinfection was effected with Dexon. Application of Temik permitted determination of losses caused by aphids as pests in their own right and as virus yellows vectors. Highest losses occurred in most years as a result of the vector effect of aphids, and rotation or monoculture practices had no significant effect on the level. Beet growing in the rotation was not possible without some damage from root-parasitic fungi; the average loss was 0.5–0.6 tonnes of sugar per ha. Reducing the rotation ultimately to monoculture increased the losses, which fluctuated widely with climatic conditions; Dexon gave between 0 and 77% more sugar by comparison with the controls. With considerable damage by fungi, the losses caused individually by fungi and aphids fell significantly, a reciprocal effect which was not found with light fungal damage and which was independent of treatment to control fungus or aphid.

Effect of chemicals on sucrose loss in sugar beets during storage. W. R. Akeson, Y. M. Yun and E. F. Sullivan. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 255–268. – Investigations showed that chemicals such as herbicides and nematicides applied early in the season had no adverse effect on stored beet as regards respiration, invert sugar formation and sugar loss. However, two out of four growth regulators applied 19 days before harvest, with the aim of reducing storage losses, had no effect at lower dosage rates but increased losses when applied at higher rates; none of the four chemicals had been used commercially. The adverse effect is attributed to toxicity to the beets. A decrease in losses resulted when post-harvest application of fungicides such as thiabendazole reduced the occurrence of rotting and mould; however, if storage conditions were such that there was little risk of mould formation, fungicide treatment would have no positive effect and could even increase losses.

The effect of root dehydration on the storage performance of a sugar beet genotype resistant to storage rot. W. M. Bugbee and D. F. Cole. *J. Amer. Soc. Sugar Beet Tech.*, 1979, **20**, 307–314. – The beet variety American Crystal 2 hybrid B (2B) was superior to the storage rot-resistant genotype 75P6 in terms of recoverable white sugar per ton of beet at harvest but was inferior to it after inoculation with *Phoma betae*, *Botrytis cinerea* and *Penicillium claviforme* and storage at 10°C and 98% relative humidity for 106 days. The amount of rot in 75P6 was half that in 2B after 8–10% loss of weight. Dehydrated roots had lower clear juice purity and yielded less sugar than did turgid roots, while severely dehydrated roots (24% weight loss) of both genotypes did not develop more rot than turgid roots that had suffered 9% weight loss, although there was a fall in sugar content, juice purity and white sugar recovery.

CANE SUGAR MANUFACTURE

Boiling house performance indicators. P. K. More. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.137–M.144. – See *I.S.J.,* 1980, **82**, 282.

A new juice clarifier is born. B. L. Mittal. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.167–M.170. – See *I.S.J.,* 1980, **82**, 157.

A critical study of the causes of high mud volume formation in sulphitation sugar factories in India. K. H. Ray and K. P. Sinha. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.171 – M.186. Clarification of refractory juice at two factories led to abnormally high mud volumes. Experimental work showed that the problem could be solved by cold preliming to pH 6.7–6.8 followed by heating to 75°C for liming and sulphitation.

New method of compound imbibition. I. S. T. Anjal and A. B. Maisale. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.199–M.205. **II.** *Idem ibid.,* M.207–M.211.

I. The authors advocate adding imbibition water to shredded cane before the crusher by (1) using some of the imbibition water normally added at the mills, (2) increasing the total imbibition water by that amount added to the pre-crusher cane, or (3) recirculating all the imbibition water to the cane chute feeding the crusher instead of at the 1st mill. The mathematics of such a scheme are worked out.

II. Laboratory and factory trials lasting one week indicated a slight reduction in bagasse pol as a result of the new imbibition scheme.

Phosphatation of unfiltered second carbonatation cane juice. Development of a new system of cane juice clarification for manufacture of superior sugar at reduced manufacturing costs. II. Factory scale trials. S. P. Mishra. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.215–M.230. – Factory-scale trials of the scheme described earlier[1] confirmed the results of laboratory and pilot-plant tests and gave a 1.5 units purity rise, a 12.5% reduction in colour and falls in lime salts and ash contents by comparison with defeco-carbonation and defeco-sulphitation.

Need for a proper formula for reduced mill extraction. J. C. Bhargava and I. S. Juneja. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, M.245–M.252. – A modification of the Hugot formula for reduced mill extraction is presented which is claimed to give a truer assessment by allowing for a reduced fibre content of 12.5% and a cane sugar content of 12.5% as well as including the number of mills in the tandem (assuming 3-roller mills). Comparison is made between values calculated with the new formula and with those of Hugot and Mittal.

Uganda and its sugar industry. S. K. Chattopadhyay. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, G.45–G.51. – A survey is presented of the Uganda sugar industry up to construction and operation (on a limited scale) of Kinyala sugar factory in 1976.

Studies on fermentation of molasses and its check-up at Balrampur. B. B. Garg and B. K. Gupta. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India,* 1978, G.81–G.103. – A case of spontaneous degradation of stored molasses is reported. A considerable rise in temperature was accompanied by foaming, which was countered by addition of 1% turkey red oil (v/v); treatment with 0.5% turkey red oil inhibited degradation.

Cane juice sampling system of Passisugar. E. T. Dalipe. *Sugarland,* 1979, **16**, (3), 16–19. – Details are given of the cane juice sampling system at Passi (Iloilo) Sugar Central Inc. which handles 30–36 samples per hr. A system of steel balls is used to identify the specific bundles of cane as they travel from the feeder table via the main and auxiliary carriers and pre-extraction mill to the 1st mill, where the juice samples are taken. Synchronization of the travel of each steel ball with the speed of the carriers (which are at right-angles to each other) is brought about through two perforated turntables, a top one corresponding to the auxiliary carrier and the bottom one to the main carrier. The speed of the turntables is governed by signals received from self-synchronous units at the head of each carrier.

Cush-cush handling at Somaiya Sugar Works, Sameerwadi. A case study. M. Singh, I. B. Adarkatti and V. M. Murugkar. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), E.1–E.7. – With increase in cane preparation for purposes of greater throughput and higher mill extraction, the amount of bagacillo also increased; this caused blinding of the DSM screens and hence greater juice load at the 2nd mill. The problem was solved by isolating the screens from the milling tandem and recycling the bagacillo from them to the 2nd mill by means of a screw conveyor which allowed drainage of the juice. This juice was sent to a special tank, while the geometry of the normal juice tanks had to be altered to avoid blockage of the 3rd and 4th mill troughs and to facilitate bagacillo removal.

A correction suggested to the present R.M.E. formula for taking into account the effect of variation in pol percent cane on mill extraction. C. M. Ugale. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), E.13–E.18. – See *I.S.J.,* 1980, **82**, 282.

Dejuicing device for strained wet bagacillo final treatment to improve milling efficiency and capacity. T. M. Karne. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), E.19–E.26. – Wet bagacillo from a DSM screen is passed through a special miniature 3-roller mill (having rollers made of seamless tubing

[1] *I.S.J.,* 1979, **81**, 85.

and of a diameter which is approximately one-third of that of a conventional mill roller) which is driven from the 1st mill. The squeezed bagacillo then falls on the intermediate carrier feeding the 2nd mill, while the juice flows under gravity through a small stationary screen. Trials showed that the bagacillo moisture content was thus reduced from 75–90% at discharge from the DSM screen to 55–60%, while 10–15% juice on cane was separated by the new unit and had a Brix intermediate between that of the juice from the 1st and 2nd mills. The economics are discussed.

Preliminary trials of a mud centrifuge. A. C. Chatterjee, V. V. Sabnis and A. F. Golandaj. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), M.1–M.8. – Preliminary trials on the use of a solid-bowl centrifuge in place of vacuum filters for clarification mud treatment are discussed. The conclusion is that neither a centrifuge nor a rotary filter will give a clarity comparable to that of clear juice from a filter-press.

Aluminium tubes: their application in the Indian sugar industry. K. M. Pole, A. C. Chatterjee, K. B. Shedji, V. V. Sabnis and C. Syamsunder. *Proc. 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, (1), M.9–M.21. – The advantages of aluminium tubes over brass or steel tubes in juice heaters are indicated on the basis of trials at Walchandnagar sugar factory. Advice is given on their installation.

Fast wearing of mill gear teeth. P. B. Bargaje. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India), 1979,* 4 pp. – Causes of rapid wear of cane mill gear teeth are examined and advice given on ways of minimizing it.

Proposed modifications for improving cane preparation, mill feeding and imbibition to improve mill performance. B. B. Nikam. *Paper presented at 29th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1979, 5 pp. – The modifications briefly described include installation of a reverse shredder towards the head of the main carrier to which chopped cane is fed from the feeder carrier (a reverse leveller being located at the point where the cane falls from the feeder carrier onto the main carrier), a new design of trash plate, and changes to the imbibition equipment.

A study of the properties of calcium phosphate precipitates. R. Fajardo G. and L. D. Bobrovnik. *Izv. Vuzov, Pishch. Tekh.,* 1979, (5), 65-67 (*Russian*). See *I.S.J.,* 1979, **81**, 216.

Mechanical advances in cane crushing mills. T. W. Gatley. *Mech. Eng. Trans. Inst. Engineers* (Australia), 1977, **ME2**, 21–26; through *S.I.A.,* 1979, **41**, Abs. 79-1611. – The disadvantages of plain bearings for mills are explained, and the design of a mill with spherical roller bearings is described with diagrams. Attention is drawn to features of the bearing design, and to the mill drive, which differs somewhat from that of conventional mills. Three mills of this type installed at Pleystowe factory are giving a very good performance. The torque is considerably lower than in mills with plain bearings, owing to the lower coefficient of friction.

Influence of technological practices on the deterioration of raw sugar. E. David. *ATAC,* 1978, **37**, (6) 13–15 (*Spanish*). – Because of deterioration in storage, much sugar is lost and some factories are obliged to reprocess up to 10% of their production. Acceptable losses can be achieved if the sugar is at a pH of about 6.8 and a temperature lower than 40°C on entering the store. Factors affecting non-sugars which contribute to deterioration include weather conditions, N fertilization, cane cleaning efficiency, juice clarification efficiency and boiling to produce suitable grain size and uniformity.

