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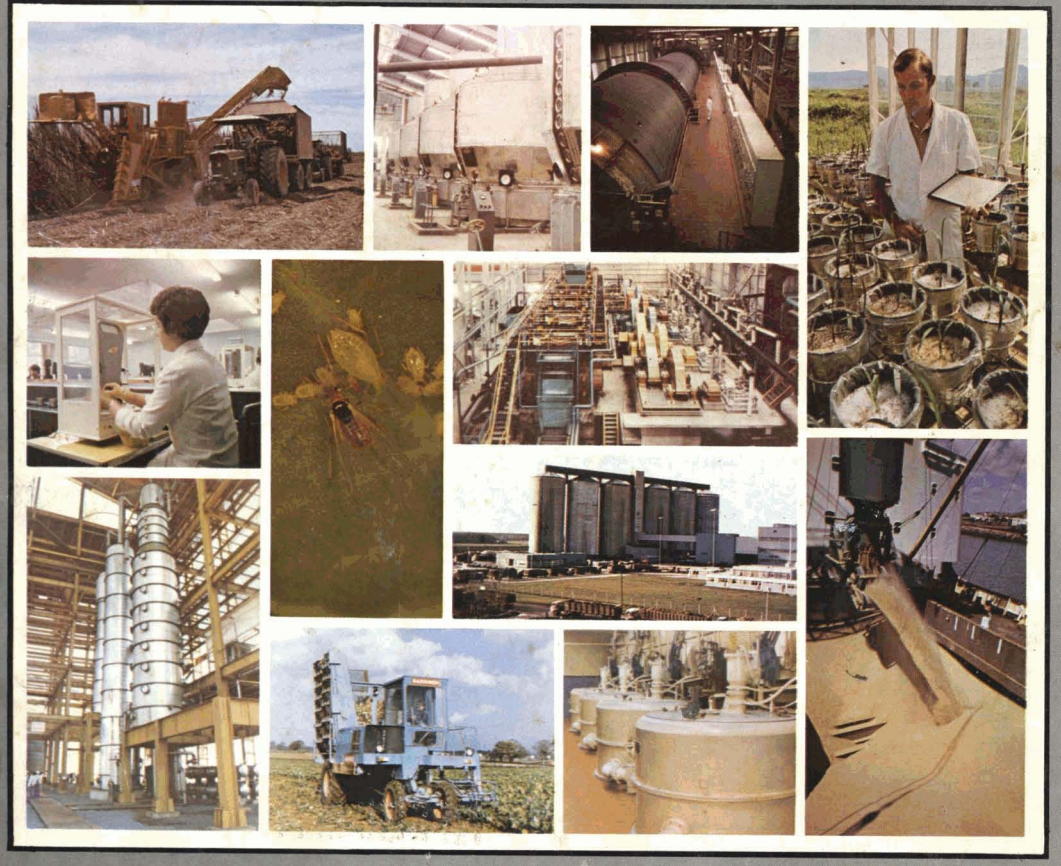

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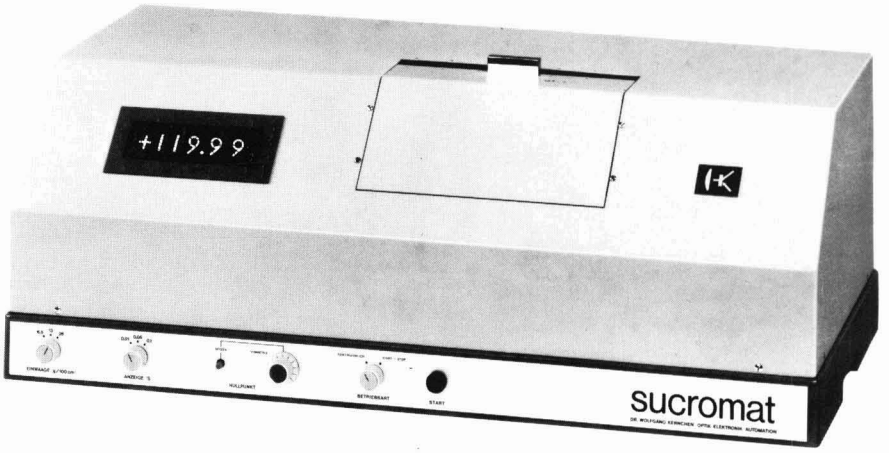

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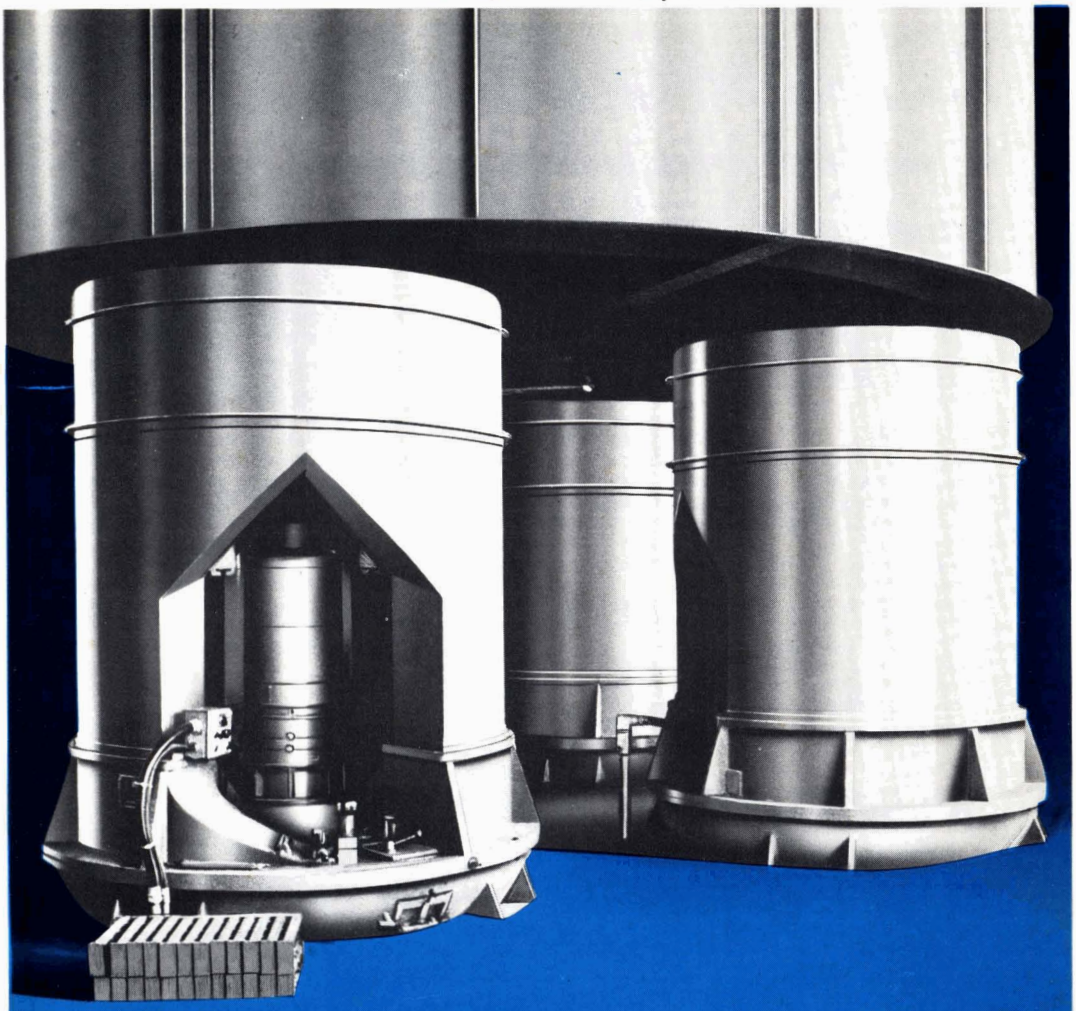

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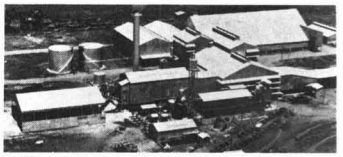

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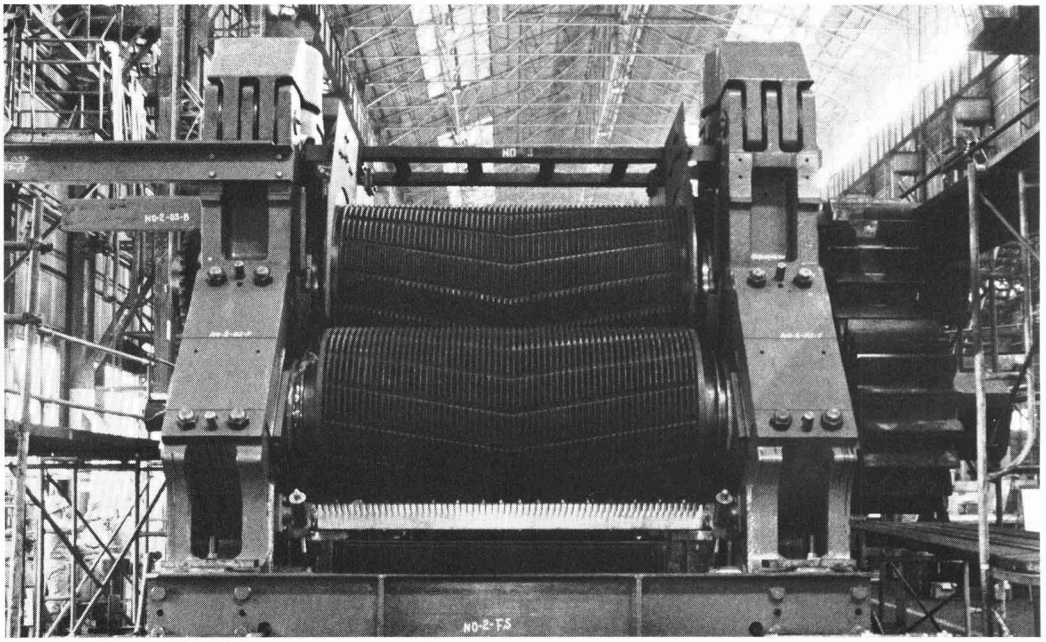

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NOTES AND COMMENTS

International Sugar Agreement

A provision of the Agreement is that the International Sugar Council shall hold one regular session in each half of the quota year and it has become customary for these to take place in May and November. The latest meeting was held on November 18 and such was the reduced role of the Agreement under present market conditions that business was completed in one afternoon.

The most important matter under discussion was the price range of the Agreement; this is well below current levels but, with the long term in view, exporting members have been seeking an increase in the trigger points of up to 5 cents a pound, to allow for inflation and the fall in the international value of the US dollar since 1977 when the price range was established. A 1-cent increase had been agreed earlier in 1980 and importing members were resistant to a further increase; however, a rise of a further 1 cent per pound was agreed, giving a new range of 13 – 23 cents. Exporting members are not satisfied, however, and will be pressing for a further review in 1981.

Since the previous meeting Zimbabwe has become an exporting member while Portugal has withdrawn from membership. Greece is not to proceed with its application for membership in view of its impending membership of the EEC from January 15, 1981, while Bangladesh, a former exporting member, has now become an importing member.

Polish sugar problems

The worst weather in living memory is reported to have badly affected the current beet crop in Poland and the Minister of Agriculture has stated that white sugar production will be between 1.1 and 1.15 million tonnes, equivalent to 1.2 – 1.25 million tonnes, raw value. This is 350-400,000 tonnes short of the country's estimated needs and the Polish news agency PAP announced that Poland would have to import this amount of sugar. Traders in the London market are sceptical about this, however, since Poland lacks foreign currency to buy such an amount, although it is seeking international loans to provide this currency. Furthermore, sugar availability for industrial purposes is to be cut.

World sugar prices

The London Daily Price for raw sugar rose from an initial £390 at the beginning of November to reach £410 on November 6, thereafter falling sharply to £370 per tonne by November 11 and hovering between this level and £355 until November 24, after which it again dropped sharply, finishing the month at £328. The initial rises were the result of reports of early wintery conditions in East Europe which were hampering beet harvesting; later reports indicated that the weather had not been as bad as earlier supposed.

Following the US Presidential elections there was a move by investors out of gold into commodities and this tended to weaken prices of sugar as well as rubber, etc. Governmental measures taken in Poland and Iran to curtail consumption were a further influence, as were reports of a sugar crop in China well above target. C. Czarnikow Ltd. noted that the sharp LDP fall at the end of November was not the result of any specific news but "We are now in a period when prices are historically high and, whatever the supply and demand position may be, prices will tend to fall unless they are constantly fuelled with fresh news underlining the current tight supply position".

White sugar prices remained under those of raw sugar until November 11 when they provided a premium of £10 a tonne. This was eliminated after a few days but then returned and the premium gradually increased to £17 at the end of the month, with an LDP(W) of £345 per tonne against an initial level of £385. The movements generally followed the price fluctuations of raw sugar but also reflected a steadily increasing interest in white sugar by countries without refining facilities.

EEC sugar regime proposals

Further details have now become available of the proposals regarding sugar which the EEC Commission has submitted for consideration by the Council of Ministers[1]. In addition to the quota recommendations reported earlier[2], it is made quite clear that it is intended to continue to apply a quota system to high fructose corn syrups. It is interesting to note, incidentally, that the Commission has once again emphasized that it continues to consider its recommendations as being of a transitional nature, notionally to run for, at most, the next five marketing years. This would seem to imply that the Commission contemplates the possibility that these arrangements will not run their full course. This could in part reflect changes which might be necessary should the Community adhere to the International Sugar Agreement and it may be noted that it is indeed recognised in the proposals that special measures might become necessary were the Community to become an ISA signatory. In addition it is indicated that changes in the world statistical situation could make it appropriate to adjust the levels of *B*-quotas for the last two campaigns of the period should such an adjustment be considered necessary.

Recognising the fact that membership of the ISA would probably impose an export limitation on the Community, the Commission considers it necessary to establish the right to impose a limitation on the export of *C*-sugar, should this be needed, coupled with the establishment of an obligation on the part of producers to carry forward such supplies as could not be exported into the following marketing year, when they would become quota sugar. In this case the cost of storage would be covered by the EEC.

It must again be emphasized that it is the Council of Ministers which must make the final decision so that these proposals may well be substantially adjusted before the regulations on the common organization of the market are finally decided.

The EEC and the International Sugar Agreement[3].

The Commission itself has long been sympathetic to the idea of joining the ISA. In 1976 talks on membership were held but eventually came to grief over the question of quotas. The Nine were offered a quota of 300,000 tonnes plus an additional 1.6 million tonnes of re-exported sugar but this fell considerably short of EEC requirements.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1980, (1513), 201-202.
[2] *I.S.J.*, 1980, **82**, 325.
[3] *Public Ledger's Commodity Week*, October 18, 1980.

In July 1980 the Commission put up a membership proposal for consideration by Ministers which was seen by some analysts at the time as being more of a political move, reflecting the EEC's failure earlier in the year to agree to reduce exports, than a proposal to be taken at face value. Sources in Brussels said that what the Commission was really doing was to try to nudge member states into a greater awareness of the need to reduce production and allow the Community to gain acceptance among other countries as a more "responsible" producer.

Some others felt that the Commission, concerned at the outflow of funds that up to this season had been necessary to maintain EEC exports, saw ISA membership as a method of limiting such expenditure by agreeing to a reduction in exports.

The response of the International Sugar Organization was pessimistic although under the circumstances, realistic as well. It doubted whether the EEC, with its strong internal agricultural lobby, would concede the kind of production limitations that would be required and that the chances of a satisfactory outcome to any talks would be slim.

This appraisal is similar to that made by trade observers. Until Ministers have succeeded in finalizing plans for the next five years it is thought that little else but "polite noises" will be made after which they may decide to open negotiations at some future date. Also Ministers are well aware that the International Sugar Agreement itself will have to be renegotiated in two and a half years time and they may feel it preferable to make constructive remarks until that time and then join a new ISA on terms to suit them. Though there are provisions under the current ISA for the EEC to join – and on terms that would not necessarily be offered to any other countries – it may be felt it would be more advantageous to join a new Agreement.

Beet growers are not at all happy about joining the ISA, fearing that, though ISA quotas are currently suspended, exports could be limited in the middle term. They pointed out that in extreme market situations sugar agreements have failed to achieve their aims of stabilizing prices and emphasized that more than 80% of the EEC's exports are to developing countries which are not members of the ISA.

Were it not for the high level of EEC exports, the growers say, world prices would be even higher than they are and the shortage situation likely to affect the world sugar economy in 1981 would be exacerbated.

Though growers may, in the end, be forced to accept the inevitability of membership, they can be expected to indulge in vociferous lobbying to delay the fateful day for as long as possible.

US refiners' purchasing policy[1]

A noteworthy feature of the world sugar market at the moment is the apparent reluctance of US refiners seriously to commence their buying this season. For reasons best known to themselves, it seems they have decided, for the time being at least, that they are not going to chase the market upwards and buy at currently high prices. Why they have decided to hold off can only be guessed at but the market's highs have been based to a considerable degree on their expected offtake and the necessity for them to replace sugar shipped abroad. Does this reluctance to come to the market signify an alternative interpretation of the supply/demand equation to that held by many other observers?

The market behaviour of US processors merits serious consideration, if for no other reason, as Rudolf Wolff & Co. point out in their latest market report, than that it was they who pricked the bubble of the last bull market in 1974/75.

By December 1974 prices had reached £650/tonne, aided by an oversold situation in the EEC and a declaration of force majeure by Poland. Many American observers felt at the time that values were too high and this was borne out in the middle of December when refiners hedged what they thought would be their surplus requirements in New York, causing prices to plummet to around £450 by the end of the month.

One of the reasons that led them to take this course of action was their discovery of consumer resistance to high price levels in the US market and it may well be that they discern similar signs today.

Whatever the reason, the US Department of Agriculture forecasts that consumption of sugar in the US will drop to less than 90 lb per head in 1980/81, the lowest level since the 1940's.

One of the factors making for possible resistance to high prices is the increasing availability and relative cheapness of corn sweeteners. Trade sources report that shipments of high fructose corn syrups in the first half of 1980 were probably 25% up on the comparable 1979 period which itself showed a 40% increase. Though prices have strengthened significantly this year in most areas of the US they are 12/15 cents per pound cheaper than sugar.

With HFCS usage expected to total 2.1 million short tons (dry basis) in the US in 1980 compared with probable consumption of 9.7 million tonnes of sugar it may be that refiners feel that the impact of corn sweeteners on the price level of sugar and the quantity required will be such as to enable them to obtain sufficient sugar without recourse to the market.

Mauritius sugar situation[2]

A devastating series of cyclones between December 1979 and March 1980 have drastically reduced the size of the 1980/81 crop as well as considerably damaging other agricultural production and infrastructure. Production of sugar had suffered in recent years with annual output averaging only 622,000 tonnes over the period 1975/78, compared with over 700,000 tonnes in 1972/74. It had been hoped that sugar production would increase as a result of extending irrigation facilities and better productivity at harvest, as well as improved yields by small planters who produce rather less than half of total output.

As a result of the cyclones, the current crop is estimated at only around 500,000 tonnes, well below the original projection of 800,000 tonnes. However, not only has the present acreage been damaged, but major irrigation projects and land development schemes have been unavoidably delayed. Production is also increasingly hampered by a shortage of labour since, despite the high level of unemployment, work on the sugar cane plantations is an unattractive proposition for the relatively well-educated workforce.

It has therefore not been possible to take full advantage of the 1980 recovery in prices on the world sugar market, since most of the 1980 output will fill the export quota of 487,000 tonnes to the EEC, but with a recovery in production likely in 1981 (although official estimates of 700,000 tonnes in 1981 and 720,000 tonnes in 1982 may be optimistic) and prospects of a further rise in the free market price, sugar earnings should improve markedly.

[1] *Public Ledger's Commodity Week*, October 25, 1980.
[2] *Abecor Country Rpt.*, October 1980.

Cane juice phosphates and clarification

By S.C. SHARMA, P.C. JOHARY and G.S.C. RAO
(Central Control & Research Laboratory, Cawnpore Sugar Works Ltd., Marhowrah, Saran, Bihar, India)

Introduction

As in other plant species, phosphorus in sugar cane is present in both inorganic and organic forms. The inorganic phosphorus in cane exists as free phosphate ions while the organic phosphorus is in the form of phospholipids, phosphoproteins, nucleotide phosphates and hexose phosphates. Such organic phosphorus compounds are considered vital for various metabolic processes and their presence in the cane plant is indispensable for its growth.

Since phosphate bonding with organic moieties, particularly adenosine, uridine nucleosides, nucleoproteins and hexoses, is energy-rich and essential for certain biochemical reactions, there is always a possibility for the conversion of organic phosphorus to inorganic phosphorus and vice-versa. In sugar cane the contents of both organic and inorganic phosphates are higher in the regions of active growth.

The utilization of phosphates in cane juice clarification is of extreme importance. Here it is only the inorganic phosphate which is concerned, however, since it is the free phosphate ions which take part in the reactions. Therefore, juices with an adequate quantity of inorganic phosphate are most desirable in respect of clarification. By and large, if the inorganic phosphate level in raw juice is less than 300 ppm w/v, additional phosphate may be required for good clarification and for production of good quality plantation white sugar.

In sugar cane a considerable amount of work has been done regarding the soil:plant phosphates relationship[1,2], the response to phosphate fertilization of yield and sucrose contents[3,4] and factors influencing the uptake and translocation of phosphates during growth and development of cane[5,6]. In a large number of fertilizer trials phosphates have been determined in almost all tissues of cane on a basis of % dry weight, and many reports have been published regarding the effect of fertilization on the total phosphate content of cane juice. However, insufficient work has been done regarding the influence of internal and external factors on the individual organic and inorganic phosphates in cane juices.

The present study was conducted, therefore, to determine the effect of crop age and N-P-K fertilization on the inorganic, organic and total phosphate contents of cane raw juice. Attempts have also been made to compare the clarification characteristics of juices with adequate natural phosphate and with added inorganic phosphate.

Methods and materials

Three field experiments were laid out in a completely randomized block design using BO 70 sugar cane variety.

S.C. Sharma

The number of treatments for each experiment varied from 6 to 10, with four replicates of each. The size of the plots ranged from 0.48 to 1.44 acres and in all plots the soil pH was around 6.0. Except where indicated the N-P-K sources were urea, single superphosphate and muriate of potash (KCl) and the levels applied were 120 lb.acre^{-1} of N, 80 lb.acre^{-1} of P_2O_5 and 40 lb.acre^{-1} of K_2O. Half the N was applied as a basal dose and the remainder within 90 days of planting. All the P and K was applied at planting. In the trial with combined inorganic and organic nitrogen fertilizer, castor cake (analysis 4.2% N, 1.9% P and 1.4% K) was used as the organic N source and ammonium sulphate and urea applied as the inorganic N source.

Three-budded setts were planted at 9 inches spacing in the rows; after 12 months growth phosphates were determined in raw juices extracted from millable cane using a power-driven laboratory crusher. To study changes in phosphates with age, random sampling with eight replicates was carried out at intervals in a separate plot of BO 70 cane and the juices analysed.

Phosphates were estimated in all the experiments by colorimetry of a blue phosphomolybdate complex using stannous chloride as reducing agent[7]. Inorganic phosphate (IP) was measured directly in juices while total phosphate (TP) was determined after wet digestion of the raw juices. The organic or bound phosphate (OP) was then calculated as the difference between TP and IP.

Results

(a) *Crop age*

With increase in the age of the crop, phosphates showed pronounced variations (Table I). Apparently, from 8 to 14 months of age, there was a significant increase in total phosphate (TP) and inorganic phosphate (IP). The organic or bound phosphate (OP) showed only an insignificant increase. With further increase of age, from 14 to 20 months, both TP and IP decreased significantly while the OP showed a slight increase to 14 months and fell thereafter. As a proportion of TP, however, the OP level continued to rise from 10 to 20 months.

Table I. Phosphates in raw juice as function of age of cane

Age of cane in months	TP (ppm)	IP (ppm)	OP (ppm)	% on TP	
				IP	OP
8	530	380	150	71.70	28.30
10	626	453	173	72.36	27.64
12	748	514	234	72.19	27.81
14	805	555	250	68.94	31.06
18	548	350	198	68.80	36.20
20	500	280	220	56.00	44.00
Mean	626	422	204		
Critical difference (C.D.) at 5%	78	42.70	N.S.		

N.S. = Non-significant

1 Ayers & Hagihara: *Soil Sci.*, 1961, **6**, 383.
2 Meyer: *Proc. 15th Congr. ISSCT*, 1974, 586-600.
3 Du Toit *et al.*: *Proc. 11th Congr. ISSCT*, 1962, 101-111.
4 van Dillewijn: "Botany of sugar cane" (Chronica Botanica, Waltham, Mass.) 1952, p.236.
5 Baver: *Hawaiian Planters' Record*, 1960, **56**, (1), 153.
6 Hartt: *Proc. 10th Congr. ISSCT*, 1959, 467-473.
7 Jackson: "Soil chemical analysis" (Asia Publishing House, India), 1974.

(b) *Combination of organic and inorganic N fertilization*

At 100% levels of organic or inorganic N levels (Treatments R_1, R_2 and R_3 of Table II) there was a marked increase in the OP and TP contents of cane juice although the rise in IP was much less significant. By contrast, the 1:2 and 1:1 combinations of castor cake with urea and ammonium sulphate (Treatments R_4 - R_7) effected increases in the IP and TP levels which were significant at C.D. 5% level. The 2:1 organic:inorganic N treatments (R_8 and R_9) did not produce much change in the phosphate fractions. The IP content as a proportion of TP was highest in the treatments which combined castor cake with ammonium sulphate (R_5, R_7 and R_9) while the OP proportion was highest where treatment was with castor cake and urea alone (R_1 and R_2). Urea alone or in a 1:1 ratio with castor cake gave the highest level of TP in the cane juices.

Table II. Influence of organic and inorganic N-levels on phosphate

Treatment	TP (ppm)	IP (ppm)	OP (ppm)	% on TP IP	% on TP OP
R1 Castor cake (CC)	720	360	360	50.0	50.0
R2 Urea (U)	800	340	460	42.50	57.50
R3 Ammonium Sulphate (AS)	610	320	290	52.46	47.54
R4 CC:U (1:2)	660	440	220	66.70	33.30
R5 CC:AS (1:2)	632	436	186	68.98	31.02
R6 CC:U (1:1)	850	530	320	62.35	37.65
R7 CC:AS (1:1)	630	520	110	82.54	17.46
R8 CC:U (2:1)	490	340	150	69.38	30.62
R9 CC:AS (2:1)	430	310	120	72.09	27.91
R10 Control	440	280	160	63.64	36.36
(C.D.) at 5%	190	122	86		

(c) *N-P-K combinations*

Combinations of N-P-K, N-P and P-K brought about significant increases in the TP and IP contents over the control (Table III) while a decrease in TP and a small increase in IP was observed with the N-K treatment. The reductions in OP were greatest with the N-P-K and P-K treatments but were less marked with the others. It is interesting to note that in the treatments with no added phosphate, i.e. the N-K and Control, the OP content as a proportion of TP reached 48 and 55%, respectively, while in the other treatments the proportion was around 25-30%.

Table III. Phosphates in cane juices as a function of N-P-K fertilization

Treatments	TP (ppm)	IP (ppm)	OP (ppm)	% on TP IP	% on TP OP
NPK	850	650	200	76.40	25.60
PK	740	520	220	70.30	29.70
NK	600	312	288	52.00	48.00
NP	830	570	260	68.67	31.33
Control	655	295	360	45.00	55.00
C.D. at 5%	71	175	148		

(d) *Variation in P_2O_5*

The supply of phosphate fertilizer greatly stimulated the accumulation of IP and TP but retarded that of OP in cane juices (Table IV). A strong and positive correlation was obtained between phosphate dosage and IP content (r = +0.88) and TP content (R = +0.94). There was a significant but negative correlation between phosphate dosage and OP content (r = –0.77). The increase in TP was due solely to the increase in IP, and the application of phosphate fertilizer thus affords a benefit in clarification.

In vivo vs. in vitro increased phosphate

Phosphate-deficient juices are known to create difficulties during clarification and, in order to overcome these, it is a common practice to add phosphate to such raw juices prior to clarification. In order to examine whether there is any difference between clarification of juices naturally rich in phosphate and juices to which supplementary phosphate has been added, a juice from cane grown in a plot with high P_2O_5 fertilization (100 lb.acre^{-1}) was obtained (C_1) and phosphate added to a second juice sample (C_2) to bring its IP, OP and TP levels to the same as those of C_1 (Treatment P_5 of Table IV). Both juices were then clarified by a normal sulphitation process using 2% milk of lime of 10°Bé. Analyses of the IP, OP and TP levels in raw and clarified juices were used to calculate the effective inorganic phosphate utilization (EIPU), effective organic phosphate utilization (EOPU) and total phosphate utilization (TPU) (Table V). Raw juice colour was measured at 420 nm after filtering through paper (Whatman No. 42) with the aid of a small quantity of kieselguhr and dilution with 4 volumes of a buffer of pH 7.0. The clarified juice colour was measured similarly but without filtration. The purity rise and fall in colour during clarification and the final mud volume are recorded for both juices in Table V.