Cooling tower design and construction. R. Lokan, P. N. Bakthavachalu, T. Balasubramani and P. Thangamuthu. *Maharashtra Sugar,* 1979, **4**, (11), 17–20. Advantages and disadvantages of water cooling towers are listed, and design, materials of construction, component parts, economics and typical performance briefly discussed.

Falling thin film evaporation in the Cuban sugar industry. M. J. Carrillo and R. Espinosa. *ATAC,* 1979, **38**, (1), 44–51 (*Spanish*). – Because of its advantages, including high heat transfer rate, constant hydrostatic pressure, absence of foaming and short residence time, the thin film evaporator has been increasingly used in the food industry, and references are given to work demonstrating the benefits, while they have also provided parameter values for the construction of a model unit for trials with cane juice evaporation. This was tried at the Central University Pilot Plant in Cuba and found to give heat transfer coefficients 1.70–1.84 times that of the first vessel of a triple effect, depending on whether a rotor was used or not.

Effect of grain size and boiling scheme on pan capacity. P. K. Singh and P. C. Shukla. *Maharashtra Sugar,* 1979, **4**, (12), 37–38, 40–41. – Three hypothetical 3-massecuite boiling schemes are calculated to demonstrate the effect of scheme and required grain size on the number of strikes per day, % crystal yield and sugar recovery, assuming a given number of pans and *A*-massecuite boiling times.

Oxidation ditches and cane wash ponds. D. F. Day. *Sugar Bull.,* 1979, **58**, (3), 8, 11. – The principle of the oxidation ditch is explained, and the Pasveer ditch described. Use of oxidation ditches to solve problems connected with cane wash water is suggested.

Cane separators. Anon. *La Ind. Azuc.,* 1979, **86**, 194-199 (*Spanish*). – An illustrated account is given of the process employed by Hawker Siddeley Canada Ltd., Lignex Products Group, for separation of cane into its components for recovery of sugar, wax and fibre[1].

The sugar industry in the Philippines. J. C. Atienza and J. K. Demeterio. *Sugar y Azúcar,* 1980, **75**, (1), 195-210. – A survey is presented of the history and development of the sugar industry in the Philippines, including cane agronomy, factory processing and sugar industry organizations.

The sugar industry in Thailand. J. Messineo. *Sugar y Azúcar,* 1980, **75**, (1), 240–244. – A survey is presented of the Thailand sugar industry and marketing, with mention of the various problems facing the industry.

[1]See *I.S.J.,* 1972, **74**, 123-124.

BEET SUGAR MANUFACTURE

Correct operation of lime kilns. Z. Kuncewicz. *Gaz. Cukr.*, 1979, **87**, 241-245 *(Polish)*. – Factors determining the operation of lime kilns are discussed, and advice is offered on ways of ensuring high performance, with a gas CO_2 content above 30%.

Scaling and methods of boiling out an evaporator. H. Dabrowski. *Gaz. Cukr.*, 1979, **87**, 245-249 *(Polish)*. The main causes of evaporator scaling are discussed, and methods of evaporator cleaning are described, covering both shut-down of the entire station or stoppage of only individual effects.

Generalization of results of an investigation into heat exchange during boiling of massecuites flowing under gravity along an inclined solid heating surface. B. G. Didushko and V. T. Garyazha. *Izv. Vuzov, Pishch. Tekh.*, 1979, (5), 103–107 (*Russian*). – Results of investigations into boiling of massecuite of 85–99.6 purity and 2–53% crystal content at a steam pressure of 0.22–0.38 x $10^5 N.m^{-2}$, heat flux of 5-45 $kW.m^{-2}$ and Reynolds' numbers of 5.2–296 were used to derive empirical equations for calculation of the heat transfer coefficient. The generalized effect of the various parameters on the Nusselt number is shown in graph form. (See also Garyazha & Didushko: *I.S.J.*, 1976, **78**, 152.)

Optimum conditions for purifying green syrup by a combined process. P. P. Zagorodnii, K. P. Zakharov, V. Z. Semenenko and T. P. Trifonova. *Izv. Vuzov, Pishch. Tekh.*, 1979, (5), 126–128 (*Russian*). – Tests were conducted on a patented system of molasses treatment involving passage through a column of strongly acid cation exchange resin to replace the alkali metals with Ca^{++} ions, followed by liming plus gassing with CO_2 and subsequent filtration. Optimum conditions were established as an initial Brix of 60-65°, a temperature of 85–90°C during both ion exchange and defeco-saturation, 30-35 minutes' retention in the latter stage, and a lime consumption of 25% CaO on weight of non-sugars in molasses (approx. 0.4% on beet). Under these conditions, a molasses purity of 78.3 was increased by an average of 4.51 units.

Contribution to the study of the mechanisms of anaerobic degradation of sugar factory pollutants. J. P. Lescure and P. Bourlet. *Sucr. Franç.*, 1979, **120**, 369-375, 413-419 (*French*). – A 200-mm column of 18 mm inside diameter, was placed in a hot water bath at 35°C and fed continuously with effluent and nutrient solution in a closed circuit; both mud and gas were analysed. From the results, which are given in table and graph form, it is concluded that, in the treatment of acids, it is advisable to avoid exceeding 2000 $mg.l^{-1}$ organic carbon in the form of acetic or formic acid, since these retard the fermentation by inhibiting enzyme activity. Periodical injections of new material are recommended so as to accelerate degradation; during these interruptions to the normal degradation process, mud activity increases. Anaerobic fermentation of sucrose was found to proceed at a very slow rate and was accompanied by an increase in mud, while the acids formed were degraded only slowly. Hence, it is advisable to degrade sucrose in the tanks before introducing water in the anaerobic fermenter.

Important variations and major transformations in the composition of juices during the manufacture of beet sugar. B. Winstrom-Olsen, R. F. Madsen and W. Kofod Nielsen. *Sucr. Belge*, 1979, **98**, 347–359. – As part of a major analytical study of the chemical composition of beet juices, the microbiology of diffusion was investigated, particularly the acids formed. While L-lactic acid is the major acid formed, substantial quantities of acetic acid are also formed; although found in raw juice, ethanol is not associated with microbial activity in the diffuser. Degradation of invert sugar is associated with increase in the concentrations of lactic and acetic acids, but the overall increase in the acid concentration is smaller than the total fall in invert sugar concentration. Glutamine is quantitatively the most important amino-acid in raw juice; most of it is transformed into pyrrolidone carboxylic acid (PCA) in purification or evaporation, without any pre-saponification to glutamic acid. A substantial fall in the amino-N content of juices is ascribed to the removal of free ammonia occurring in raw juice and of ammonia released by the formation of PCA.

Purification of intermediate products of sugar manufacture by means of electrodialysis with intensified polarization of the anion exchange membranes. M. P. Kupchik, M. I. Ponomarev and I. G. Bazhal. *Nauch. Trudy Kubansk. Univ.*, 1977, **232**, (2), 122–127; through *S.I.A.*, 1979, **41**, Abs. 79–1500. – The application of a potential gradient high enough to polarize an anionic membrane can cause reversible precipitation, on the membrane, of adjacent organic substances dissociable into large anions. Tests on the use of this phenomenon to improve the colour and purity of low grade syrups (as 3% beet molasses solution and 1st run-off syrup diluted to 15–16°Bx) are briefly reported.

Test on use of "carbo-ammoniate" to reduce sugar losses during sugar beet storage at Kamenets-Podol'skii sugar factory. V. B. Varshavskaya, N. I. Danilyak, R. F. Protsko, N. E. Ignat'ev and G. I. Vilesov. *Sakhar. Prom.*, 1979, (12), 13–15 (*Russian*). – Because of its physico-chemical properties, particularly its high alkalinity and ability to release CO_2 and free ammonia when degraded, "carbo-ammoniate" (a fertilizer made up of urea and ammonium carbonate dissolved in ammoniacal water) was regarded as a possible preservative for stored beet. Trials in 1977/78 and 1978/79 showed that spraying the beets with a 4:1 water dilution as they were being piled reduced daily sugar losses and the extent of rotting over a period of 65 and 93 days. The effect is based on the creation of an environment that does not favour respiration or sprouting.

Influence of different forms of recycle on the efficiency of progressive preliming. K. P. Zakharov, V. Z. Semenenko, R. G. Zhizhina, N. I. Zharinov and A. P. Lapin. *Sakhar. Prom.*, 1979, (12), 19–23 (*Russian*). – The effect on 1st and 2nd carbonatation juice and thick juice parameters of recycling 1st carbonatation juice or 1st or 2nd carbonatation mud to progressive preliming was investigated. Tabulated results showed that recycling 100% 1st carbonatation juice or 20–40% 1st carbonatation mud had almost the same effects, whereas 2nd carbonatation mud at 60% on preliming juice was better in terms of colloid coagulation and stabilization, filtration of 1st carbonatation juice and quality of thin and thick juice. Best results were achieved when 2nd carbonatation mud recycle was coupled with 1st carbonatation juice liming (with 0.5% CaO on juice) before 2nd carbonatation.

Optimization of concentration processes in the sugar industry. P. Mosel, H. Lichø, E. Schröter and P. Valentin. *Zuckerind.*, 1979, **104**, 1101–1107 (*German*). – The amount of energy consumed in West German sugar factories is given as 5.4 tonnes per tonne of white sugar produced and the heat economy of a sugar factory is examined to see where savings in heat consumption can be made. Apart from agricultural measures and improvements in juice purification, the major steps considered include use of pan stirrers and reduction of the temperature in boiling, greater use of crystallizers (even after 1st and 2nd strikes), low-temperature evaporation of thick juice to 72°Bx and of raw sugar *B* run-off to 74°Bx, and compression of pan vapours for re-use in boiling; since this last measure entails high capital costs and consumption of additional electricity, it should be regarded as a last resort only after all other possibilities of energy saving have been exhausted.

Sugar losses due to mechanical injury to beet. K. Vukov and G. Pátkai. *Zuckerind.*, 1979, **104**, 1117–1119 (*German*). – See *I.S.J.*, 1980, **82**, 345.

Metal powder-spray flame processes and their application in the sugar industry. E. A. Bertold. *Zuckerind.*, 1979, **104**, 1120–1123 (*German*). – The spray flame welding processes using alloy powders, such as developed by Eutectic + Castolin, are described and their potential application in the sugar industry indicated.

Modern European systems for exhaustion of beet molasses. R. F. Madsen and W. Kofod Nielsen. *Sugar Tech. Rev.*, 1979, **7**, 49–85. – A review is presented of crystallizer development, with particular attention to optimum cooling rates and temperatures, water addition and massecuite re-heating before spinning. Also discussed are: retention time determination, molasses exhaustion in Denmark, purity determination in relation to molasses exhaustion, pilot-plant experiments, crystallization theory, the effect of back-mixing and time on crystallization rate in continuous crystallizers, heat transfer, new systems and results obtained with a DDS vertical crystallizer and tube cooler, in which water-cooled tubes in one of a pair of interconnecting cylinders are pushed down by a piston while those in the other cylinder are raised by a piston at the rate of four strokes per min.

The steam economy in a sugar factory. S. Zagrodzki. *Gaz. Cukr.*, 1979, **87**, 265–269 (*Polish*). – The use of high-pressure boilers at up to 8.0 MPa (78.5 atm) is recommended as one means of reducing steam and fuel consumption and at the same time producing cheap electricity via a turbo-generator.

Possible means of improving the heat economy in sugar factories. T. Bogumil. *Gaz. Cukr.*, 1979, **87**, 269–275 (*Polish*). – The heating schemes at two Polish sugar factories of identical size, operating the same number of days and using about the same manufacturing processes, are compared. At Kruszwica, average fuel consumption during three campaigns was 6.2% on beet, while Koscian consumed an average of 8.9% on beet. The reasons for the differences are indicated, and results of adoption of a number of measures at both factories in 1978/79 are discussed.

A quadruple-effect evaporator system with turbo-compression. S. M. Zagrodzki. *Gaz. Cukr.*, 1979, **87**, 275–279 (*Polish*). – Details are given of a quadruple-effect evaporator operating in conjunction with a turbo-compressor. With condensate expansion and use of pan vapour to heat raw juice, the system consumes 29 tonnes of steam per tonne of beet at a thick juice Brix of 70°; this compares with 40.8 tonnes of steam per tonne of beet for an identical evaporator operating under ideal conditions but without turbo-compression.

Optimum 1st carbonatation conditions. K. P. Zakharov, R. G. Zhizhina, V. Z. Semenenko, P. P. Zagorodnii and V. V. Filomeeva. *Sakhar. Prom.*, 1980, (1), 24–27 (*Russian*). The effect of 1st carbonatation juice pH on thick juice parameters is examined, and the significance of juice conductivity as a guide to optimum carbonatation conditions indicated. The point at which there is a distinct change in conductivity of unfiltered 1st carbonatation juice is that which corresponds to optimum thick juice parameters, so that carbonatation should be carried out at the corresponding pH, which at high raw juice purity will be approx. $pH_{20} = 11.0$.

Results of departmental trials on a vessel for progressive preliming in the warm-hot juice purification scheme. L. P. Reva, V. V. Pyshnyak, P. N. Korolyuk and A. I. Bryukhovetskii. *Sakhar. Prom.*, 1980, (1), 28–30 (*Russian*). – The prelimer described earlier[1] was used in tests in which progressive preliming was carried out for 14 min at 55–62°C, with recycling of approx. 75% unfiltered 1st carbonatation juice to the zone in which the pH_{20} was about 9.0, followed by cold-hot fractional liming. Comparison with preliming at 85°C and recycling of 150% 1st carbonatation juice showed that the new system was better in terms of juice colour and lime salts content, while 1st carbonatation juice settling was faster and filtration better.

The use of siliconized hardening for components of equipment used to transfer beet sugar factory products. I. I. Chenkalyuk and V. I. Udovitskii. *Sakhar. Prom.*, 1980, (1), 33–36 (*Russian*). – For metal pump components exposed to erosion and corrosion in a beet sugar factory, it is recommended to use surface hardening treatment such as siliconization and/or chrome plating, etc. Details are given of the effects of treatment on various grades of steel immersed in corrosive solutions.

The control of adiabatic and non-adiabatic dryers. H. A. Paschold. *Sugar J.*, *1979*, **42**, (5), 7–12.–See *I.S.J.*, 1980, **82**, 92.

Liquid sugar. J. Bures. *Listy Cukr.*, 1980, **96**, 5–8 (*Czech*). – Details are given of the four types of liquid sugar produced in Czechoslovakia, with information on their uses.

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[1] *I.S.J.*, 1979, **81**, 183.

NEW BOOKS

Sugar year book 1979. 356 pp; 10.0 x 13.3 cm. (International Sugar Organization, 28 Haymarket, London SW1Y 4SP, England.) 1980. Price: £7.00.

This small book continues the 21 editions published by the International Sugar Council and the 11 published by the ISO under the International Sugar Agreement of 1968; it thus is the 33rd of the series and provides in a compact form detailed statistics of sugar movements, production and consumption, etc. in 127 countries or territories. In the case of members of the Agreement, statistics are supplied under its Rules to the ISO while those of non-members are supplied by the governments concerned, extracted from publications or estimated. They generally are for calendar years and are in terms of tonnes, raw value, where possible. The statistics cover the years 1973 – 1979 inclusive, with 1972 in some cases. A separate section covers world production, imports, exports, consumption, prices, stocks in selected countries, etc. and a table of equivalent weights is included. The reviewer's one criticism of this most convenient and useful book is that figures are given for the EEC en bloc while it would be more realistic and valuable, he feels, for the figures of the individual members to be tabulated with summarized totals for the Community if desired.

Sugar Research Institute Annual Review, 1979-1980. 20 pp; 21.7 x 27.9 cm. (Sugar Research Ltd., Mackay, Queensland, Australia.) 1980.

The 30 Australian sugar factories are members of Sugar Research Ltd. and support and benefit from the work done by Dr. J. R. Allen and his team at the Sugar Research Institute. This was set up in 1953 although Sugar Research Ltd. was founded in 1949. Since 1967 support has also been received from the C.S.I.R.O. both financial and in the form of cooperative research. The present report describes work done by SRI staff during the 1979/80 season and wide ranges of interest and methods are disclosed, including mill roller roughness measurements, a neutron activation method for measuring dirt in cane, measurement of the fatigue strength of roller shell material, development of battery-powered electric locomotives for cane haulage, use of a computer for data analysis and plotting in graph form, characterization of polysaccharides, monitoring of bacterial and fungal spores in bagasse storage areas, development of HPLC for routine analysis of sucrose and other sugars, measurement of forces acting on cane haulage track and bins, determination of the effect of burning on cane quality, steam turbine trials, anaerobic digestion of wastes from ethanol production, bagasse drying, pelleting and storage, direct vapour heating of cane juice, molasses exhaustion studies, establishment of relationships between syrup heat transfer and operating conditions in boiling, feeding of bagasse as roughage to cattle, various studies in regard to ethanol production, development of a mathematical model of a sugar factory, inspection of water cooling towers, cane transport scheduling and bin maintenance, remote-controlled and multiple-unit locomotives, and the study of microorganisms in milling trains and diffusers.

Annual Report 1979 of the Experiment Station. Eds. D. J. Heinz and M. K. Carlson. 79 pp; 20.5 x 26.7 cm.(Hawaiian Sugar Planters' Association, 99 – 193 Aiea Heights Drive, Aiea, HI 96701, USA.) 1980.

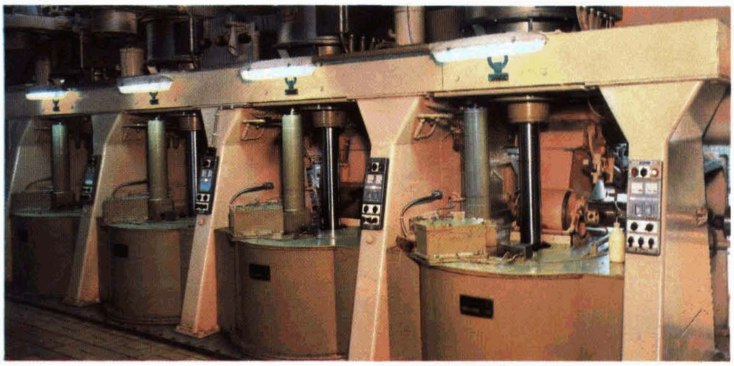
Up to 1965 there had been a steadily increasing average yield of sugar per acre, up to 11.12 short tons, but since that year the industry average has varied between 10.21 and 10.86 tons, the consequence of a decline on the leeward plantations which has counterbalanced improved yields on the Hilo-Hamakua coast. The reasons for the decline are pinpointed by the Director of the HSPA Experiment Station and Dr. Heinz in his introduction outlines the work being done to remedy the situation. A wealth of detail of the Station's work is then presented in the reports of the different departments, including those concerned with cane breeding and selection, environmental studies, irrigation, fertilization, soils and nutrition, growth and metabolism, weeds, insects and rats, diseases, cane and juice processing at the factory, and energy. Reports are also presented on the supporting services provided by the Station, and on its training programs, as well as a list of papers published by staff members, and a roster of staff as at December 31, 1979.