Table IV. Phosphates in juices of cane with different levels of phosphate fertilization

Treatments	P_2O_5 level, lb.acre^{-1}	TP (ppm)	IP (ppm)	OP (ppm)	% on TP IP	% on TP OP
P_1	25	520	330	190	63.50	36.50
P_2	40	600	435	165	72.50	27.50
P_3	60	640	492	148	77.00	23.00
P_4	80	740	590	150	79.72	20.28
P_5	100	790	641	149	81.23	18.77
P_6	Control	500	300	200	60.00	40.00
C.D. at 5%		39.00	57.00	15.42		

Table V. Effect of in vivo and in vitro additions of phosphate on phosphate utilization during clarification

Type of addition	% EIPU	% EOPU	% TPU	Purity rise	% Colour drop	% Final mud volume
C_1 Phosphate added to cane @ 100 lb.acre^{-1}	91.89	45.38	80.05	0.89	73	22
C_2 Phosphate added to raw juice at 150 ppm	92.29	48.32	82.23	0.68	68	30

As anticipated, the EIPU values were considerably higher than those of EOPU and were almost equal. In vitro addition of P_2O_5 to raw juice increased the EOPU by 2.96%, so raising the TPU. Colour removal and purity rise were less when phosphate was added to the raw juice and mud volume was greater; it was also observed that clarity of the clear juice was inferior.

Discussion

According to Hartt[6], the total phosphate content fluctuates more closely with fertilization than the OP content in 8-10 internodal tissue. Our results obtained with raw juice from millable stalks correspond exactly with this observation. The pronounced variation in TP with age and fertilization was due to significant changes in IP content rather than to changes in OP.

During the period from 8 to 14 months of age, the 44.74% increase in IP and 41.6% increase in TP in raw juice suggest either migration of IP from the regions of active growth to the cane stalks or a low rate of combination of absorbed phosphorus with organic moieties. These observations are in line with earlier notions regarding migration of P with age.

The decrease of 49.55% in IP and 37.89% in TP after maturity, in the 14-20 months of age period, may be attributed to climatic factors and to resumed growth;

this has also been observed by other workers[4,8]. Clements *et al.*[9] demonstrated that the most active metabolic tissues of cane maintain relatively high phosphate levels by drawing on the older tissues. It is also known that, when the phosphate supply is inadequate, the phosphate present in millable cane stalks migrates quickly to apical meristems and young leaves[5]. This appears to have occurred in the treatment where phosphate was totally withheld. Curiously, withdrawal of phosphate from the stalks was mainly monitored by IP level rather than OP. This conclusion is further supported by data from the experiments on variation in P_2O_5. Overall, the results emphasize the sensitivity of the IP to age and fertilizer supply.

Perhaps the most important observation from this work is that, under certain fertilizer regimes, the IP can drop significantly while TP is unaffected. For example, in conditions when inorganic and organic N were applied singly to cane (Treatments R_1 - R_3 of Table II) or where N-K fertilizer is applied (See Table III) the raw juices contain significantly high quantities of total phosphate although only about half of this is in the form of inorganic phosphate. The juices obtained do not respond well to clarification and, because of their high OP content, are likely to contain a high colloid content which may give trouble.

Preliminary studies with respect to in vivo and in vitro addition of phosphate suggest the need to study this matter in further detail, since the juice naturally rich in phosphate showed superiority in purity rise, colour removal, juice clarity and final mud volume by comparison with juice having extra phosphate added, although the latter had an equal EIPU and greater EOPU and TPU. The increased EOPU may be attributed to an initial drop in juice pH which was due to the addition of phosphoric acid (from pH 5.6 to 4.8).

The above work leads us to confirm the need for application of balanced fertilizer quantities to the sugar cane crop in order to obtain juice which will respond well to clarification treatments for the manufacture of direct consumption plantation white sugar. In areas where phosphorus is not fixed in the soil and where juices are deficient in phosphate it is desirable to add fertilizer to permit a better uptake of phosphate and establishment of adequate natural IP in the plant itself instead of depending on supplementary addition of phosphate to raw juice before clarification. It may be added that external addition of phosphate does not permit uniform mixing in raw juice while the application of P as fertilizer to soils results in the homogeneous distribution of IP and TP in the juice from the millable stalks.

Summary

Field trials have been conducted to evaluate the influence of crop age and fertilization on the inorganic (IP), organic (OP) and total phosphate (TP) in cane juice. It was observed that significant increases in TP content during the peak of maturity, with balanced N-P-K fertilization and with 1:2 and 1:1 combinations of organic and inorganic N fertilizer, were due to pronounced accumulation of IP in the juices. Significant positive correlations were obtained between increased P fertilization and IP (r = +0.88) and TP (r = +0.94) whereas OP showed a significant negative correlation (r = −0.77). Use of N-K fertilizer or only inorganic or organic N increased the OP content significantly in raw juice. Preliminary comparison of in vivo and in vitro addition of phosphate indicated the former's superiority in clarification characteristics.

Les phosphates du jus de canne et la clarification

Des essais sur champ ont été effectués dans le but d'apprécier l'influence de l'âge de la culture et de la fumure sur la teneur en phosphate inorganique (IP), organique (OP) et total (TP) dans le jus de canne. On a observé que des accroissements significatifs en TP au cours de la pointe de maturité, avec une fumure N-P-K équilibrée et avec des combinaisons 1:2 et 1:1 d'engrais azoté organique et inorganique, étaient dûs à une accumulation prononcée de IP dans les jus. On a obtenu des corrélations positives significatives entre l'augmentation de la fumure en P et IP (r = + 0,88) et TP (r = + 0,94), tandis que OP manifesta une corrélation significative négative (r = − 0,88). L'emploi d'un engrais N-K ou uniquement de N inorganique ou organique augmenta de façon significative la teneur en OP du just brut. La comparaison préalable d'addition de phosphate in vivo et in vitro révéla la supériorité de la première en ce qui concerne les caractéristiques de clarification.

Rohrsaftphosphate und Klärung

Felduntersuchungen wurden durchgeführt, um den Einfluß von Rohralter und Düngung auf den Gehalt an anorganischem (IP), organischem (OP) und Gesamt-Phosphat (TP) im Rohrsaft festzustellen. Es wurde beobachter, daß signifikante Zunahmen des TP-Gehaltes während der Hauptreife, mit ausgewogener N-P-K-Düngung und mit 1:2- und 1:1-Kombinationen von organischem und anorganischem Dünger, auf eine ausgeprägte Akkumulation von IP im Saft zurückgeführt werden kann. Signifikante positive Korrelationen wurden zwischen zunehmender P-Düngung und IP (r = + 0,88) und TP (r = + 0,94) erhalten, während OP eine signifikante negative Korrelation (r = −0,77) hatte. Die Verwendung von N-K-Dünger oder nur organischem oder anorganischem N erhöhte den OP-Gehalt signifikant im Rohsaft. Vorversuche mit in vivo und in vitro zugegebenem Phosphat zeigten die Überlegenheit des erstgenannten in den Charakteristika der Klärung.

Fosfatos en jugo de caña y clarificación

Ensayos en el campo se han conducido para evaluar la influencia de edad de la cosecha y de fertilización sobre los contenidos de fosfato inorgánico (IP), orgánico (OP) y total (TP) en jugo de caña. Se ha observado que un aumento significativo en contenido de TP durante el pico de madurez, con fertilización N-P-K balanceado y con combinaciones 1:2 y 1:1 de fertilizante N orgánico y inorgánico, fué la resulta de acumulación de IP en los jugos. Corelaciones significativas y positivas se han obtenido entre aumentos en fertilización con P y IP (r = + 0.88) y TP (r = + 0.94), mientras que OP demuestra una corelación significativa pero negativa (r = − 0.77). Uso de N-K como fertilizante o solamente N inorgánico o N orgánico ha aumentado significantemente el contenido de OP en jugo crudo. Comparación preliminar de adición in vivo y in vitro de fosfato ha indicado la superioridad del anterior respecto de características de clarificación.

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[8] Humbert: "The growing of sugar cane" (Elsevier, Amsterdam), 1968, p.163.

[9] *Hawaiian Planters' Record*, 1942, **45**, 227-239.

Evaluation of raw sugar quality and refining operations

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This report is designed to illustrate a practical system for evaluation of raw sugar refining qualities and refinery processing operations. These evaluations use large numbers of laboratory and plant data from an older refinery which has had major changes in unit processes in the past few years.

It covers a multi-year period beginning in 1974 and includes 185 operating periods varying in length from a few days to several weeks. During this time, there was a gradually increasing melt rate from approximately half of its rated capacity to full capacity within a period of a year. During this same period also, 80 widely differing raw sugars were processed. The data, equations and graphs contained in this report were prepared by a system developed for a programmable calculator and an automatic plotter. This system permitted fast, convenient and accurate processing of all available data and made it possible to make many correlations in a minimum of time. The system used could be used in a raw sugar factory or any other manufacturing operation in which large amounts of data are involved and several variables are operating simultaneously.

Analysis of the data in this report focused on the effects of non-sucrose raw sugar impurities on the recovery of sugar under routine conditions of operations. It has been shown that invert sugar and ash have measurable effects on yield, and colour an indirect effect.

Introduction

Before polarization became the basic parameter by which raw sugar was commercially valued, other factors such as colour, crystal quality and moisture were used as a basis to determine a settlement price. In the early nineteenth century those factors were probably the result of the sugar refiner's goal to manufacture a white, dried, crystalline product, usually in the form of a loaf, with the greatest possible yield. It was then known that some grades of sugar resulted in higher yields and had better refining qualities. An official study in England[1] in the early 1830's gave the following yield information about raw sugars from different sources as shown below.

At that time, the British government based its schedule of drawbacks of duty and premiums for the exported white sugar on the assumption that 100 parts of raw sugar contained 59 parts of refined sugar[1]. The government of France, in 1833, used rates that ranged from 75 to 78 parts of white sugar from 100 parts of raw sugar[2].

	% Yield			
	Refined Sugar	Molasses Raw Sugar	Syrup	Loss
Jamaica raw sugar	56.61	19.10	20.56	3.75
Clayed Brazilian sugar	72.68	9.74	13.91	3.67
Raw sugar from open kettles	62.58	19.80	13.70	4.00
Raw sugar from vacuum pans	70.53	15.04	10.68	3.75

Polarization became a factor in determining the purchase price of raw sugar for sugar refineries in continental Europe about the middle of the nineteenth century. Peligot, in 1850, suggested[3] that ash be considered in determining sugar value because it caused a loss in sucrose recovery equal to five times the quantity of ash contained in raw sugar. Monnier developed a formula[3] for evaluating raw sugar that included correction of polarization by an ash factor. This formula became the basis for the pricing of raw sugar in many European countries and, in modified form, is still being used in some instances. Other methods for determining the yields of refined sugar from raw sugars of different qualities were suggested. Pagnoul's formula[4] deducted both ash and reducing sugars from polarization and provided a loss allowance of 1.5%. Scheibler recommended in 1871 that organic non-sugars be subtracted from the polarization[3], and Weiler proposed that twice the amount of total non-sugars be subtracted from the polarization[3]. Payen was the first to suggest that raw sugar be evaluated on its crystal content[5]. He obtained the weight of the crystal by removing the molasses film with an acidified, sugar-saturated alcohol solution. Scheibler, Koydl & Herzfeld-Simmermann proposed modifications of Payen's procedure[6].

Materials balance accounting in raw sugar mills and refineries employ other yield formulae in an effort to measure efficiency of sugar recovery rather than for pricing purposes. The Hulla-Suchomel formula[7] or its

1 Von Lippmann: "Geschichte des Zuckers", 2nd Edn. (Springer, Berlin) 1929, p.243.
2 *ibid.*, p.745.
3 Wohryzek: "Chemie der Zuckerindustrie", 2nd Edn. (Springer, Berlin) 1928, p.493.
4 *ibid.*, p.494.
5 Deerr: "Cane Sugar", 2nd Edn. (Norman Rodger, London) 1921, p.437.
6 *ibid.*, p.438.
7 *ibid.*, pp.438-439.


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modification is widely used in the beet sugar industry for this purpose. This formula is as follows:

$$\% \text{ available sugar} = \frac{100T\,(j-m)}{T_I\,(s-m)}$$

where T is the total solids in raw material;
T_I is the total solids in the refined product; and
j, s and m are the purities of raw material, sugar and by-product, respectively.

Winter observed in 1897 in Java that one part of non-sucrose matter in sugar juice held 0.4 parts of sucrose in final molasses. From this observation, the following formula was derived:

$$\% \text{ sugar recovery} = 100\,(1.4 - \frac{40}{j})$$

in which j is the purity of the starting material.

This is a simplification of more generalized formulae containing functions of the purities of the raw material and that of the sugar and molasses products. This formula is commonly called the Winter-Carp formula today.

Deerr[8] developed the general equation:

$$\% \text{ available sucrose} = \frac{100s\,(j-m)}{j\,(s-m)}$$

in which s, j and m are purities of raw sugar, original material and molasses. However, Deerr also pointed out that this formula can be used as a starting point to develop other formulae in the control of different products in the mill or the refinery[9].

United States tariff regulations promulgated in 1789, 1790, 1816, 1832, 1842, 1846 and 1857 used trade names to determine duty on imported sugar. For example, the Tariff Act of 1842 assessed raw and brown sugars at 2½ cents per pound, refined sugar (loaf or candy sugar) at 6 cents per pound, and all other sugars, i.e. white clayed, at 4 cents per pound[10].

The Tarriff Act of 1861 introduced a colour criterion for classifying sugars entering the United States. The tariff rates were based on colour standards maintained by Netherlands Trading Society[11] and commonly referred to as the "Dutch Standard," a series of sugar samples graded in colour from dark brown to white. The samples were numbered from 8 to 25 with 8 being the darkest or lowest value, and 25 the lightest or highest value. In 1883, polarization became the exclusive test in evaluating raw sugars.

The United States Jones-Costigan Act of 1934 provided a quota system in which the overall quantities of raw sugar to be imported were based on a concept called "raw value." The raw value of a sugar is the quantity of that sugar needed to produce 100 pounds of refined, granulated sugar. A base value for sugar polarizing 96 sugar degrees was set at 107 pounds. The raw value was based on an average of results obtained in sugar refineries operating at that time.

Tate & Lyle Refineries Ltd. have over the years developed a series of refinery recovery formulae[12]. These formulae included factors for polarization (P), invert sugar (V), and ash(A) and are summarized below:

(1) Commercial net yield (1863): $Y = P - 5A$
(2) True net yield (1916) (sucrose S substituted for polarization P): $Y = S - 1.3 - 5A$
(3) New net yield (1923): $Y = S - \frac{1}{2}V - 4A$

Later, an "ideal molasses" formula was developed:

(4) Ideal molasses formula (1935): $Z = 55 + 14g$

in which Z is the total sugars as a percentage of solids in molasses and g is the ratio of invert sugar (V) to non-sugars (N.S.).

This formula assumes that the ratio of ash and organic non-sugars remain the same in both raw sugar and molasses. This formula was further modified in 1944[13] to:

$$Z = 100\left(\frac{1.4 + g^2}{2.5 + g^2}\right)$$

and again in 1971 to:

$$Z = \frac{100\,(5 + 3g)}{3\,(3 + g)}$$

In 1966, the American Sugar Company, a sugar refiner with headquarters in the United States, developed a raw sugar purchase contract in which penalties and premiums were assessed for several parameters other than polarization. Parameters were established initially for ash, moisture, grain size, colour and filtrability. Technical difficulties with procedures for determining filtrability ultimately led to its exclusion from the non-sugar parameters in 1972. After ten years of experience with the inclusion of non-sugar parameters for adjusting raw sugar prices, the American Sugar Company (now Amstar Corporation) modified the penalty and premium limits for the remaining non-pol parameters in 1979. A discussion of the effects of quality provisions of the Amstar contract was published by John V. López-Oña in 1979[14].

Polarization, or perhaps sucrose content, is the most important parameter for determining the value of raw sugar and the most important factor in estimating the quantity of refined sugar that can be extracted in a refinery equipped with the conventional sugar refining processes. Most of the yield formulae relating to sugar refinery operations were developed around bone char processes. Revere Sugar Corporation does not use bone char in any of its three refineries, but it was considered that appraisal using existing formulae of the operations of the Charlestown refinery would be instructive. We also considered that it would be of interest to others as well to compare to the extent possible the effects of factors other than pol (or sucrose content) on operations and yield. Those other factors are invert sugar content, ash and colour. In some instances, refinery facilities are a dominant factor, but we believe that the use of large amounts of data over a long period of time tend to neutralize the facilities aspect of the appraisal. The mixture of cargoes varying significantly in composition during a given production interval tends to obscure the effects of a specific raw sugar, but some measure of the contribution of specific components in raw sugar is discernible.

While the roots of the Charlestown refinery extend back to 1864, the current facility was erected between 1914 and 1918. Various modifications have been made from time to time, and today the refinery operates more than 300 days annually.

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[8] *ibid.*, p.558.
[9] Browne & Zerban: "Sugar Analysis", 3rd Edn. (Wiley, New York), 1955, pp.1040-1041.
[10] Cottrell: "Beet Sugar Economics", (Caxton Printers, Caldwell, Idaho) 1952, p.265.
[11] Browne: "A Handbook of Sugar Analysis," (Wiley, New York) 1912,p.498.
[12] Lyle: "Technology for Sugar Refinery Workers, 3rd Edn., (Chapman & Hall, London) 1957, pp.346-351.
[13] "A Handbook of Technical Control Methods", (Tate & Lyle Refineries Ltd., Liverpool) 1971, p.27.
[14] *Sugar y Azúcar*, 1979, **74**, (5), 42-49.

Evaluation of raw sugar quality

The refining processes currently in use consist of affination with an attendant remelt system, carbonatation, granular carbon and resin decolorization, and crystallization. Carbonatation replaced phosphate clarification about ten years ago and the bone char system was replaced approximately five years ago. A schematic diagram of the present plant is shown in Fig. 1.

Engineering, were converted to weighted weekly averages reflecting the melt for each week. In some instances, data were averaged over other time intervals as well. Compositional data for every cargo being processed during each week have been included in order to estimate the contribution each cargo made to a week's results. Similarly, data were accumulated by liquidation schedule for cross-checking purposes including that of materials balance.

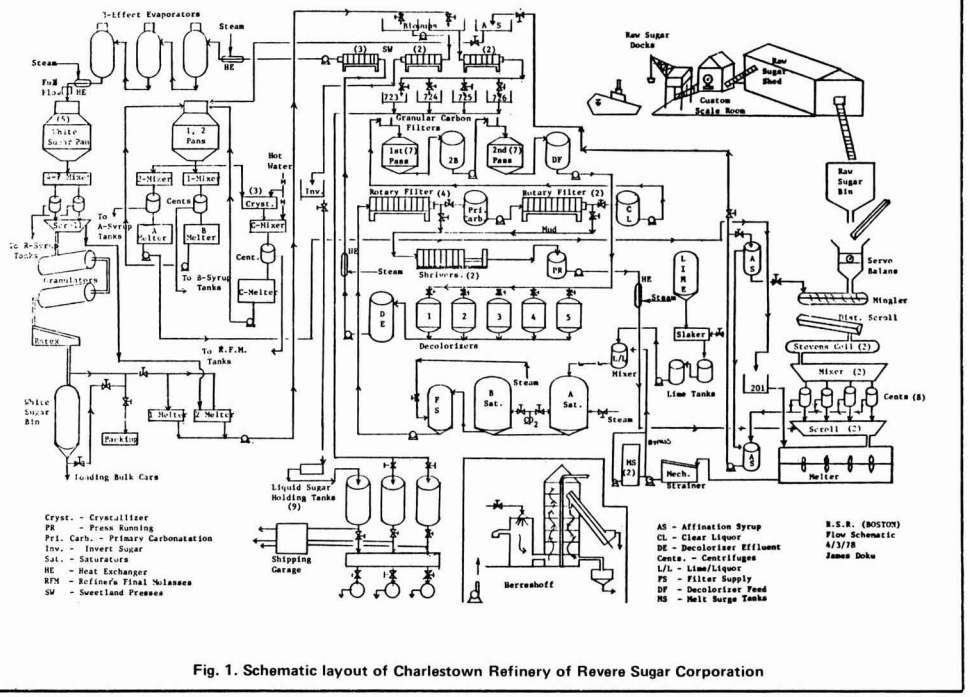


Fig. 1. Schematic layout of Charlestown Refinery of Revere Sugar Corporation

The major products manufactured at the Charlestown refinery consist of refined granulated sugar in several sizes, several sucrose and invert sugar type liquid sugars as well as blends of liquid sugar with starch hydrolysate products, and refiners' final molasses. All refined sugar is produced as granulated and liquids are manufactured from it. No soft sugars are manufactured, with the consequence that affination and refiners' syrups are ultimately boiled to remelt sugar and final molasses.

The quality of the granulated sugar manufactured is dictated largely by the demands of the United States sugar market. The market is dominated by food processors and the quality of Revere's final products is a reflection of their requirements. The specifications for "bottlers' sugar"[15] is more or less a summation of all food processors overall quality requirements and the refinery is geared to meet them. How well it has done so is shown in Fig. 2, showing colour and ash of refined sugar produced since conversion to granular carbon a few years ago.

Methods for processing data

The applicable analytical data determined by Charlestown's Process Control Laboratory, together with the necessary quantitative information from Operations and

Cargo analyses are shown in Table I. While cargoes from all over the world were processed during the period of time covered by the report, the largest single source of raw sugar during this period was the Philippines. A wide range of quality is reflected in the cargoes. Accordingly, we do not believe there is any unusual bias in the results of our evaluation arising from a large number of abnormal cargoes. The overlap of cargoes being processed during any given week obviously tends to average out the effect of individual cargo quality, but it is our opinion that some of those effects are demonstrated to a certain degree by the manner in which the data have been handled.

The large amount of data involved in this study could be handled only by computer within a reasonable period of time. For this purpose, appropriate programs were developed for a Hewlett Packard HP9815A so that calculated results and their comparisons could be obtained promptly once appropriate data were fed into the computer. The graphs contained in this review were

[15] "Standards and Test Procedures for 'Bottlers' Granulated and Liquid Sugar", (American Bottlers of Carbonated Beverages, Washington, D.C.) 1962.

prepared on a Hewlett Packard HP9872A automatic plotter. Using cumulative melt as a basis, periodically averaged data can be evaluated graphically as well as mathematically to provide more incisive analysis. This technique can provide an overview of the effect of a given parameter on specific processes, identifying problem periods, show rates of changes, if any, from slopes of the various curves, and provide a better basis for statistical analysis because of the large number of data points.

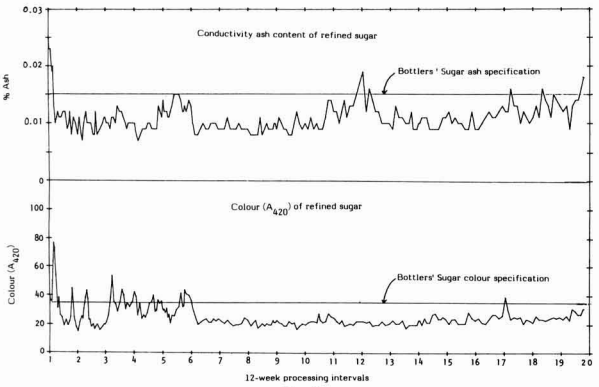


Fig. 2.

Table I. Sources and composition of cargoes processed

	Number of Cargoes	Range of composition: Pol % High	Pol % Low	Moisture % High	Moisture % Low	Invert Sugar % High	Invert Sugar % Low	Ash % High	Ash % Low	Colour (ICUMSA 2) High	Colour (ICUMSA 2) Low	Undetermined High	Undetermined Low
Australia	2	98.675	98.641	0.245	0.225	0.222	0.219	0.420	0.310	194	134	0.523	0.423
Bolivia	2	97.912	97.524	0.520	0.450	0.551	0.493	0.660	0.360	114	91	0.694	0.527
Brazil	5	97.939	97.492	0.460	0.310	0.930	0.655	0.470	0.290	256	138	0.681	0.418
Colombia	2	97.816	97.542	0.495	0.345	0.718	0.699	0.440	0.430	128	120	0.675	0.523
Dominican Republic	10	98.027	95.949	0.665	0.400	1.720	0.627	0.470	0.320	389	125	0.938	0.448
Guatemala	6	96.944	96.195	1.015	0.380	1.254	0.915	0.630	0.370	153	111	0.912	0.735
India	2	99.421	98.145	0.440	0.080	0.396	0.167	0.350	0.090	120	57	0.582	0.205
Malawi	2	98.519	98.485	0.215	0.120	0.212	0.211	0.600	0.500	117	92	0.536	0.509
Natal	2	98.611	98.529	0.200	0.130	0.613	0.590	0.185	0.480	139	93	0.359	0.338
Philippines	28	97.868	96.096	0.785	0.200	1.616	0.767	0.440	0.290	377	153	0.991	0.378
El Salvador	5	97.810	96.056	0.815	0.280	1.206	0.715	0.546	0.440	288	107	1.238	0.200
Swaziland	2	98.679	98.651	0.250	0.245	0.422	0.332	0.290	0.265	118	107	0.325	0.324
Others*	12	98.659	96.608	0.795	0.150	1.023	0.315	0.680	0.265	276	97	0.934	0.234
Total	80												

* Twelve single cargoes were received from each of the following countries: Argentina, Barbados, Belize, Costa Rica, East Africa, Hawaii, Honduras, Madagascar, Mozambique, Nicaragua, Taiwan and Thailand.

Initially, we selected the 1971 Tate & Lyle molasses exhaustion formula to convert to a raw sugar yield form[16]. However, it was decided to use refinery final molasses solids as the basis for determining yield because measurement of sucrose output is more difficult to obtain with the desired degree of accuracy owing to a large number of factors including the errors introduced by estimates of major in-stock items such as sugar in bulk sugar bins, and absorbent column contents, and the adjustments made to shipping data to arrive at net deliveries for a given processing period. On the other hand, the quantity of refinery final molasses is a smaller number based on daily weights, only minor inventory, and without adjustments for net shipments. Accordingly, the Tate & Lyle formula was converted to the following expression to give the yield of final molasses from a given raw sugar:

$$R = \frac{9}{4}(100-P-M) - 1.995\,V$$

in which R is the refinery final molasses solids; P is the pol of the raw sugar; M is moisture; and V is the invert sugar content of the raw sugar.

Yields calculated by this equation for liquidation periods included in the study were compared with actual yields for the same periods as a function of weighted pol. The results are shown in Fig. 3. The two lines are practically parallel but show a wide gap between calculated and actual. This comparison demonstrates that the formula reflects only part of the effects of other non-pol components in typical raw sugars. Furthermore, when used as a yield formula, it does not include factors for mechanical losses or additions to invert sugar, organic non-sugars and ash during processing.

When contributions by ash, organic non-sugars and moisture are incorporated in the calculations, a more complex and meaningful relationship was derived from the following steps:

1. An assumption was made that non-sucrose impurities in final molasses are a function of those impurities in the raw sugar and those resulting from the process. Their weighted quantities for the liquidation periods were calculated as a function of the actual quantity of non-sucrose molasses solids produced during that period and resulted in the following equation:

   Non-sucrose molasses solids
   = 1.14V + 2.17A + 0.74U − 0.40
   in which V, A and U are invert sugar, ash and organic non-sugars contained in raw sugar.
   A similar relationship between sucrose in final molasses and the same parameters resulted in:

   Sucrose in molasses
   = 0.76V + 1.94A + 0.54U + 0.29.
2. Combining the two expressions into a single equation representing total solids in final molasses gives:

   R = 1.90V + 4.11A + 1.28U − 0.11
3. Since granulated sugar yield for a refinery can be stated as the difference between sucrose in raw sugar and the sum of the sucrose contained in final molasses and operating losses, the estimated yield of granulated sugar from a given raw sugar can be derived from the following group of equations:

   (a) Sucrose in raw sugar = P + 0.22V;
   (b) Sucrose in final molasses = 0.76V + 1.94A + 0.54U + 0.29;
   (c) Organic non-sugars U = 100 − P − 1.22V − A − M.

On incorporating the factor 0.83, the average operating loss previously determined to be independent of raw sugar composition, the resulting estimated yield equation for the Charlestown refinery becomes:

$$Y = 1.346P + 0.11V + 0.54M - 1.40A - 54.57.$$

Results and discussion

The Charlestown formula for estimating the yield of granulated sugar from any raw sugar reflects both the raw sugar composition and the processing peculiarities, including its limitations, of the Charlestown refinery. This formula is not proposed as a general yield equation that fits any refinery or as an idealized formula setting a goal for achievement. However, the procedures which were followed in developing the Charlestown formula can be utilized for any refinery provided the appropriate

[16] Reed: *Proc. 36th Meeting Sugar Ind. Tech.*, 1977, 143-144.