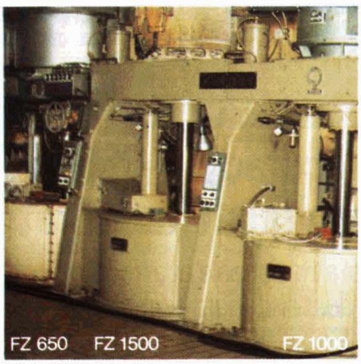
Aporte a la bibliografia agricola Argentina 1909–1979 (Contribution to the agricultural bibliography of Argentina 1909–1979.) 127 pp; 16.5 x 21.5 cm. (Estación Experimental Agro-Industrial "Obispo Colombres", Tucumán, Argentina.) 1980.

Miscellaneous Publication No. 68 of the Obispo Colombres Experiment Station is a bibliography of works published in Argentina on various agricultural subjects, including sugar cane and beet as well as cane processing and by-products. An author index precedes the main body of the work, which is arranged alphabetically by subjects which appear in a contents section. Under each section, the authors are given in alphabetical order, with the titles of their works (also in alphabetical order). As a reference work, the book makes a valuable contribution to the world's sugar literature.

F. O. Licht international sugar economic yearbook and directory 1980. Ed. H. Ahlfeld. 622 + lxi pp; 22 x 29.5 cm. (F. O. Licht GmbH, P.O. Box 1220, D-2418 D-2418 Ratzeburg, Germany.) 1980. Price: 98.00 DM.

The latest edition of this well-known directory maintains the level of excellence set by preceding editions, and at what, in these days of rising costs, may be regarded as a reasonable price. It includes names and addresses of companies, organizations and institutions connected with sugar, the locations and capacities of the world's beet and cane sugar factories (numbering some 2500), product reports, a Buyers' Guide (preceded by a brief Spanish–English glossary acting as guide to the headings), and a collection of review articles by leading specialists. A collection of sugar statistics for 1979/80 is featured in a 61-page supplement housed in a pocket at the end of the book. The type is very clear on a matt paper and all the essential information is in English, with only some company reports given in German only.

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LABORATORY STUDIES

Calculation of the properties of saturated sucrose solutions in multi-component solvents. V. M. Perelygin, G. P. Remizov and A. I. Gnezdilova. *Izv. Vuzov, Pishch. Tekh.*, 1979, (5), 45–48 (*Russian*). – A complex equation developed for calculation of sucrose properties in a multi-component solvent on the basis of analogy with sucrose behaviour in water, in aqueous solutions of individual non-sugars and in aqueous solutions of binary mixtures of non-sugars was applied to calculation of sucrose solubility and solution viscosity and density in the system water-NaCl-KCl-NH_4Cl. Comparison of results with experimental values from the literature showed relative deviations of ± 0.62% for solubility, ± 3.20% for viscosity and ± 0.07% for density.

Studies on the use of flocculating agents during sugar cane juice clarification. XI. Settling studies with Califloc A. A. S. Bose, K. C. Gupta and S. K. Suri. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, M. 75-M. 81. In laboratory studies, the title flocculant at 2 ppm (found to be the optimum) approximately trebled the settling rate by comparison with the control. It was better than two other flocculants, Tulsepar A-30 and Ulsepar A-40, in respect of settling rate and final mud volume.

Factors affecting the total polyphenolic content in cane juices and their fate during clarification. S. C. Sharma, G. S. C. Rad and P. C. Johary. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, M. 123-M.136. Investigations of cane juice polyphenols showed that there were considerable differences between the total polyphenol contents (TPP) in a number of cane varieties and that the highest content ocurred in the cane tops, so that the TPP of mixed juice would be expected to rise with increase in the amount of tops accompanying the cane. The TPP also rose with cane staleness and red rot infection. Agronomic factors and environment also affect the TPP, which also rose with red coloration of cane left standing in the field after leaf removal or as a result of lodging. The amount of TPP extracted with a laboratory crusher was much lower than extracted in a factory mill; this was attributed to cane preparation in the factory. Comparison of the quantities of TPP eliminated in clarification showed that carbonatation removed the greatest amount, followed by defecation, while phosphatation was the least effective.

Chemical composition and clarification characteristics of juices as affected by lodging of sugar cane. S. C. Sharma, P. C. Johary and G. S. C. Rao. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, M.187-M.198. Studies showed that the juice from lodged cane contained more total polyphenols, total amino-acids and fibre and less P_2O_5 and K_2O than erect cane, while the total N and Cao contents were about the same for both. Laboratory clarification took longer with the juice from lodged cane, while the mud volume was greater and the juice slightly turbid by comparison with normal juice. Liming with 2.5% CaO instead of 1.5 or 1.0% reduced both mud volume and optical density.

Spectrophotometric method of determination of sugar traces. I. M. Prasad, J. K. Srivastava and G. Ramanathan. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, C.1-C.6. – Spectrophotometric determination of sucrose in trace quantities was based on the Molisch method, which involves reaction with α-naphthol and conc. sulphuric acid, cooling and measurement of absorption at 570 nm.

Abnormal behaviour of boiler water. S. T. Anjal and A. B. Maisale. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, C.7-C.12. – Addition of alkali to boiler feed water at a number of Indian sugar factories caused the pH to fall. Analysis revealed the presence of methyl glyoxal, thought to be formed in the vapour cell preceding the 1st evaporator effect from reducing sugars undergoing degradation at high temperature and pressure and subsequently discharged in the condensate.

Distinction between vacuum pan and khandsari sugars by direct and alternating current polarographic studies based on variation in anionic surface active substances. S. K. D. Agarwal and R. K. Gupta. *Proc. 42nd Ann. Conv. Sugar Tech. Assoc. India*, 1978, G.29 – G.43. Comparison between open-pan khandsari and white sugar as produced in a normal vacuum pan factory is shown to be possible by polarography; the surfactants typically present in khandsari give well-defined A.C. and D.C. polarograms that are quite distinct from those for white sugar.

Dialysis of caramels: ultraviolet spectrophotometric and chromatographic behaviour of components constituting caramel. S. K. D. Agarwal and K. V. Gupta. *Proc. 42nd Ann. Con. Sugar Tech. Assoc. India*, 1978, G.139-G.152. Fractions of caramel (obtained by heating crystal sugar or by treatment of dextrose with NaOH) were subjected to dialysis and then studied spectrometrically and by paper chromatography. R_f values of spots developed with 2:2:1 ethanol: butanol: water and sprayed with silver nitrate are tabulated as well as the U.V. peak values.

Contribution to the knowledge on olfactory degradation products in anaerobically treated sugar factory and model waste waters. E. Reinefeld, H. P. Hoffmann-Walbeck and J. Wittek. *Zuckerind.*, 1979, **104**, 1022-1027 *(German)*. – Gas-liquid chromatography was used for quantiative determination of the lower fatty acids (up to C_6) and for qualitative determination of free amines in a study of the odour associated with waste water undergoing continuous anaerobic treatment. Details are given of the procedures used and results are tabulated. It was found that the effluent from small continuous units contained one-third of the total acid content (as equivalents) in the form of acetic, propionic and butyric acids, although no relationship could be found between the fatty acid concentration and degree of degradation; fatty acids represented some 80% of the residual COD. Several amines were found besides ammonia in both the effluent and the gas liberated. As regards odour, the most important appeared to be methylamine, dimethylamine, triethylamine, tetramethylenediamine and trimethylamine.

BY-PRODUCTS

Production of sugar and alcohol from cellulosic agricultural by-products. E. J. del Rosario, A. L. Gonzales, L. C. Vilela *et al. Philippine J. Crop Sci.*, 1977, **2**, (1), 1-11; through *S.I.A.*, 1979, **41**, Abs.79-1208. – Bagasse and other cellulosic waste materials were hydrolysed with dilute H_2SO_4 under a range of conditions. For bagasse, the saccharification efficiency was fairly high (31.2%), but the resulting solution contained only 2.4% reducing sugars, of which only approx. 40% were hexoses; the hexose concentration was therefore too low for fermentation to alcohol. In enzymic saccharification of bagasse the efficiency was 29.7%; pretreatment with 1% NaOH increased this to 49.0%. The hexose concentration at 2.5% was still too low for alcoholic fermentation to be practicable, although the efficiency of hexose conversion to alcohol was high (90%).

Maize substitution by Biofermel (molasses and pre-fermented faeces) in diets for bovine cattle. R. Alvarez, V. Pacheco, J. P. E. Pérez-Gavilán, I. Pouso and G. Viniegr -González. *Cuban J. Agric. Sci.*, 1979, **13**, 83-91. A new anaerobic fermentation process was used to transform a mixture of molasses, fibres, faeces and urea into a feed containing 12% crude protein, 14% crude fibre and 12% minerals. Feeding trials showed that the new feed, supplemented with cotton seed cake meal, forage and mineral salts gave a daily weight gain at lower feed conversion requirement than did a ration containing ground maize, molasses and mineral salts.

Distillery fuel savings by efficient molasses processing and stillage utilization. P. Kujala. *Sugar y Azúcar, 1979,* **74**, (10), 13-16. – The Alfa-Laval Almotherm molasses pre-treatment process is discussed and its advantages relative to subsequent fermentation, distillation and stillage (vinasse) evaporation are indicated, including higher ethanol productivity as a result of pasteurization (which eliminates bacteria and allows the yeast to act as a single inoculum), increase in the fermentation potential through conversion of some non-fermentable to fermentable components and through removal of certain impurities, reduction of scale formation in the distillation column and vinasse evaporator through removal of lime salts, and improvement in the vinasse quality (after yeast separation) to permit its re-use as process water in molasses dilution. The benefit of vinasse recycling (up to 60% of the total) as regards savings in steam is compared with the advantage of evaporation to give a fuel for a special boiler, such as developed by A. Ahlström Oy., of Finland, for generation of steam and recovery of the potassium-containing ash which is of value as a fertilizer. A diagram is presented of a vinasse treatment scheme.

Problems of utilization of sugar factory carbonatation mud and flume-wash water mud. E. Bajcsy, I. Horvath and J. Lugosi. *Cukoripar,* 1979, **32**, 122–124 *(Hungarian).* – Tabulated data indicate the quantities of mud requiring disposal at 11 Hungarian factories in 1975–77, and the question of its use as fertilizer and for land filling is discussed. Transporting the mud from the factories is the major problem, and the authors consider possible solutions.