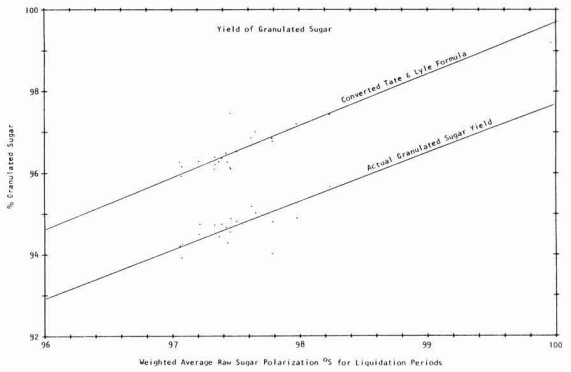


Fig. 3.

data are available in sufficient quantity.

A test of the Charlestown formula for molasses solids is based on production of final molasses since the production data were considered more complete and reliable. The molasses solids equation has been applied to eighteen cargoes which were processed substantially unmixed with other cargoes. A comparison of the final molasses solids produced for each cargo with that estimated is shown in Table II. There is relatively good agreement between the two, suggesting that this approach is valid for Charlestown's conditions.

The final molasses solids equation points out the substantial contributions made by invert sugar and ash to molasses production. It emphasizes the fact that ash has a significant effect on Charlestown molasses production. While ash appears to have a much greater effect than invert sugar, the size of the ash factor is considerably offset by the fact that the raw sugars processed at Charlestown contain much smaller amounts of ash than of invert sugar. The relative contributions of those two impurities is complicated by the fact that invert sugar has a decreasing effect on polarization in excess of its actual quantity in raw sugars. Its effects show up in both the polarization and invert sugar parameters.

There are other aspects of invert sugar that are not obviously demonstrated by the Charlestown formula. It has been our experience that raw sugars with high invert sugar content tend to have a low pH. Even though much of the invert sugar is removed during affination, the washed sugar tends to have a low pH. Consequently, high invert sugar usually leads to the addition of alkali to adjust low pH in the melt liquor, raising its ash content. The invert sugar content of the cargoes processed are shown in Fig. 4. Cargoes varied widely and a substantial number had invert sugar in excess of 0.8%.

An effort to estimate the combined effects of invert sugar and ash is shown in Table III. Cargoes containing various combinations of invert sugar and ash were selected for evaluation by both the molasses solids equation and the yield formula. The results indicated that both low invert sugar and low ash raw sugars are the most desirable for Charlestown, and high invert sugar and high ash are the least desirable. The other combinations have intermediate effects. Efforts to emphasize the effects of invert sugar and ash on refinery operations are considerably overshadowed by polarization because it is so large in comparison with impurities.

Colour cannot be over-emphasized as a factor in evaluating raw sugar. Neither can it be adequately quantified in order to develop a direct relation between the amount of colour in a raw sugar and its effect on granulated sugar recovery. The fact that decolorizing systems are a very large part of a refinery and represent a tremendous investment in plant facilities for the removal of a small amount of an impurity are far better parameters for demonstrating its importance.

While colour is removed at the affination station, substantial amounts are returned to process by way of remelt sugars. The recycling of colour by way of remelt sugar is shown in Fig. 5. In this figure, the colour of washed raw sugar and melt liquor composed of washed raw and remelt sugars are shown over a substantial operating period. Also shown in the figure is the melt rate for the same period. When viewed together, it is obvious that colour is one of the factors affecting melt rate, adding significantly to the cost of refining dark-coloured sugars. Fig. 6 shows the colour (A_{560}) of all cargoes covered by this report, with lines superimposed on it showing the lower penalty limit and the upper premium limit of the latest Amstar contract. More than half of the cargoes processed exceeded the lower penalty limit and very few fell in the premium range for colour.

Table II. Comparison of molasses solids produced and estimated for individual cargoes

Cargo No.	Cargo composition % Pol	Moisture	Invert	Ash	Undetermined	Molasses Solids (% on Raw Sugar) Actual	Estimated
28	96.48	0.76	1.19	0.60	0.72	5.40	5.54
31	97.78	0.32	0.79	0.35	0.58	3.80	3.57
32	97.65	0.39	0.77	0.33	0.70	3.60	3.61
35	97.18	0.54	0.94	0.35	0.79	4.00	4.13
36	97.01	0.41	0.98	0.48	0.90	5.21	4.88
39	97.37	0.27	0.87	0.36	0.94	4.33	4.23
40	97.45	0.27	0.89	0.37	0.83	4.13	4.16
41	97.56	0.26	0.86	0.39	0.75	3.76	4.09
43	97.12	0.46	1.06	0.40	0.74	5.39	4.50
44	97.05	0.66	0.95	0.39	0.75	4.08	4.26
47	98.08	0.33	0.69	0.35	0.41	3.14	3.16
49	97.59	0.37	0.86	0.32	0.68	3.96	3.71
58	96.58	0.55	1.39	0.38	0.80	6.26	5.12
59	97.25	0.37	1.02	0.37	0.76	4.29	4.32
62	97.54	0.35	0.82	0.43	0.68	3.50	4.09
63	97.75	0.31	0.77	0.41	0.59	3.50	3.79
68	96.10	0.69	1.62	0.37	0.87	5.87	5.60
75	97.15	0.39	0.79	0.41	1.09	4.62	4.47

The effects of raw sugar grain size on Charlestown's operations have not yet been analysed. In a general way, it is recognized that small grain or mixed grain raw sugars require additional washing at the affination station, placing a larger load on the remelt system. Under most conditions, the net effect of small and mixed grain is reflected in a decrease in melt rate and a loss of sucrose to final molasses.

Conclusions

An analysis of the operating data from the Charles-

town refinery over a period of several years has demonstrated to us that the refinery has certain characteristics

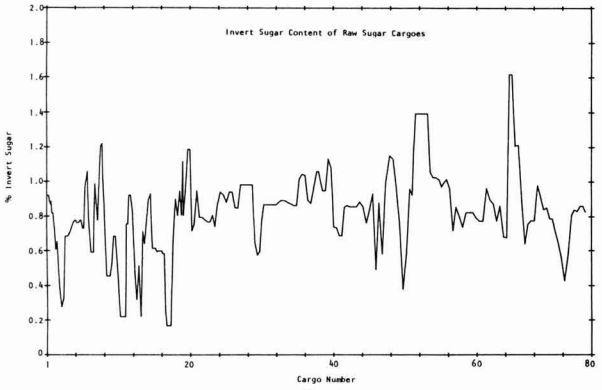


Fig. 4.

which prevent complete separation of the refinery's individuality from the effect of raw sugar quality on operations and sugar quality. Nonetheless, this analysis does show that high levels of invert sugar, ash and colour have an adverse effect on yields of refined sugar and contribute to operating problems as well.

Invert sugar is probably the largest single contributor to reduced recovery even though the Charlestown yield formula does not indicate its total role in that area. Secondary effects attributable in part to invert sugar include depressed melt liquor pH and degradation of invert sugar to colour and organic acids. Those secondary effects require an increase in added ash to correct the low pH. Yield formulae including polarization as the major factor do not reveal this insidious character of invert sugar even though the invert sugar factor is overstated in relation to its effect on polarization. The secondary effects, however, are not taken into consideration by "ideal" yield formulae.

High ash raw sugars are considered undesirable at Charlestown. This attitude is supported by both the molasses solids and granulated sugar yield equations based on Charlestown's operating experience. We have not yet determined the more complex relationships among ash, invert sugar and organic non-sugar and their contributions to reductions in granulated sugar yield.

Colour, like invert sugar, has secondary effects on recovery that are difficult to quantify. Since a colour factor is not amenable to incorporation into yield formulae, it must be evaluated in relation to the overall operation and the standards set for finished products, with the result that the decolorizing system has been geared to processing raw sugar with the highest colour. That has led to an enlarged decolorizing system. Dark-coloured raw sugars also make themselves felt in the remelt system. Since the remelt system is finite in size, significant amounts of colour are recycled to the melt system and the amount of colour recycled is related to the colour of the raw sugar. The net effect of colour on remelt and decolorizing systems is usually a reduction in melt rate, significantly increasing costs.

Finally, a method for processing and comparing large amounts of raw material and operations data has been developed. Improvements in those techniques will permit Revere to make more piercing analyses of all its refinery operations.

Table III. Combined effects of invert sugar and ash

Cargo No.	% on Raw Sugar Pol	Moisture (M)	Invert (V)	Ash (A)	Undetermined (U)	Estimated Yield (% on Raw Sugar) Molasses Solids	Granulated Sugar
			Low Invert/Low Ash				
23	99.42	0.08	0.17	0.09	0.21	0.85	97.93
37	98.65	0.25	0.42	0.27	0.32	2.21	96.62
57	98.68	0.25	0.33	0.29	0.38	2.20	96.63
			High Invert/High Ash				
11	96.57	0.62	1.25	0.55	0.74	5.47	93.32
28	96.48	0.76	1.19	0.60	0.72	5.54	93.18
26	96.20	1.02	1.02	0.63	0.91	5.58	92.83
			High Invert/Low Ash				
68	96.10	0.69	1.62	0.37	0.87	5.60	92.93
55	96.99	0.50	1.13	0.35	0.79	4.49	94.17
45	96.94	0.38	1.24	0.37	0.79	4.78	94.01
			Low Invert/High Ash				
53	97.77	0.30	0.32	0.62	0.93	4.24	94.79
4	98.49	0.12	0.21	0.60	0.54	3.45	95.82
72	98.52	0.22	0.21	0.50	0.51	3.00	96.06

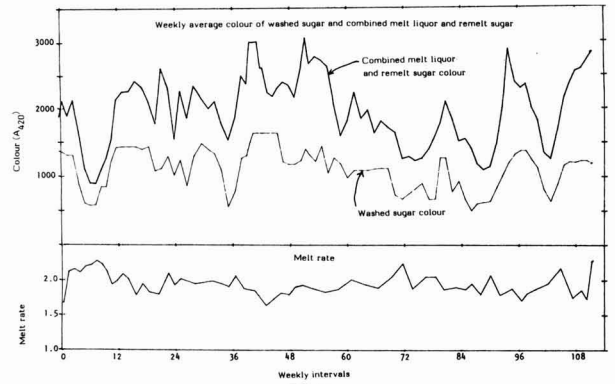


Fig. 5.

Summary

A computer analysis of laboratory data collected over several years from 1974 at the Charlestown refinery of Revere Sugar Corporation has permitted correlation of raw sugar characteristics with refinery yield. The analysis has demonstrated the measurable effects of invert sugar and ash content on yield as well as the indirect effect of colour.

L'évaluation de la qualité du sucre brut et des opérations de raffinage

Une analyse par ordinateur des données de laboratoire receuillies au cours de plusieurs années à partir de 1974 à la raffinerie de Charlestown de la Revere Sugar Corporation a permis d'établir une corrélation entre les caractéristiques du sucre brut et le rendement de la raffinerie.

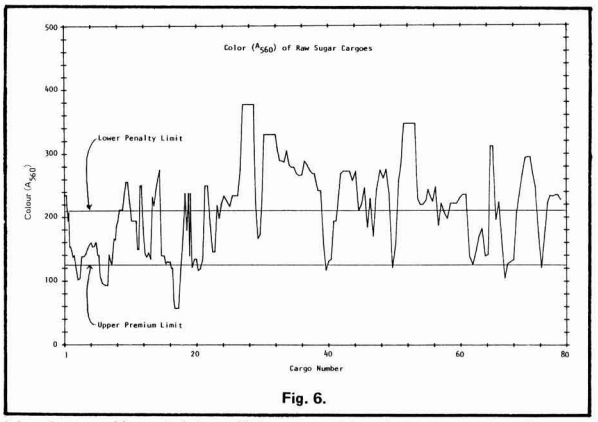


Fig. 6.

L'analyse a démontré les effets mesurables des teneurs en sucre inverti et en cendres sur le rendement ainsi que l'effet indirect de la coloration.

Bewertung der Rohzuckerqualität und Raffinationsverfahren

Eine Computeranalyse von Laboratoriumsunterlagen, die über mehrere Jahre hindurch von 1974 an in der Raffinerie Charlestown der Revere Sugar Corporation gesammelt wurden, hat eine Korrelation zwischen Rohzuckereigenschaften und Raffinerieausbeute ergeben. Die Analyse zeigte meßbare Auswirkungen von Invertzucker und Aschegehalt auf den Ertrag und eine indirekte Auswirkung der Farbe.

Valoración de la calidad de azúcar crudo y de operación de una refinería

Un análisis con un computador de dados del laboratorio, obtenido durante algunos años desde 1974 a la refinería de Charlestown, E.U.A., de Revere Sugar Corporation, ha permitido la corelación de los característicos de azúcar crudo con la recuperación del azúcar refinado. El análisis ha demostrado los efectos mensurables sobre recuperación de azúcar invertido y del contenido de ceniza tanto como el efecto indirecto de color.

1980 Technical Session on Cane Sugar Refining Research

More than one hundred delegates of the world's cane sugar refining industry met in New Orleans, Louisiana, during October 19 – 21, 1980, to discuss recent advances in cane sugar technology. A conference is held every two years by the Cane Sugar Refining Research Project Inc. and the Southern Regional Research Center of the United States Department of Agriculture. CSRRPI is funded by the major cane sugar processing companies of the world, and is located at the Southern Regional Research Center, under the direction of Dr. Margaret A. Clarke (CSRRPI) and Dr. Frank G. Carpenter (USDA).

In the keynote talk of the meeting, Dr. C. C. Chou of Amstar Corporation described experiences with dextran problems in sugar refining. His work on developing a standard, meaningful test for dextrans in raw sugars, and on determining the degree of distortion of the pol reading by dextrans, was of great general interest. Dr. Chou showed how slight the effect of most refining processes is on dextran removal. Dr. Andrew VanHook, Professor Emeritus at Holy Cross College, suggested explanations for the influence of dextrans on crystal shape, and showed how the careful control of temperature in crystallizer operations can optimize sugar yields.

A panel discussion on dextrans, moderated by Dr. Clarke, viewed the spectrum of dextran problems from field activities, discussed by Dr. James E. Irvine of the USDA, who explained the nature of *Leuconostoc* infection, to customer problems, including cloudiness in cordials and liqueurs and shrinking of hard candy, discussed by Dr. Graham Vane of Tate & Lyle Ltd. (and presented by Ervin G. Muller of Tate & Lyle). Dr. Milo Matic, Visiting Professor at Audubon Sugar Institute, Louisiana State University, explained the problem of dextrans in raw sugar mills, and pointed out the complex nature of what is referred to as "dextran". H. Richard Priester, Savannah Sugars, discussed the difficulty of removing dextrans in a refinery and the importance of control on incoming raws. Earl J. Roberts, CSRRPI, reviewed current methods of analysis for dextrans and other polysaccharides, and identified the faults of each method.

Several papers were presented by the CSRRPI group on their recent work: Mary An Godshall discussed her elegant techniques for elucidation of flavour and odour compounds in brown sugars and syrups. Special gas-liquid chromatography and mass spectrometry techniques are combined with chemical syntheses and taste panel surveys. Earl J. Roberts recounted his study of colour formation in various stages of sugar boiling, and examined colour connected with turbidity, as regards amounts of colour and molecular weight range of suspended material. Margaret A. Clarke told about the usefulness of high pressure liquid chromatographic techniques to measure sugars, colorants, organic acids and other minor constituents (an area of specialization for CSRRPI) and discussed some very recently developed techniques of special interest to the sugar industry. James P. Devereux, a senior chemical engineering student at L.S.U., working with CSRRPI for the past summer, described his construction of a model vacuum pan to be used in studies of the behaviour of colorant compounds in crystallization.

Dr. Ian Sangster, Director of the Sugar Industry Research Institute of Jamaica, told delegates about the activities of his Institute, from the pilot plant sugar factory and cane derinding separation, with subsequent preparation of particle board, to education of sugar industry workers. John A. Hupfer, of the Commodity

Credit Corporation, USDA, described his studies on pol and moisture changes in raw sugars held in storage by the CCC.

The other key topic at the conference – besides dextran – was changing process technology. Dr. Richard Riffer, of California and Hawaiian Sugar Company, talked about his work on the effect of different compounds as additives and treatments for sugar purification which may lead to entirely new refining processes. Dr. Robert Kunin created great interest with his new idea, the use of powdered ion exchange resins in pressure filters; resins are used on a throw-away basis. This work has been done in consultation with Graver Water Division of Ecodyne Corporation. Dr. Kunin, in a second paper, explained some functions of ion exchange resins by comparing their structure to that of bone char. Dr. Robert W. Walker, of Rohm and Haas Co., told of the success of a two-bed system using strong base resins – acrylic followed by styrene – for sugar liquor decolorization.

Ion exchange technology was a major feature of a symposium, chaired by Raymond Knecht, Colonial Sugars, on experience with decolorization alternatives. Mike Cox, of Huletts Refineries, described operations, including the use of ultrafiltration to treat regenerant solution, in the new ion-exchange system that has recently replaced the char house at Huletts. Howard R. Delaney, of CSR Ltd., talked about his company's Adelaide refinery, where colour removal after carbonatation is by ion-exchange resins alone, and connected some of CSR's research in colorant materials to refinery performance. Thomas N. Pearson, of Imperial Sugars, discussed his company's new granular carbon decolorization station, and pointed out some problems that had arisen – pressure buildup, for one – and their solutions – prior removal of filter aid fines, in that case. R. Stuart Patterson talked about C and H's prospective use of more ion-exchange decolorization, in the light of their current use of bone char, and enumerated some pros and cons of various decolorization techniques and applications.

Everyone gathered at a Banquet on October 20th to enjoy the anecdotes of Master of Ceremonies F. A. Graugnard of Louisiana Sugar Cane Products, and to welcome Dr. Michael C. Bennett of Tate & Lyle Ltd. to his second term as President of CSRRPI. Other officers include Treasurer Joseph A. Metzler, Godchaux–Henderson Co., and Secretary, H. Richard Priester, Savannah Sugars.

Handling low-grade massecuite

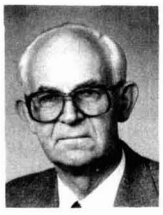
By CHRISTIAN MØLLER (The Danish Sugar Corporation)

Introduction

Yield improvements and throughput limitations make it very important to obtain a minimum purity of the final molasses. The problem is primarily a question of pan boiling and crystallization technique, but a proper adjustment of the massecuite with respect to purity, together with optimal tightening of the massecuite in the low grade pans, have shown great influence on the molasses.

Background

The massecuite going to the low-grade crystallizers should be adjusted to obtain the highest possible crystallization velocity. According to extensive measurements by Grut[1] this may be achieved by keeping an almost constant non-sugar:water ratio throughout the cooling of the massecuite in the crystallizers. Grut found the optimum non-sugar:water ratio to be about 2.8, but recent re-examinations on actual low-grade massecuites have shown a minor increase in the optimum non-sugar:water ratio towards 3.0 in order to obtain the maximum crystallization rate.



C. Møller

However, the non-sugar:water ratio is related to the liquid phase only of the massecuite and is insufficient alone to fix the optimum conditions of the strikes being dropped to the crystallizers. The content of solid sugar in the massecuite throughout its passage from the pans to the centrifugals has also been shown to have an important influence on its handling.

Theory

The non-sugar:water ratio is calculated as shown in equation(a):

$$NS/W = \frac{Bx_{mc} - Pol_{mc}}{100 - Bx_{mc}}$$

$$= \frac{Bx_{mc} - 0.01 \times Bx_{mc} \times Q_{mc}}{100 - Bx_{mc}} \qquad (a)$$

where Bx_{mc} : wt % dry substance in massecuite,
Pol_{mc} : wt % sugar in massecuite,
Q_{mc} : purity of massecuite, and
NS/W : non-sugar:water ratio.

Using this equation, with the above mentioned optimum NS/W = 3.0, we obtain a relation between massecuite dry substance and massecuite purity, as expressed in equation (b):

$$Bx_{mc} = \frac{300}{4 - 0.01 \times Q_{mc}} \qquad (b)$$

Equation (b) is thereby valid for massecuites with optimum crystallization rates.

[1] *Zucker*, 1953, **6**, 412-416.

The sugar content (wt %) in massecuite can be determined from equations (c) and (d):

$$Pol_{mc} = \frac{Q_{mc}}{100} \times Bx_{mc} \qquad (c)$$

$$Pol_{mc} = K + (Bx_{mc} - K) \times \frac{Q_{mol}}{100} \qquad (d)$$

where Q_{mol} : purity of molasses, and
K : wt% solid sugar in massecuite.

From (c) and (d) we derive equation (e):

$$K = \frac{Bx_{mc} \times (Q_{mc} - Q_{mol})}{100 - Q_{mol}} \qquad (e)$$

From equations (b) and (e) we can derive a relationship between massecuite dry substance (Bx_{mc}), massecuite purity (Q_{mc}), molasses purity (Q_{mol}) and the final amount of solid sugar at spinning (K).

With this composition of the massecuite the need for supplementary dilution in the crystallizers is eliminated, and the final result of the low grade work depends on local details such as residence time, cooling efficiency and the possibility of reheating.

Conclusion

If we adjust massecuite purity in the vacuum pans according to preliminary laboratory analysis on samples from the pans followed by appropriate intake of calculated amounts of syrup or molasses, this prevents any dilution in the crystallizers and always gives us smooth and trouble-free low-grade work.

Summary

It is possible to obtain smooth and uncomplicated low-grade work together with a minimum purity of the final molasses. This may be done by adjusting massecuite purity in the vacuum pans by appropriate intake of syrup or molasses.

Table I. Solid sugar (wt %) in massecuite at spinning calculated for different massecuite purities, massecuite dry substances and molasses purities. Non-sugar: water ratio in massecuite = 3.0

Massecuite purity	Massecuite dry substance	Molasses purity						
		58	59	60	61	62	63	64
		Solid sugar % massecuite						
76.0	92.6	39.7	38.4	37.0	35.6	34.1	32.5	30.9
76.5	92.7	40.8	39.6	38.2	36.8	35.4	33.8	32.2
77.0	92.9	42.0	40.8	39.5	38.1	36.7	35.2	33.5
77.5	93.0	43.2	42.0	40.7	39.4	37.9	36.5	34.9
78.0	93.2	44.4	43.2	41.9	40.6	39.2	37.8	36.2
78.5	93.3	45.5	44.4	43.2	41.9	40.5	39.1	37.6
79.0	93.5	46.8	45.6	44.4	43.2	41.8	40.4	39.0
79.5	93.6	47.9	46.8	45.6	44.4	43.1	41.7	40.3
80.0	93.8	49.1	48.0	46.9	45.7	44.4	43.1	41.7
80.5	93.9	50.3	49.2	48.1	47.0	45.7	44.4	43.0
81.0	94.0	51.5	50.4	49.4	48.2	47.0	45.7	44.4
81.5	94.2	52.7	51.7	50.6	49.5	48.3	47.1	45.8
82.0	94.3	53.9	52.9	51.9	50.8	49.6	48.4	47.2

Discussion

How can we obtain smooth and uncomplicated low-grade work? A massecuite containing between about 42 and 47% solid sugar by weight and with a reasonable grain quality is easily spun. The content calculated from equation (e), combined with equation (b) which is valid for optimum crystallization rates, can be used to determine the required conditions. In Table I, the solid sugar content by weight in the massecuite is calculated for different strikes and varying molasses purities.

From the table, we can see that all strikes can give a final percentage of solid sugar between 42 and 47; it is only a question of adjusting the purity of and dry substance in the massecuite at dropping from the vacuum pans. In practice the adjustment must be done with a view to the purity of the final molasses obtained. But it should always be possible to make the adjustment to give resulting values of K between the two broken lines in the table.

Le travail des masses cuites du dernier jet

Il est possible de réaliser un travail aisé et peu compliqué en dernier jet, allant de pair avec une basse pureté des mélasses finales. Ceci peut se faire en ajustant la masse cuite dans les appareils à cuire par une rentrée appropriée d'égout ou de mélasse.

Handhabung von Nachprodukt-Füllmasse

Es ist möglich, eine gute und unkomplizierte Nachproduktarbeit bei gleichzeitig minimaler Reinheit der Endmelassen zu erreichen. Dies kann durch die Einstellung der Füllmassereinheit in den Vakuum-Kochapparaten vermittels eines entsprechenden Einzugs von Sirup oder Melasse erreicht werden.

Manejo de masa cocida de bajo grado

Es posible obtener trabajo suave y no-complicado en bajo grado, junto con una pureza mínima de la melaza final. Esto puede obtenerse por ajuste de la pureza de la masa cocida en los tachos por alimentación con meladura o melaza como apropriada.

SUGAR CANE AGRONOMY

The use of meteorological parameters in determining sugar cane irrigation. P. C. Prasad. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India),* 1976, (1), Ag.113-Ag.124. – The determination of the irrigation requirements of cane on the basis of climatic parameters such as air temperature and solar radiation and of evapotranspiration is discussed with 52 references to the literature. Advantages of the micro-meteorological approach are indicated, and mention is made of the value of the Penman equation for estimating potential evapotranspiration based on a combination of energy and aerodynamic factors[1].

Irrigation of cane in accordance with the characteristics of each zone. R. Vigoa and J. M. Egaña. *ATAC*, 1978, **37**, (5), 4-11 *(Spanish)*. – Central Bolivia's cane area is taken as a typical example of the way reliance on natural rainfall has limited cane supply and consequently sugar outturn to less than the factory's potential capacity. Obstacles to gravity, i.e. furrow, irrigation exist in different zones and a plan was drawn up for expansion of the irrigated area, employing spray irrigation where furrow irrigation could not be used. Over the 1913 ha of three zones, the yield was raised from 56.2 to 76.4 tonnes.ha^{-1}.

Influence of the fertility and structural aggregate size of a red soil on cane productivity. M. Domínguez and M. Fonseca. *ATAC*, 1978, **37**, (5), 47-64 *(Spanish)*. A report is presented on studies in which the development of cane plants was used as the parameter for assessing the effect of granulometry and nutrient status of a Cuban ferralitic clay soil.

Effect of different methods of sugar cane planting on yield and economics of potato, followed by wheat. K. S. Rathi, R. A. Singh and V. P. Singh. *Indian Sugar Crops J.*, 1979, **6**, 29-33. – The effect of different methods of cane planting on the yields of early potato and subsequent late wheat, both grown as intercrops, was investigated as well as on cane yield and juice quality. Most profitable was planting of two cane rows 30 cm apart, with a 90 cm space between the cane and two ridges of potatoes; after lifting of the potatoes, four rows of wheat were planted in the 90-cm skip.

A study on the effect of minimum and maximum temperature on sugar recovery. H. V. L. Bathla and K. Singh. *Indian Sugar Crops J.*, 1979, **6**, 36-37. – Statistical analysis of 11 years' data failed to show any specific trend in the correlation between cane sugar recovery and minimum and maximum temperatures.

The role of soil moisture on the growth and yield of sugar cane under a sub-tropical climate. S. J. Yang. *Taiwan Sugar*, 1979, **26**, 84-93. – The physiological importance of water in the plant is briefly indicated, and the availability of soil water to cane discussed. The effects of soil moisture on cane germination, of moisture stress and excess soil moisture on cane growth, and of soil moisture on cane sugar content are examined, and some recommendations are given on irrigation and drainage to increase cane sugar yield.

A new approach to interplanting maize with sugar cane. D. S. Cheng. *Taiwan Sugar*, 1979, **26**, 95-97. – While the traditional method of maize intercropping has been to plant it in a single line between two cane rows at a seedling distance of 30 cm, a new practice has been tested in which two lines of maize are planted in alternate interrows, at a seedling distance of 25 cm, dwarf vegetable or legume crops being grown in the blank inter-rows. The new practice overcomes the problem with the traditional system of shading the young cane and thus delaying tiller development, while the total maize population is greater by 8-17%. Cane and sugar yields were increased by 3% and 6%, respectively, by comparison with traditional intercropping.

High population stands. C. Richard. *Sugar Bull.*, 1979, **57**, (18), 8-9, 14. – Details are given of practices used by certain Louisiana cane farmers in wide furrow planting as a means of obtaining increased cane yields.

Effect of companion cropping sequences on the yield and quality of sugar cane ratoons. K. S. Rathi and R. A. Singh. *Indian Sugar*, 1979, **29**, 15-18. – Trials are reported in which intercropping with potato followed by onion gave a higher ratoon yield than did cane grown alone, although the cane yield was not markedly different for the different intercrop sequences.

Response of sugar cane to phosphate at higher levels of nitrogen fertilization. J. P. Patil, S. J. Ranadive and D. G. Hapase. *Indian Sugar*, 1979, **29**, 23-26. – In fertilization studies, phosphate applied alone did not have any consistent effect on yield and quality of sugar cane, whereas applied together with nitrogen at a P:N ratio of 1:5 or 2:5 (with N at 250 kg.ha^{-1}) it increased both cane and sugar yield appreciably by comparison with absence of fertilization.

Pre-harvest maturity service in sugar factories of Uttar Pradesh during the 1975-76 season. A. P. Gupta. *Sharkara,* 1976, **15**, (2), 11-24. – See Gupta: *I.S.J.*, 1978, **80**, 206.