Beet pulp and its future. M. Demaux. *Sucr. Franç.*, 1979, **120**, 357–364 *(French).* – Aspects of pulp pressing and drying and the nature and quality of the final product are discussed. Tabulated data compare the composition of dry pulp with that of molasses and vinasse, as well as other products, all of which are usable as additives to pulp. Other aspects of pulp considered include its pressing after ensilage, fermentation to yield methane, and its use as a fuel in its own right.

Optimization of resources in the fermentation and distillation stations of an alcohol distillery. L. A. Chamarro. *Sugar y Azúcar,* 1979, **74**, (11), 54–55, 57. – Optimization of fermentation conditions, adoption of yeast recirculation, recovery of alcohol from the CO_2 produced during fermentation, optimization of flow in the rectification column, recovery of heat from vinasse and re-utilization of cooling water have led to a reduction in costs and improvement in the quality of alcohol obtained from cane molasses at the distillery of Cía. Licorera de Nicaragua S.A. at Chichigalpa, Nicaragua. Details are given of the various techniques applied.

Sugar-based fermentation for fuel alcohol. J. E. Irvine. *Paper presented to 1st Amer. Conf. on Renewable Sources of Energy,* 1979, 23 pp. – The potential use of molasses (beet or cane), cane, beet and sorghum as feedstock for manufacture of fuel alcohol is discussed, with mention of costs, energy yields per ton of cane, cane areas and yield per ha in North and Central America (and hence potential yield) and average cane sugar content in Louisiana. The alcohol fermentation process is outlined, and reference made to the high proportion of distillation costs represented by the fuel needed to remove water from the alcohol. It is concluded that each type of crop mentioned has disadvantages, so that extension of the period of operation of a distillery to include each crop as it becomes available is recommended.

Renewable sources of energy and the tropical connexion: an agronomic approach. A. E. Abrahams and P. J. Abrahams. *Paper presented to 1st Amer. Conf. on Renewable Sources of Energy,* 1979, 13 pp. – The suitability of various crops from the standpoint of solar energy input and photosynthetic efficiency is discussed, whereby it is stated that sugar cane is one of the best crops since it utilizes 2% of the incident solar energy; this efficiency is genetically determined, so that efficient breeding may improve it. Land suitability and future availability for cropping in the USA are among other factors considered, and current land usage is indicated; 11 million acres are devoted to cane and 1.4 million acres to beet out of a total of 250 million acres used for various crops.

Preliminary environmental and planning considerations for gasohol production. K. D. Carey. *Paper presented to 1st Amer. Conf. on Renewable Sources of Energy,* 1979, 12 pp. – Distillery planning and the question of environmental protection legislation in regard to distillery waste disposal are discussed.

PATENTS

UNITED STATES

Dextrose isomerization with iron ion-thiol activator ion-dextrose isomerase systems. T. L. Hurst, of Decatur, IL, USA, *assr.* A. E. Staley Manufacturing Co. **4,113,565.** December 13, 1976; September 12, 1978. – Dextrose is isomerized to levulose by dextrose isomerase enzyme (derived from *Bacillus coagulans* or a *Streptomyces* sp.) in the presence of a stabilizing and activating amount ($>5 \times 10^{-3}$ M) (0.00002 – 0.03M) of water-soluble Fe and (at least 0.0001M) thiol activator ions (SO_3^{--}, ascorbate, *iso*-ascorbate, SCN\ or thioglycollate ions) [and at least one of the group Mn, Co and (0.002 – 0.02M) (0.0003 – 0.1M) Mg ions] as a metal activator.

Revivification of an insolublized dextrose isomerase. Y. Fujita, A. Matsumoto, I. Miyachi, N. Imai, I. Kawakami, T. Hishida and A. Kamata, *assrs.* Mitsubishi Chemical Industries Ltd. and Seikagaku Kogyo Co. Ltd. **4,113,561.** March 24, 1977; September 12, 1978. – The enzyme (dextrose isomerase adsorbed on a microporous synthetic anion exchange resin) (and deactivated to 15 – 50% of its initial activity) is treated to remove adsorbed substances by sequential contact (at 50° – 70°C) with an (0.2 – 2N) aqueous mineral acid (HCl, H_2SO_4), a (0.2 – 2N) aqueous alkali (NaOH, KOH) and an (0.2 – 5M) aqueous electrolytic salt (NaCl, KCl, Na_2SO_4, K_2SO_4) and an aqueous mineral acid (or mixtures). The resin is converted to a salt type to regenerate it and fresh enzyme adsorbed on it.

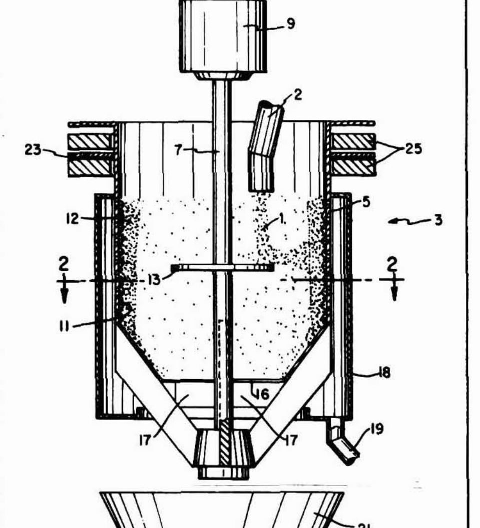
Nutritive sugar production from cane juice. J. Shimizu and K. Hashizume, *assrs.* Mitsui Sugar Co. Ltd., of Tokyo, Japan. **4,115,147.** March 19,1977; September 19, 1978. – Cane juice is treated by ultrafiltration through a membrane with a molecular weight cut of 10,000 - 30,000 and the permeate concentrated by evaporation to give a nutritive non-centrifugal sugar, while the concentrate from the ultrafiltration is processed in the conventional manner to sugar.

Beet harvester. R. L. Kilburn, of Denver, CO, USA. *assr.* HFE Inc. **4,116,279.** April 20, 1977; September 26, 1978.

Solvent refining of sugar. D. F. Othmer, of Brooklyn, NY, USA. **4,116,712.** September 6, 1977; September 26, 1978. – A mixture of raw sugar and 0.2 – 45% water (a massecuite, a syrup) is brought into contact with (0.3 – 3.0 volumes per volume of mixture of) a counter-current solvent mixture comprising (25 – 80%) (5 – 30%) acetone and either ethanol or acetic acid (plus 1 – 5% of water) (at pH 1.25 – 1.3 by addition of mineral acid) [at a temperature 1 – 60°C different from (lower than) that of the sugar mixture]. Impurities from the sugar are transferred to the solvent mixture and some of the latter is retained by the sugar-water mixture. This is separated and the solvent mixture recovered. Any insoluble impurities separated hydraulically from the raw sugar during the treatment are removed physically from the solvent mixture and the solvents recovered to provide a molasses. This may be brought to 40 – 70°Bx and extracted in counter-current with a second solvent, mostly acetone (containing 1 – 30% *iso*-propyl ether)to give, after evaporation of solvent from the extract, an extract molasses containing a higher percentage of oils, fats, waxes, etc., as well as a syrup containing much of the invert sugars originally present in the sugar-water mixture.

Preparation of sucrose 6,6'-dichlorohexaacetate. R. A. Khan, K. S. Mufti and K. J. Parker, *assrs.* Tate & Lyle Ltd., of London, England. **4,117,224.** December 11, 1975; September 26, 1978. – A cooled solution of sucrose in N,N–dimethylformamide is reacted (at between – 40° and – 15°C) with methane sulphonyl chloride (10 moles/mole of sucrose) (and the reaction completed by bringing to 60° – 70°C). The product is brought into contact *in situ* with an acetylating agent whereby the hexaacetate of 6,6'dichloro–6,6'dideoxysucrose (and the pentaacetate of 1,6,6' trichloro-1, 6,6'–trideoxysucrose) is formed; the hexaacetate (and pentaacetate) is isolated from the reaction mixture. (The polyacetates are then de-acetylated to give free 6,6'–dichloro–6,6'–dideoxysucrose and 1,6,6'–trichloro–1,6,6'–trideoxysucrose, respectively). Formation of the trichloro compound as a by-product is suppressed by initiating the reaction at between –40°C and –15°C.

Automatic discharge centrifugal. J. Halder L., of Alajuela, Costa Rica. **4,118,248.** March 17, 1977; October 3, 1978.



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

Massecuite is supplied through feed pipe 2 to the interior of centrifugal 1 and is distributed by plate 13 fastened to the shaft 7 of the machine. The sugar crystals form a bed 12 on the inside of the screen 11 and, after sufficient time to allow separation of molasses, the centrifugal is slowed from operating speed to about 100 – 200 r.p.m. By means of a brake shoe 25 acting on a disc 23 mounted on the top of the drum, the latter is then brought to a rapid stop. The inertia possessed by the bed of sugar within the basket causes it to seperate from the screen, whereupon it falls to the bottom of the centrifugal, passing through apertures 17 in the base 16 and so into collector 21.

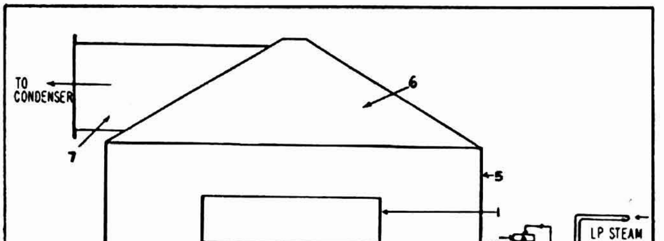
Sugar manufacture. M. Bosnjak, of Denver, CO, USA, *assr.* Buttes Gas & Oil Co. **4,119,436.** May 23, 1977; October 10, 1978. – An aqueous sugar-bearing juice is concentrated to a predetermined solids content and the sugar crystallized by boiling using a predeterminable quantity and quality of steam as heat source. The proportion of the total amount of water contained in the juice which is needed to be evaporated to provide the steam for boiling is estimated and evaporated in a recompression evaporator which is more energy-efficient than a multiple-effect. The balance is evaporated in a single-effect evaporator and some of the vapour used for process heating while the heat value or the remainder is recovered by exchange with a refrigerant.

Beet harvester. A. E. Ernst, of Wolverton, MN, USA. **4,120,363.** November 26, 1976; October 10, 1978.

Increasing the sugar content of cane. G. G. Otten, of Cincinnati, OH, USA, *assr.* Proctor & Gamble Co. **4,120.688.** August 15, 1977; October 17, 1978.–The sucrose yield of cane is increased by applying, 2 – 10 (3 –9) weeks before harvest, 0.1 – 15 lb/acre (0.25 – 10 lb/acre) (0.5 – 8 lb/acre) of aminomethylphosphonic acid (as an aqueous formulation) [containing 0.01 – 5% (0.05 – 0.5%) of a non-phytotoxic surfactant (nonylphenol condensed with 10.5 moles of ethylene oxide per mole)].

Semi-continuous vacuum pan. D. Gotthard, of Sydney, Australia, *assr.* CSR Ltd. **4,120,745.** August 31, 1976; October 17, 1978.

Pan 1 is an open circular cylinder positioned at the apex of a hollow cone-shaped compartment 2 having a conventional butterfly discharge valve 16 in its bottom. Pans 3 and 4 are open circular annular troughs of increasing diameter positioned around compartment 2 and each having similar discharge valves 17,18. All three pans are housed in a cylindrical main compartment 5 which provides a common vapour space 6 leading through a main vapour pipe 7 to a condenser. Below compartment 5 is an annular heavying-up compartment 8 containing a heavying-up pan 9 similar to the pans above. Compartment 8 has a vapour space 10 that can be isolated from vapour space 6 and leads to another condenser through pipe 11. The pans 1, 3, 4 and 9 are provided with steam through calandrias 12, 13, 14 and 15, the number of tubes and so heating area increasing progressively. The steam fed to each calandria is governed by valves 19, 20, 21 and 23 and measured by orifice plates connected to differential pressure transmitters 30, 31, 32 and 33. Feed to the pans through conventional pipes is governed by valves 23, 24 and 25 which operate according to the electrical conductivity of the massecuite measured by electrodes 34, 35 and 36. The massecuite level in each pan is measured by conventional differential pressure cells 26, 27, 28 and 29, and each pan has its own temperature indicator.



Magma is fed into pan 1 via pipe 37 to cover calandria 12 and the pan then fed with syrup via control valve 23. When the discharge level is reached in pan 1 the D.P. cell sends a signal to open valve 16 and the massecuite falls into pan 3, while a fresh supply of magma enters pan 1. Similarly the massecuite is boiled in pan 3 with syrup feed under the control of valve 24 and is eventually discharged into pan 4, and so on. Massecuite from pan 4 is heavied-up in pan 9 and, when it is ready for discharge, the vapour space 10 is isolated, the vacuum broken and the pan emptied. Compartment 8 is steamed out, the vacuum re-established and the vapour spaces 6 and 10 reconnected so that the pan can receive a new charge of massecuite.

Cane harvesters. D. J. Quick, of Bundaberg, Australia, *assr.* Massey-Ferguson Services N.V. (A) **4,121,778.** January 10, 1977; October 24, 1978. (B) **4,129,339.** March 24, 1977; December 12, 1978.

Beet harvester hitch. E. H. Ellinger, of Crookston, MN, USA, *assr.* Dee Inc. **4,123,081.** July 22, 1977; October 31, 1978.

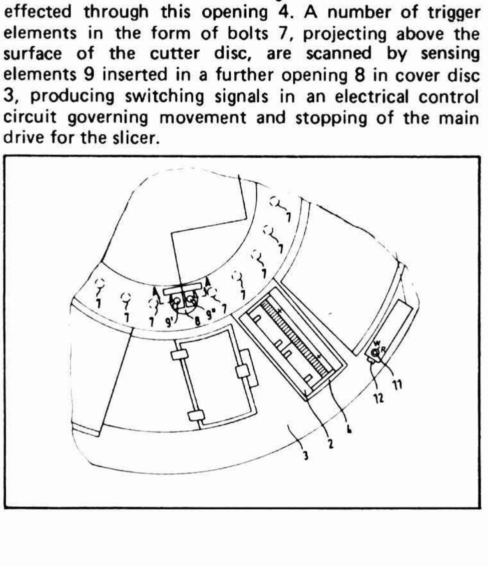
Continuous process for production of polysaccharide under phosphate limiting conditions. R. C. Righelato and L. Deavin, of Reading, England, *assrs.* Tate & Lyle Ltd. **4,130,461.** May 20, 1977; December 19, 1978. – See UK Patent 1,513,104[1].

UNITED KINGDOM

Recovery of a levulose-rich fraction from an isomerized starch conversion syrup. A/S De Danske Sukkerfabrikker and DDS-Kroyer A/S, of Copenhagen, Denmark, **1,539,533.** July 13, 1976; January 31, 1979. Isomerized starch conversion syrup is passed first into a cation exchange resin column in Na^+ form, recovering a first fraction of di- and higher saccharides and a second fraction is introduced into a second cation exchange resin column in CA^{++} form from which simultaneously a volume of water corresponding to that of the first fraction is withdrawn. From the second column come successively a dextrose-rich fraction and a levulose-rich fraction; the first of these is isomerized and re-cycled to the first column. The di- and higher saccharides fraction may be concentrated (by reverse osmosis) and added to the levulose-rich fraction.

Beet slicer. H. Putsch & Comp., of Hagen, Germany. **1,542,351.** October 26, 1977; March 14, 1979.

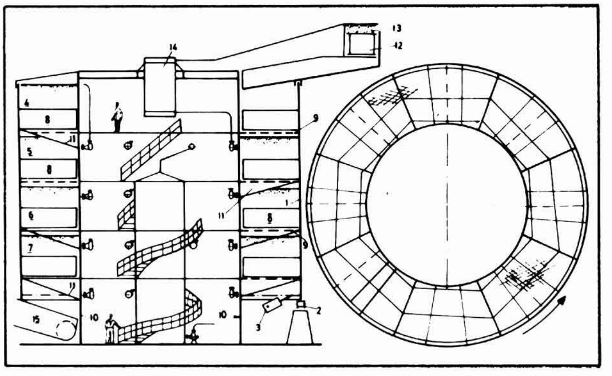
The slicer is provided with a cutter disc carrying a number of removable blade boxes 2. A cover disc 3 is located above the cutter disc and is provided with a closable opening 4 through which blade boxes 2 may be removed and inserted; cleaning of the blades is also effected through this opening 4. A number of trigger elements in the form of bolts 7, projecting above the surface of the cutter disc, are scanned by sensing elements 9 inserted in a further opening 8 in cover disc 3, producing switching signals in an electrical control circuit governing movement and stopping of the main drive for the slicer.



In order to change a blade box, the selector switch 11 is set to the appropriate position W and key 12 is actuated. The cutter disc moves and stops with the next blade box directly beneath the opening 4 so that it may be changed. When the key 12 is again actuated the next blade box is brought into position. For blade cleaning, the selector switch 11 is set to position R and the key 12 actuated; the blade box is brought to a position where access is possible to the blades from above and below, i.e. a few angular degrees earlier than for changing.

Cane diffuser. J. M. T. Cargill, of Mount Edgecombe, Natal, South Africa. **1,542,482.** September 14, 1976; March 21, 1979.

The diffuser consists of an outer cyclindrical shell 1 supported on its bottom perimeter on rollers 2. The



shell is rotated slowly by sets of hydraulic rams 3 which act against evenly spaced pins attached to the bottom of the shell. The shell is divided into vertical stages 4, 5, 6 and 7, each stage having plate arms 8 attached vertically to shell 1 and extending radially inwards. The plate arms form compartments and convey the cane or bagasse across the screen decks 9. A fixed inner column 10 provides the support for the screen decks 9 and also the juice collection trays 11. The fixed inner column 10 is also divided into vertical stages 4, 5, 6 and 7 so that fixed and rotating members form a complete stage. Each screen deck 9 and juice tray 11 has a segment removed to form a hatch through which material can fall from one level to that below.

Prepared cane is brought by conveyor 12 to the top of the diffuser and heated with scalding juice supplied by heater 14 to sprays 13. The cane falls onto the screen deck 9 of the first stage 4 and is carried around by arms 8 for a complete circuit, and then falls through the discharge hatch to stage 5. The circuit is repeated in each stage and the bagasse is finally discharged over conveyor 15 which removes it from the diffuser. Imbibition water is sprayed over the bagasse in the compartments just before it is discharged and drains through to the collecting tray sections beneath, from which it is pumped to spray points above the compartments nearer the head of the diffuser, following a countercurrent path. Part of the juice draining into trays 11 below stage 4 is sent to heater 14 and the remainder sent to process.

[1] *I.S.J.*, 1981, **83**, 62.

TRADE NOTICES

Metering pump. Chem-Tech International, P.O. Box 98, Lawrence, MA 01843, USA.

Chem-Tech International have announced the introduction of a new Series 100D duplex metering pump. Its dual-cam mechanism allows a more flexible operating range and provides for the widest selection of output combinations. Housings are flame-retarding moulded plastics which are also resistant to the action of chemicals. The twenty models in the series cover the capacity range 8-290 gal/day, with a discharge pressure of up to 75 $lb.in^{-2}$, according to model. The unit, of application e.g. in the treatment of low-pressure boiler water and cooling towers, is compact and inexpensive. Chem-Tech also manufacture complete chemical feed systems, details of which are available.