Influence of variable manganese on accumulation of nitrogen, phosphorus and potassium in sugar cane. A. P. Gupta and G. S. C. Rao. *Sharkara*, 1976, **15**, (3), 5-11. Co 1148 cane setts were pot-grown in sand culture to which Ca, K, Mg and SO_4 solutions were applied as well as trace elements. Mn was applied in four different quantities. Where no Mn or an insufficient amount was applied, the plants showed symptoms of Mn deficiency within 2½ months. The concentrations of N, P and K were affected by increased Mn applications according to the part of the plant in question (root, stem tissue or elongating leaf blade), the element involved and the level of Mn.

Drip design and equipment update in the Hawaiian sugar industry. R. Eveleth. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 36-38. – Facets of drip irrigation discussed include pre-filtration of the water, chlorination

[1] Proc. Royal Soc. Ser. A., 1948, **193**, 120-146.

as a microbiological control means, application of fertilizers through drip irrigation tubing, accessories for water flow control, and tube flushing. Types of tubing used are indicated, and problems encountered are briefly mentioned, the plugging of tubes being considered the most serious.

Basic cultivation practices in flat culture fields at Hawaiian Commercial & Sugar Company. R. Isa. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 39-40. – Four major operations in conversion of cane fields and former pineapple land to drip irrigation are briefly described: treatment of the soil with calcium silicate (to reduce acidity and raise the silica content) and breaking-up of the lumpy soil after removal of stones and trash and filling-up of old ditches, followed by laying of the drip irrigation tubing; preparation of new land without ploughing; ratooning; and replanting of the fields (manually to make maximum use of the field area).

Preparation practices for drip irrigation at McBryde Sugar Company. J. W. Hosie. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 41-42. – An outline is presented of the practices used at McBryde to prepare fields for planting and drip irrigation tube installation. Problems mentioned include the difficulty of removing clods, and lack of precision in laying tubing between the cane lines in the ratoon fields.

Fertilization, irrigation and ripening in drip irrigation at Olokele Sugar Company. G. H. Wachi. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 43-45. – Almost all of the fertilizer used is in liquid form, and is applied through the drip irrigation tubing (with the exception of the initial application below the setts in the plant cane fields); phosphate is also applied through the system to ratoons. Irrigation scheduling and prediction of sugar yields are based on a summation of water balance on a weekly basis, while historical pan evaporation data are used to calculate the number of days for drying-off before the cane is harvested.

Fertilization, irrigation and ripening with drip irrigation at Oahu Sugar Company. M. Furukawa. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 46-48. – Fertilization via drip irrigation tubing at Oahu is discussed, and aspects of the drip irrigation system used are examined. Ripening intervals are generally shorter with drip than with furrow irrigation (presumably because of a more limited root system). Polaris is applied to as many fields as possible throughout the year, and the cane moisture and nitrogen indices are monitored from about 3 months before harvest; a moisture index of approx. 73% and a nitrogen index of about 1.2 are aimed at.

Fertilization, irrigation control and ripening of drip-irrigated fields. R. Smith. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 49-50. – Details are given of the title operations in Wailuku Sugar Co. cane fields. One problem that drastically affects the performance of the irrigation system is damage to the tubing by ants. While monitoring the sheath moisture levels on a weekly basis 7 months before the expected harvest date has overcome ripening problems, non-uniformity in ripening still occurs because of pinching and plugging of the drip tubing (as well as ant damage) during the ripening period.

Seed cutting at Hawaiian Commercial & Sugar Company. C. T. Fisher. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 51-53. – Details are given of the mechanical harvesting of seed cane at HC & S, and reasons for replacing manual cutting are explained.

Machine *versus* hand-cut seed at The Lihue Plantation Company. J. B. Thomson. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 54-56. – Reasons for changing from mechanical harvesting to manual cutting of seed cane are given, and advantages of the system are listed. The costs of the manual and mechanical schemes are compared.

Water-yield relationships under drip irrigation. W. Gibson. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 60-63. – In an examination of potential evapotranspiration (PE), i.e. the amount of water used by the cane when not under water stress, it is shown that, for full-canopy cane, ET $\simeq$ Pe (where ET = evapotranspiration and Pe = pan evaporation) when furrow or sprinkler irrigation is used; however, with drip irrigation the ET:Pe ratio is apparently lower than unity. The most efficient use of irrigation water is obtained when the crop is grown under water stress, although maximum yield is achieved only when there is no water stress. While water-yield relationships have been fairly well established for cane grown under furrow and sprinkler irrigation, no comparable data are available for drip-irrigated cane, although the amount of effective water applied by drip irrigation may be determined with a good degree of accuracy, unlike the approximations achievable at best with the other forms of irrigation. An excellent correlation has been established between solar radiation and evaporation, and would be an excellent replacement for pan evaporation in estimation of potential evapotranspiration.

Status of control of ant damage to drip irrigation tubing. A. K. Ota and V. Chang. *Rpts. 37th Ann. Rpt. Hawaiian Sugar Tech.*, 1978, 79-82. – While the fire ant, *Solenopsis geminata*, has been the most damaging species as far as irrigation tubing is concerned, it is predominant only in the lower, drier, leeward fields on the islands of Oahu and Maui, whereas the big-headed ant, *Pheidole megacephala*, is dominant in most cane fields of Hawaii, and so potentially poses a greater problem than the fire ant. While Mirex 300 granulated bait has dramatically reduced ant damage, it is non-degradable and is therefore to be phased out of use. A degradable Mirex bait, Ferriamicide, has shown promise, but has yet to be officially recommended because of lack of knowledge on some of its metabolites and breakdown products. Tests with Heptachlor injected through drip irrigation tubing at 0.25 lb.acre^{-1} a.i. has given excellent protection for 3 months. Insecticide barriers around the tubing or at each orifice, where most of the ant damage occurs, need to be applied repeatedly, as none of the potential pesticides remains effective in soil for more than 4 months. Chlorpyrifos has given mixed results, and more work on determining the most suitable dosage rate and retreatment intervals is needed; it is also useful for control of mosquitoes and termites. Pydrin, a synthetic pyrethroid, has given good results, but requires more research. Investigations are also being conducted on development of ant-resistant tubing; organo-tin compounds have shown great promise, but are too toxic, while the resistance imparted by many chemical additives has lasted only a few weeks.

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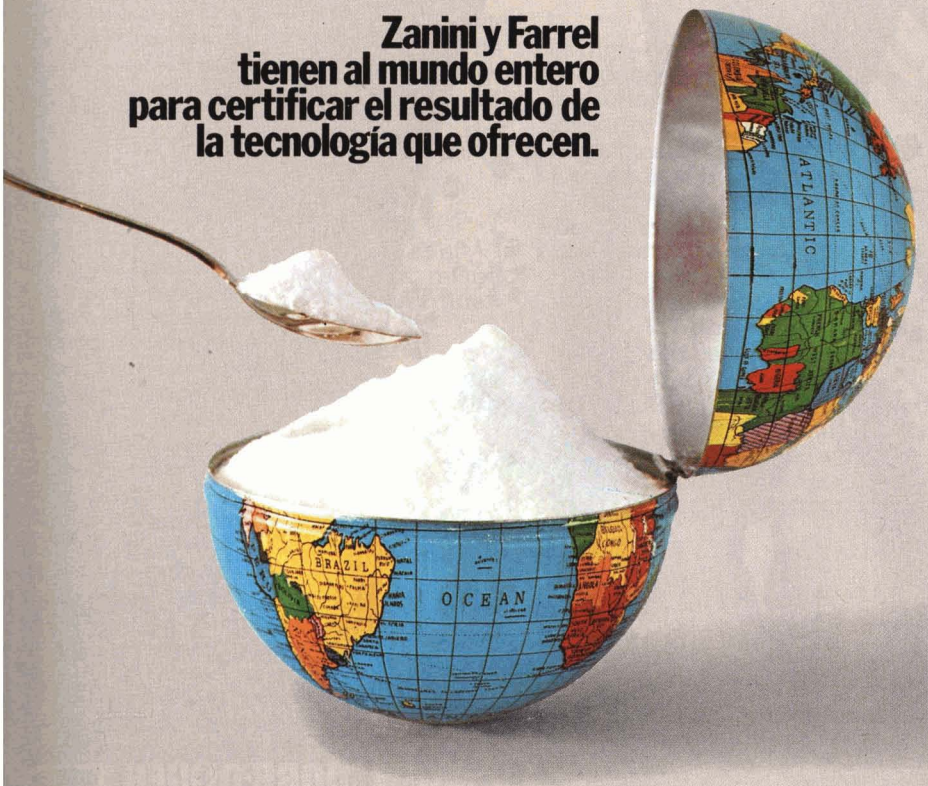

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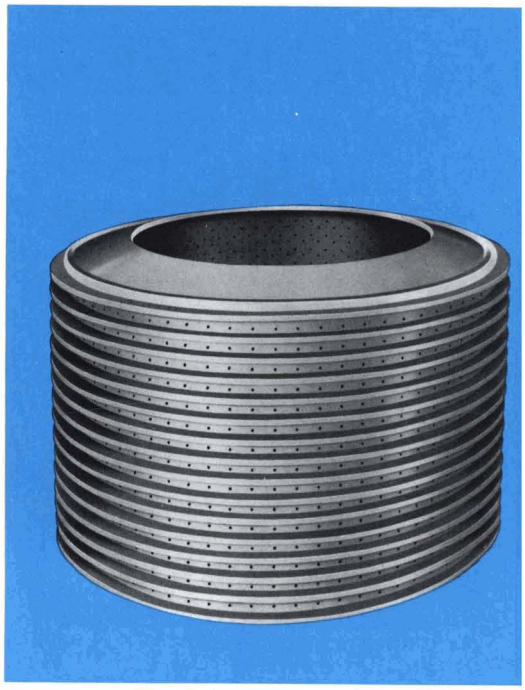

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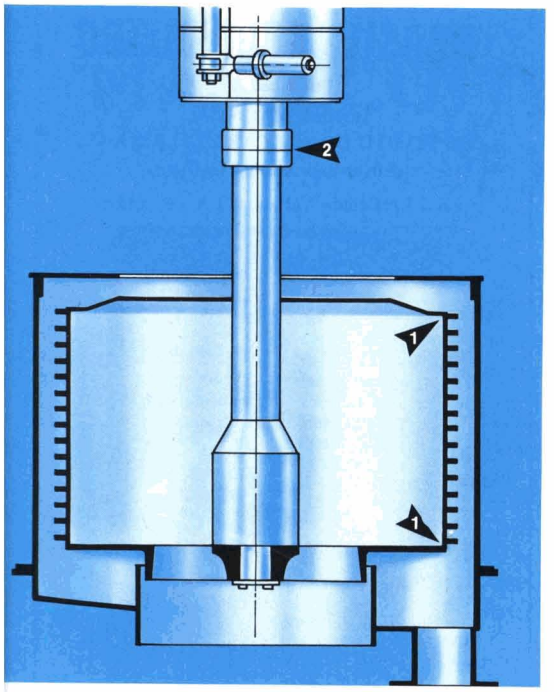

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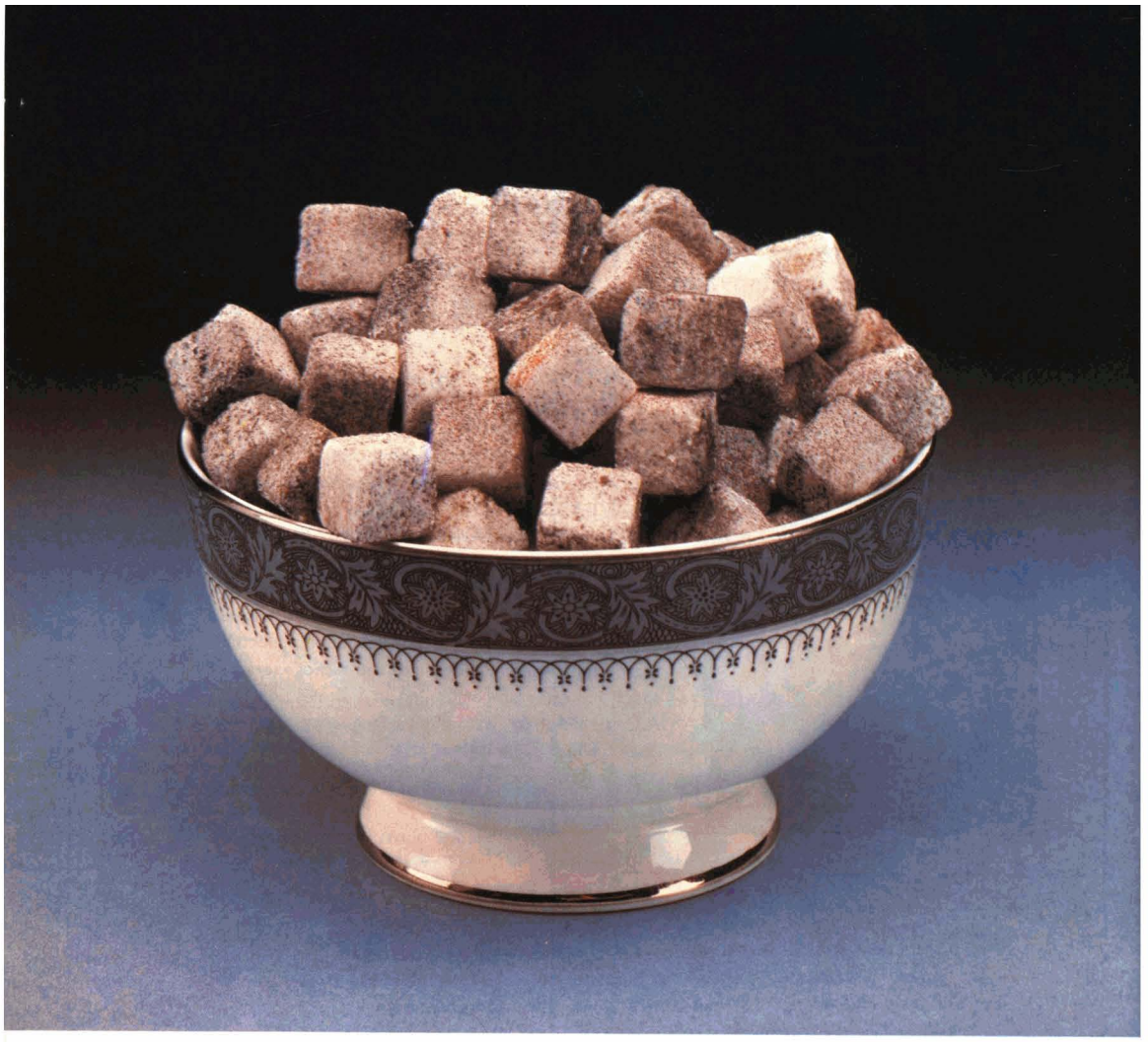

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CANE SUGAR MANUFACTURE

Harvesting and cane quality. W. R. Burgher and K. J. Nix. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 33-39. Results were assembled over two seasons using three makes of harvester, some with single and some double base cutters. Harvested cane was sampled and analysed and the results assessed statistically. Extraneous matter and billet damage lowered average c.c.s. by between 1.1 and 1.4 units. The effects of soil (as ash) are related to fibre. While machine design affects the harvested cane cleanliness and quality, operator technique is of prime importance. The loss of c.c.s. associated with badly cut and dirty cane is estimated to cost the mill at least 3 weeks of operations and to reduce the growers' potential earnings by 10%.