Packaging systems. Reed Medway Packaging Systems Ltd., Aylesford, Maidstone, Kent ME20 7PQ, England.

The Reed Medway Sac-Applicator takes each empty sack from a magazine and places it on a filling spout in a rapid two-stage operation; the sack mouth is fully enclosed on the elliptical spout so as to exclude dust. The MK VA Sac-Sealer prepares the top of the filled sack for stitching by means of spreader arms and creasing bars, after which the sack enters the sewing head via a short chain feeder. Each sack receives a ticket from an automatic dispenser as it passes through the sewing head. The operator merely has to replenish the empty sack magazine occasionally and generally supervise the line.

Icing sugar grinding and sieving. KEK, Hulley Rd., Hurdsfield Industrial Estate, Macclesfield, Cheshire SK10 2ND, England.

KEK are the suppliers and designers of a complete icing sugar grinding and sieving system installed at the Brigg sugar factory of British Sugar Corporation Ltd. Sugar is carried on a horizontal conveyor via a feed hopper to a KEK auto-vibratory feeder which delivers it to a 2H universal grinding mill equipped with a special pin-and-disc configuration producing approximately 1500 kg of icing sugar per hr. Calcium diphosphate is added at the mill feed point in order to improve flow and storage properties of the sugar. Before packaging, the icing sugar is treated in a KEK A800 centrifugal sifter.

PUBLICATIONS RECEIVED

Power transmission. Renold Ltd., Renold House, Styal Rd., Wythenshawe, Manchester M22 5WL, England.

A recent issue of the Renold Review of Power Transmission outlines the activities of Renold Ltd. in the field of power transmission by providing profiles of the various products the company manufactures: chains (precision roller and conveyor), wormgear units and gear sets, thyristor-controlled variable-speed drives, the Carter variable-speed transmission, mechanical variable-speed units, helical gears, hydraulic motors, helical compressor rotors, couplings, clutches and brakes, sprag clutches, and Ajax spindles. Also described are Manesty tablet-making machines, Parkson milling machines and Sunderland gear planers, and Holcroft castings and forgings.

Continuous vacuum pan. Fives-Cail Babcock, 7 rue Montalivet, 75383 Paris Cedex 08, France.

A new 17-page brochure in English, French and Spanish gives details of the FCB continuous vacuum pan such as installed at Nassandres. The information includes a summary of the advantages of the system, operation of the pan, its automatic control, a description of the pan (with diagram), results obtained, dimensioning of a pan station and the range of pans available (covering the massecuite volume range of 22.5–120m^3).

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

A leaflet from Eshowe Wagon Works features the Upfold cane loader, which will fit any tractor, can lift to a height greater than 3.6 m, has a daily capacity of 250 tonnes of cane, slews to both sides, has an independent hydraulic system and is simple to operate and maintain. Although inexpensive, it is tough, sturdy and reliable.

Lime kilns and fluidized bed dryers. West's Prochem Ltd., Coniscliffe House, Coniscliffe Rd., Darlington, Co. Durham DL3 7EU, England.

A new brochure gives details of West's Prochem activities in various fields, including the design and construction of lime kilns and fluidized bed dryers. A number of beet sugar factories figure among plants using West's Prochem lime kilns, while refined sugar is handled by West's Prochem fluidized bed dryers at two plants, one in South Africa (handling 40 $tonnes.hr^{-1}$) and the other in Mauritius (handling 20 $tonnes.hr^{-1}$).

Automatic control systems and instrumentation. Foxboro Yoxall, Redhill, Surrey RH1 2HL, England.

Literature from Foxboro describes the many facets of the company's process management and control activities, including measuring, transmitting and recording equipment for various parameters such as flow, temperature, pressure, etc., and computerized systems. Of particular interest is a description of a vacuum pan control system in a Dutch sugar factory which was designed to reduce the campaign length by 10 days and allow for an increase in the daily slice from 7000 to 10,000 tonnes of beet.

Anti-foam agents. Hodag Chemical Corporation, 7247 North Central Park Ave., Skokie, IL 60076, USA.

Brochures available from Hodag describe their range of silicone anti-foam agents and methods of applying anti-foam agents such as used in the sugar industry. Another brochure gives information on Hodag non-ionic surfactants and emulsifiers.

Cooling towers. Carter Industrial Products Ltd., Redhill Rd., Birmingham B25 8EY, England.

A 6-page leaflet describes Carter water cooling towers, which are available in a very wide range of types and sizes. For corrosion prevention, Galvatite IZ steel is used in conjunction with heavy-duty black bitumen paint; the metal is hot-dip galvanized before painting, while the bitumen prevents loss of zinc. The result is a system that will withstand the rigours of industrial usage for a much greater time than other systems. The cooling towers are also available in glass fibre or timber.

Turbines. Elliott Overseas Co., P.O. Box 800, Jeannette, PA 15644, USA.

Bulletin H-31G gives details of Elliott YR single-stage turbines and their advantages, among which are interchangeability of parts and suitability of materials for normal outdoor installation. Graphs are reproduced for calculating requisite operational parameters, and photographs highlight the good points of the turbines and their components.

French contribution to Kenana sugar complex. – The French concern Technip was responsible for overall engineering, equipment procurement and supply of the Kenana sugar complex recently inaugurated in the Sudan. Two-thirds of the equipment was supplied by French companies, including Fives-Cail Babcock (responsible for the supply of 14 cane mills, 13 vacuum pans and 32 centrifugals), Engrenages et Réducteurs (gearing), Filtres Gaudfrin (filtration equipment) and SEUM (evaporators). Pumps, compressors, instrumentation and electrical equipment also came from France.

Steam turbine order. – Peter Brotherhood Ltd. are supplying a 1300 bhp steam turbine to drive a cane mill in a Sudan sugar factory. The order was placed by Fletcher and Stewart Ltd.

Statements published in this section are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

South Africa sugar exports, 1980[1]

	1980	1979
	tonnes, raw value	
Canada	175,310	229,790
Japan	476,577	445,126
United States	132,042	48,964
Zaire	557	0
Other Countries	0	400
	784,486	724,280

GATT panel ruling on Brazil complaint over EEC sugar exports[2]. The panel set up under the General Agreement on Tariffs and Trade to investigate the Brazilian complaint of unfair behaviour by the EEC has found that the EEC system for granting refunds on exports of sugar must be considered a form of subsidy. However, while there had been a marked expansion in Community exports during 1976-1979 whereas Brazil's market share had fallen, and taking into account the difficulties in establishing causal relationships, the Panel was not able to conclude that the EEC had a more than equitable share of world export trade. Nevertheless, the Community's system and its application constituted a permanent source of uncertainty in world sugar markets and constituted a threat of serious prejudice; for the period and field concerned, the EEC had not collaborated with other contracting parties to further the principles and objectives set out in Article XXXVI of the Agreement.

Dominican Republic sugar recovery[3].– The 1980/81 sugar crop has been officially estimated at 1.25 million tonnes, against 1 million in 1979/80, the lowest crop for ten years because of labour disputes and crop disease. The Consejo Estatal de Azúcar (CEA) plans to produce 714,250 tonnes against an estimated 685,000 tonnes in 1979/80 which was more than 150,000 tonnes below the CEA target. The CEA has invested heavily to improve production levels by purchasing new machinery to increase mechanization of the harvest and by renewing plantations; 17,607 hectares were replanted in 1980 compared with 4979 ha in 1979 and the recommended level of 15,758 ha.

UK sugar exports, 1980[4]. — Official statistics of the UK exports of sugar for 1980 total 95,251 tonnes, tel quel, up from 71,509 tonnes in 1979. The major destinations were Norway (18,821 tonnes *vs.* 29,896 tonnes in 1979), Morocco (18,300 tonnes *vs.* nil), Portugal (13,760 tonnes *vs.* 26), Nigeria (11,709 tonnes *vs.* 6307) and Tunisia (10,125 tonnes *vs.* 12,300). Exports to Lebanon fell from 10,032 tonnes in 1979 to 16 tonnes.

Yugoslavia sugar production 1980/81[5]. — In 1980/81 sugar production in Yugoslavia amounted to 728,263 tonnes, raw value, about 57,000 tonnes less than earlier expectations and 119,565 tonnes less than the record crop of 1979/80. The beet area is to be increased by 38.8% in 1981/82 to 180,475 hectares.

Switzerland sugar imports[6]. — In 1980 Switzerland imported 126,991 tonnes of sugar, against 149,085 in 1979. Suppliers included Cuba with 2782 tonnes (2576 tonnes in 1979), France with 38,888 tonnes (45,784), the UK with 2767 tonnes (1320) and West Germany with 81,082 tonnes (98,982) while other countries supplied 1472 tonnes (423).

Austria sugar production, 1980/81[7]. — The six Austrian sugar factories processed 2,587,000 tonnes of beet in the 1980/81 campaign, 20.6% more than in the previous one, to produce 419,000 tonnes of white sugar (455,000 tonnes, raw value), an increase of 11.7%. Owing to the generally unfavourable weather during 1980 the sugar content of the beets was substantially lower than in 1979 (17.7% *vs.* 19.2%), although the start of the campaign was delayed until October. Of the total production, some 310,000 tonnes is for domestic consumption, the remainder to be exported or taken into stock.

Sucrochemical plant closure threat[8]. — Employees at the Knowlsey factory of Talres Ltd., a subsidiary of Tate & Lyle Ltd., near Liverpool, have been warned that the future is under review. The factory, built to produce detergents from sugar[9], may thus be closed before production even starts.

Iran beet sugar output reduction[10]. — The Iranian President Bani-Sadr recently said that sugar beet production in 1980 declined by 90%, which could mean that total beet sugar output in 1980/81 could have been less than 50,000 tonnes.

Finland sugar imports and exports, 1980[11]

	1980	1979
	tonnes, tel quel	
Imports		
Australia	4,885	0
Cuba	98,665	85,711
France	13,172	21,422
Germany, West	0	7,433
Poland	1,000	0
Zimbabwe	51,678	0
Other countries	84	253
	169,484	114,819
Exports		
Algeria	18,148	11,600
Norway	18,837	16,147
USSR	16,274	0
Other countries	1,182	1,376
	54,441	29,123

West Indies Sugar Technologists 1982 Meeting. — The 1982 Meeting of the W.I.S.T. will be held in St. Kitts during June 14 — 18 and members will be glad to welcome sugar technologists from other countries who attend and also papers submitted for presentation and discussion on any technical subjects connected with the cane sugar industry. Interested persons are requested to notify the Secretary of the Association of their wish to attend no later than the end of September 1981. The address is P.O. Box 230, 80 Abercromby Street, Port-of-Spain, Trinidad.

Sugar Industry Technologists Inc. "Crystal Award". — The major award made each year to an outstanding person in the sugar industry by Sugar Industry Technologists Inc. as the "SIT Crystal Award for Achievement in Sugar Technology" will, under new By-laws made at the recent 40th Annual Meeting in March 1981, be made annually to one or two outstanding individuals, members or not, who have contributed notably to technological advancement of the sugar refining industry. The next meeting of the SIT will be held in Atlanta, GA, during May 2 — 6, 1982, and details can be obtained in due course from Mr. George W. Muller, Jr., Executive Director, at P.O. Box DD, Oak Harbor, WA 98277, U.S.A.

Tunisian sugar complex.—A new complex is being built for Société CST (Complexe Sucrier de Tunisie) at Ben Bechire, near Jendouba, as a joint venture of Snamprogetti S.p.A. and Braunschweigische Maschinenbauanstalt AG under the supervision of the French consultants, SOFRECO. The project will comprise a beet sugar factory of 4000 tonnes daily slice, a yeast plant having a production capacity of 7.5 tonnes of dry yeast per day, and a unit for producing dried pulp. The complex is planned for completion for the 1982 campaign.

UK beet research and education funding. — Programs of research and education in sugar beet growing have been financed by the UK industry since 1936. The current program includes research into plant breeding, variety trials, plant physiology, agronomy, crop husbandry, nutrition, pest and disease control, prevention of virus infection, machinery and investigations into weed beet, as well as advice and education to growers through publications, films and demonstrations. The program has been agreed by the British Sugar Corporation and representatives of the National Farmers' Union, the Agricultural Research Council and the Ministry of Agriculture and is funded by a levy which, for the year commenced April 1, 1981, has been set at £0.08 per tonne of beet.

1 F.O. Licht, *International Sugar Rpt.*, 1981, **113**, S105.
2 *World Sugar J.*, 1981 **3**, (8), 20.
3 *Bank of London & S. America*, 1981, **15**, 26.
4 C. Czarnikow Ltd., *Sugar Review*, 1981, (1531), 24.
5 *World Sugar J.*, 1981, **3**, (8), 35.
6 C. Czarnikow Ltd., *Sugar Review*, 1981, (1531), 24.
7 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 117.
8 *The Times*, February 19, 1981.
9 I.S.J., 1977, **79, 360**.
10 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 141.
11 C. Czarnikow Ltd., *Sugar Review*, 1981, (1532), 29.

Cuba sugar exports, 1980[1]

	1980	1979	1978
		tonnes, raw value	
Albania	17,069	24,649	20,997
Algeria	207,131	203,088	175,633
Angola	67,173	53,886	68,059
Bulgaria	234,112	218,223	189,623
Canada	263,508	316,249	279,021
Caribbean Islands	1,571	1,509	1,799
China	512,095	485,625	533,853
Czechoslovakia	98,775	99,060	84,850
Denmark	0	38,622	0
Dutch Antilles	2,183	541	2,479
Egypt	138,088	111,320	127,054
Finland	78,124	102,162	88,197
Germany, East	209,900	223,100	200,717
Hungary	34,152	72,414	58,424
Indonesia	39,394	132,531	105,159
Iraq	277,840	248,484	191,421
Jamaica	1,081	0	11,102
Japan	267,082	297,300	530,096
Kampuchea	5,423	0	0
Korea, South	10,897	21,621	11,838
Libya	75,723	42,694	27,073
Malaysia	25,206	25,299	64,401
Mexico	401,122	0	0
Mongolia	4,720	4,658	4,678
Morocco	0	12,443	132,366
New Zealand	0	58,781	0
Nicaragua	10,830	0	0
Poland	63,128	63,660	60,209
Portugal	131,377	116,613	141,771
Rumania	46,754	39,017	0
Singapore	12,611	12,611	0
Spain	0	79,807	0
Surinam	0	0	2,654
Switzerland	3,640	2,870	1,453
Syria	133,999	140,799	87,044
Tanzania	11,383	0	0
Tunisia	32,904	35,963	10,647
Uganda	1,084	0	0
USSR	2,726,339	3,842,211	3,936,133
Vietnam	41,841	111,498	82,468
Yemen Dem. Rep.	0	10,839	0
Other countries	2,815	6,698	0
	6,191,074	7,269,429	7,231,219

Greece sugar production 1980/81[2]. — The latest campaign ended in the middle of January and the President of Hellenic Sugar Industry A/S announced that about 171,000 tonnes of sugar had been produced from a slice of 1,440,000 tonnes of beet, as against 300,000 tonnes of sugar from 2,741,000 tonnes of beet in 1979/80. It is hoped that, by increasing the price paid for beets from 2100 to 2650 drachmae per tonne, the area sown to beet will be increased this year and sugar production raised to cover domestic requirements of 300,000 tonnes.

Indian government sugar purchase difficulties[3].—The Indian government is reported to be having difficulty in its efforts to buy 180,000 tonnes of sugar in the domestic market to repay by the end of April the quantity imported last summer in order to overcome shortages caused by low domestic sugar production. The State Trading Corporation has rejected three buying tenders, saying that the sugar manufacturers were asking too high a price, at 6850 - 7000 rupees per tonne, although the Indian Sugar Mills Association claims that the price is reasonable since the producers can get the same or even higher prices on the free domestic market. Of their production, manufacturers must sell 65% to the Government at a low statutory price and the Government wishes to buy the 180,000 from the free market quota; consequently, the manufacturers are not likely to sell at a price below those prevailing in the market. The Government has banned exports retrospectively from February 21 and there is a danger that the Government may have to default on the contracted repayment, although perhaps only in respect of the date.

Mexico sugar imports reduction[4].— Mexico will import 500,000 tonnes of sugar in 1981, substantially down on the 1980 import requirements of 740,000 tonnes, according to the President of the National Union of Sugar Cane Workers. At least 100,000 tonnes of the country's 1981 sugar needs will be filled with Cuban sugar and a delegation from Havana has recently visited Mexico to finalize details of a supply contract. Rust and smut diseases are affecting the current cane crop, but Mexico is confident that it can overcome these problems and should be self-sufficient in sugar by 1983.

Norway sugar imports, 1980[5]

	1980	1979
	tonnes, white value	
Australia	0	24
Austria	18,022	23,833
Belgium/Luxembourg	5,063	5,087
Czechoslovakia	2,009	825
Denmark	75,784	51,582
Finland	18,525	16,349
France	5,426	6,990
Germany, East	23	1,388
Germany, West	8,730	22,285
Holland	11	37
Poland	200	0
Sweden	2,648	10,382
Switzerland	150	20
Trinidad	0	2
UK	21,787	32,784
Total	158,378	171,588
Total, raw value	172,150	186,509

Antigua sugar industry revival[6]. — Antigua's sugar industry is to restart production for the first time since 1971 with land to be planted with cane under a government scheme expected to quadruple to over 3,000 acres in the coming years.

Argentina sugar production, 1980[7]. — Argentina's sugar cane crop in 1980 was a record 17.2 million tonnes against 3.9 million tonnes in 1979 (of which nearly 2 million tonnes was utilized for alcohol production). Argentine sugar production in the 1980/81 season amounted to 1.71 million tonnes, raw value, up some 300,000 tonnes from 1979/80.

French fuel alcohol program[8]. —The use of sugar beet to make alcohol to use as a fuel additive will not affect the quantity available for French sugar production, according to the Director of the Alcohol Beet Association. Beet producers see alcohol distillation as complementary to sugar production and there is no question of competition between the two activities. The Minister of Industry launched a plan in January aimed at pushing the proportion of non-oil fuels, including beet-based alcohol, used in the French transport system to a maximum of 50% by 1990.

British Sugar Corporation bid. — In May last year S. & W. Berisford Ltd., food merchants and commodity traders, made a take-over bid for the British Sugar Corporation Ltd. and, because they were involved in a similar kind of business, the bid was referred to the UK Monopolies Commission for investigation[8]. The Commission has now published its report which recommends that the bid may continue, subject to certain conditions. These are that, should Berisford succeed in gaining control. it should cease trading in Tate & Lyle sugar products except where this is necessary for incorporation in the existing products of Berisford or BSC. Also, BSC must be maintained as a separate subsidiary without any major change in its activities and with its reports and accounts published in a similar way to that of the present. The Government has announced that the bid may go forward under these conditions, and Berisford has accepted them.

New Burma sugar factory[6]. — Burma's Foodstuff Industries Corporation has awarded a contract worth 4,000 million yen (£8,000,000) to Hitachi Zosen of Japan for the construction of a new sugar factory. Daily cane crushing capacity will be 1500 tonnes, similar to the capacity of the existing plant which will be rehabilitated as part of the same project. The project is scheduled for completion by April 1983.

1 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, S141.
2 *Zuckerind.*, 1981, **105**, 191.
3 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 122; *The Times*, February 28, 1981.
4 *Public Ledger*, February 21, 1981.
5 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, S100.
6 *Abecor County Rpt.*, February 1981.
7 F. O. Licht, *International Sugar Rpt.*, 1981, **113**, 120.
8 *Reuter Sugar Newsletter*, February 4, 1981.
9 *I.S.J.*, 1980, **82**, 197.
10 *World Sugar J.*, 1981, **3**, (9), 32.

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