Harvester test – chopper knife life studies. T. G. Fuelling and C. R. Henkel. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 75-79. – A survey was made of billet quality produced using three types of cane harvester in the Tully mill area during 1978. The knives supplied conformed to the life recommended by the manufacturer. The Massey-Ferguson chopper system was superior in supplying a consistent supply of sound billets over the recommended interval; the Claas 1400 system, although similar, produced a lower level of sound billets, and possible reasons are suggested. The Toft 6000 chopper system gave a consistent supply of sound billets for only a small tonnage, but blades are easily changed and this is essential for good quality cane supply.

Cane transport from wet fields. T. G. Fuelling. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 81-87. – A study of the causes of poor ratooning after harvesting in wet weather showed that transport of cane from wet fields does not cause significant compaction, and the cause of crop damage is excess water. Greater compaction occurs in drier soil and is normally removed by cultivation. Continued rain on uncultivated fields causes ponding which harms the ratoon crop and may be minimized by drainage. The practice of slotting with a narrow ripper is effective. Conventional bin trailers have poor flotation and limited wet weather capability, but higher flotation equipment is now available, and against the higher cost must be set the benefits of reduced field damage, improved performance and increased efficiency. The high costs of wages makes the lower labour requirement of tipper bins attractive.

Trash disposal after green cane harvesting. D. R. Ridge, A. P. Hurney and K. J. Chandler. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 89-93. – Experiments at two Experiment Stations showed that there appeared to be no serious agronomic problems in disposing of the residue from green cane harvesting whether by burning, incorporation or retention as a trash blanket. Further work is required to determine long-term effects on cane yields and to refine methods of incorporation and nitrogen application rates. The trash blanket normally dries out quickly after harvest and, from early observation of borer populations, these should be no serious problem, although numbers should continue to be monitored; the army worm is a potential problem.

Electric points drive systems for sugar mill tramways. J. Hayes and C. Forbes. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 249-252. – In view of the time lost (12 minutes) when a train of cane rail cars crosses the Government Railway lines on the way to the factory (45 crossings per 24 hr for deliveries to Racecourse mill), owing to the need for manual points changes, an experiment was made with an electric motor-driven points change unit operated by remote control from the locomotive cab. A description is given of the unit and its operation which proved successful, so that application has been made to Queensland Railways for adoption of an automatic system.

Improved transitions for circular curves in permanent way. R. Mitchell. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 253-258. – A detailed description is given of the formulae and calculations, covering both theoretical and practical considerations, for setting out transitions for circular curves in railway track, and a worked example is provided.

Aspects of track network design. R. Mitchell and T. J. McBride. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 259-266. – A rational method is outlined for the design of leads or turnouts and combinations of these, taking as its basis the fundamental formulae for circular curves. From the basic components of a lead (the switches and the crossing) an optimum lead design is developed and this then simplified to a mathematical model which can be used in designing track networks in general. Examples for both a standard network and a more complicated network are given.

Machinery selection for cane farming. C. R. Henkel. *Australian Canegrower*, 1979, **1**, (2), 50-54. – Factors to be considered in selecting cane harvesting equipment, planting equipment and tractors are listed in the form of questions and answers.

Spiral stone picker is cheap and effective. Anon. *Australian Canegrower*, 1979, **1**, (2), 57-58. – Photographs accompany a description of a home-made tractor-drawn stone picker built by Mr. J. Pelizzari. It takes the form of a 3 m long metal cage having a diameter of 1.8 m at the front end and 0.9 m at the rear. Two spirals inside the cage are made of bar metal. As the cage rotates it scoops up soil and stones (up to the size of a football). A bin at the rear has a capacity of about 1 tonne of stones.

Experience with an Australian automatic billet planter. S. W. D. Baxter. *Rpts. 37th Ann. Conf. Hawaiian Sugar Tech.*, 1978, 128-130. – The development of the Massey-Ferguson MF 50 automatic cane billet planter is described. The author emphasizes the greater need to exercise care in the transport and handling of the seed material than with conventional cutter-planters; indications are that eye damage during chopper-harvesting, transport and planting can be such as to warrant 30-40% more seed material than with conventional planters.

SUGAR BEET AGRONOMY

New herbicides in sugar beet agriculture. J. Kositorna. *Gaz. Cukr.*, 1979, **86**, 93-94 *(Polish)*. – The effectiveness of Ro-Neet 6E presowing herbicide is briefly discussed. The influence of soil moisture on losses of cycloate (its active ingredient) with time is indicated in graph form, and advice is given on optimum application.

The quality of bolted beet from field stands. U. Beiss, K. Bürcky and C. Winner. *Zuckerind.*, 1979, **104**, 283-287 *(German)*. – Investigations in 1971, 1973 and 1977 indicated a lower sugar content, Brix, purity, amino-N and other N fractions in bolted than in non-bolted beet, while the marc, invert sugar, Na and K contents were higher. No significant conclusion could be drawn on press juice purity, but the soluble ash, lime salts and colour contents were higher, after clarification, than in juice from non-bolted beet. The processing quality of early bolters was somewhat lower than of late bolters. A considerable fall in quality occurred in untopped bolters with green stalks intact.

Weeds. W. C. von Kessel. *Die Zuckerrübe*, 1979, **28**, (3), 8-12 *(German)*. – Aspects of weeds examined include: changes that have occurred in the weed flora of West Germany over the last 20 years; the length of time during which seeds remain viable, extending from 3 years for cleavers (*Galium aparine*) to 11 years for charlock (*Sinapis arvensis*); seed production by the most important weeds; the harm weeds cause through competition for water, nutrients and light; beet harvesting problems in fields highly infested with weeds; the costs of control; herbicide price differences between member-countries of the EEC; and precautions needed in chemical control.

Weed control after sugar beet emergence. W. R. Schäufele. *Die Zuckerrübe*, 1979, **28**, (3), 14-16 *(German)*. – Trials on control of weeds and grasses with post-emergence foliar sprays and soil-applied herbicides are reported.

Annual mercury: an upstart. Anon. *Die Zuckerrübe*, 1979, **28**, 17 *(German)*. – Advice is given on chemical control of *Mercurialis annua*, a spurge, which has spread from water-meadows and gardens to beet fields in recent years; a late-grower, it may reach a height of 50-60 cm and can disrupt harvesting.

Dependence of herbicide activity in sugar beet on climate and soil conditions. H. Hack and H. Kirfel. *Die Zuckerrübe*, 1979, **28**, (3), 41-43 *(German)*. – The effects of temperature and of soil type and moisture content on the activity of foliar and soil-applied herbicides are examined.

Field trials with Goltix herbicide in sugar beet agriculture. W. R. Schäufele and C. Winner. *Zuckerind.*, 1979, **104**, 414-418 *(German)*. – Trials conducted during 1975-78 with Goltix pre-sowing and pre- and post-emergence herbicide are reported. The effectiveness of the herbicide against specific weeds is indicated. When applied as a pre-emergence treatment, Goltix did have some adverse effect on beet emergence, early development and final yield, the extent of this effect being governed by the weather conditions.

Tests on prolonged storage of sugar beet in 1977-78. L. Lukács. *Cukoripar*, 1979, **32**, 48-53 *(Hungarian)*. Beets were stored at three locations for 70-80 days in large prismatic piles measuring 44 m long x 20 m wide x 6 m high. Treatment with various fungicides in powder or liquid form had little effect, by comparison with the control, in terms of weight and sugar loss, conductimetric ash, noxious N, resistance to slicing and elasticity modulus. However, tests are continuing to see if there are other fungicides that could have a positive effect.

Biochemical sugar losses during storage. K. Hangyál and R. Lásztity. *Proc. 16th Gen. Assembly CITS*, 1979, 419-429 *(German)*. – The activities of invertase and pectinase and concentrations of invert sugar, mono- and oligosaccharides and lactic acid were determined in stored beet as a function of storage period, irrigation and nitrogen fertilization. While the agronomic factors were found to affect the biochemical sugar losses, there was no statistically significant correlation between induced changes in the factors and values of the parameters under investigation, probably because of considerable scatter. Hence, the agronomic factors were to be varied to a greater extent during the next growth period.

Sugar beet storage technology and the more important factors during the pre-storage period. G. Szabó. *Cukoripar*, 1979, **32**, 1-5, 41-47, 81-87 *(Hungarian)*. Agronomic factors affecting beet size, sugar content and yield are examined, and sugar distribution in the root and effect of topping on field recovery and storage losses and properties discussed. The optimum period of storage under Hungarian conditions whereby processing quality does not fall appreciably and losses are minimal is indicated, and ideal piling conditions and the equipment used for beet yard work are described.

Trials on chemical control of wild oats in sugar beet. K. Posch. *Cukoripar*, 1979, **32**, 87-90 *(Hungarian)*. Trials are reported in which a number of herbicide combinations were compared for their effectiveness against wild oats *(Avena fatua)*. Best results, in terms of % destruction of the weed and low level of toxicity toward beet, were given by Pyramin + Avadex BW at 4.3 + 3.5 $kg.ha^{-1}$ and Betanal + NP-48 at 5.0 + 1.5 $kg.ha^{-1}$.

New production technology – theory and practice of mechanization. T. Karwowski. *Gaz. Cukr.*, 1979, **87**, 113-116 *(Polish)*. – Aspects of modern beet agronomy, whereby beet is planted to final stand, are described, including seedbed preparation, precision drilling, cultivation and harvesting.

Effect of irrigation on sugar beet yield and quality. W. Kosieradzki. *Gaz. Cukr.*, 1979, **87**, 119-120 *(Polish)*. Advice is given on optimization of irrigation and fertilization of beet so as to obtain maximum sugar yield; the recommendations are based on results from East Germany.

Weed beet. A. Vigoureux. *Le Betteravier*, 1979, **13**, (132), 11-12 *(French)*. – By means of a series of six photographs, the author explains the best approach to the problem of bolted beet elimination.

Beet agricultural research in France. *Compte Rendu Inst. Tech. Franç. Betterave Industrielle*, 1978, 219 pp *(French)*. – The work is divided into five sections: (i) spring work, covering seedbed preparation, application of Temik nematicide by micro-granulator (laboratory tests showing that irregularity in distribution was a result of conglomeration caused by atmospheric moisture, so that drying of the granules is necessary before application), and elimination of bolted beet; (2) chemical weed control; (3) control of beet pests and diseases, particularly virus yellows and powdery mildew; (4) agronomy, including varietal trials, nutrient investigations (particularly of nitrogen and trace elements), and irrigation trials; and (5) harvesting, covering equipment, the effect of precision seed drilling, comparative tests on loader-harvesters provided with cleaning systems, and beet cleaners.

Trials on soil with stepwise N supply for determination of the optimum nitrogen application for sugar beet. A. von Müller, I. Feyerabend and C. Winner. *Zuckerind.*, 1979, **104**, 485-495 *(German)*. – The nitrate-N content in the soil was determined and compared with N uptake by beet in field tests in which N had been applied in a stepped pattern. N applied in the previous autumn or winter did not undergo any noticeable loss in the various profile depths by the time of its determination in the following spring. There was no difference between N already present in the soil and applied as fertilizer, as regards effect on beet yield and quality. Measurements down to a depth of 90 cm provided a useful basis for a balance between N supply and uptake. In the first year of the 2-year tests, N in the topsoil seemed of greater importance than that in the lower layers. At the test site, 200 $kg.ha^{-1}$ was the average total N requirement, i.e. applied + soil N, at the 4-leaf stage; additional application in summer made up the extra amount required up to harvest. Where the beets grew in fields which had been left fallow and received inadequate applied N, they took up more from the soil than would be expected from the nitrate-N accumulation in the top 90 cm, indicating that the N was being extracted from the lower layers.

Measures for increasing sugar beet production in 1979. Z. Stanescu and G. Cloţan. *Cer. Plante Tehn., Prod. Veg.*, 1979, **31**, (3), 8-16 *(Rumanian)*. – Recommendations are given on all major aspects of beet agronomy whereby an average yield of more than 30 $tonnes.ha^{-1}$ might be obtained in Rumania.

Main elements of sugar beet agronomy under irrigation conditions in the Burnas plain. G. Ştefan and O. Ştefan. *Cer. Plante Tehn., Prod. Veg.*, 1979, **31**, (5), 18-24 *(Rumanian)*. – From results for 1976-78 in this southern area of Rumania , recommendations are given on variety, fertilization, planting density, herbicides, treatment against leaf spot and optimum irrigation.

Irrigation. Anon. *Die Zuckerrübe*, 1979, **28**, (4), 14 *(German)*. – Beet irrigation is briefly discussed, particularly the most suitable time of first and last application, field capacity (availability of water to the crop) as a function of soil type and properties, and relative amount of water to apply (which should allow for a 25% reserve in the soil after the crop needs have been satisfied).

Catch crop cultivation – agronomic necessity or luxury? B. Märländer. *Die Zuckerrübe*, 1979, **28**, (4), 16-17 *(German)*. – The advantage of a catch crop as source of organic matter and as a means of improving the soil texture for the subsequent beet crop is discussed and suitable crops are listed. The effects on beet and sugar yield are examined.

Lime – an important fertilizer in sugar beet farming. Anon. *Die Zuckerrübe*, 1979, **28**, (4), 18-19 *(German)*. The value of lime as both fertilizer and soil improver is discussed and forms available are listed. The effects of various fertilizers on the soil lime content are indicated.

Costs of sugar beet transport. W. Gehlen. *Die Zuckerrübe*, 1979, **28**, (4), 20-21 *(German)*. – Beet transport costs are discussed in terms of system, distance from field to factory and effective unit capacity under West German conditions.

Technical aspects of beet transport. E. Dohne. *Die Zuckerrübe*, 1979, **28**, (4), 22-27 *(German)*. – Various aspects of beet transport are examined, including conformity with road traffic regulations as regards brakes and lighting, tractor power, trailer design and construction, loading and field track load-bearing capacities and widths.

Thoughts on agricultural transport technology. H. J. Laeske. *Die Zuckerrübe*, 1979, **28**, (4), 28-29 *(German)*. The capacities of beet trailer "trains" are discussed, and reference made to a 2-trailer system having a total capacity of 25 tonnes of beet.

Straw and green manure – humus supply in the autumn. Anon. *Die Zuckerrübe*, 1979, **28**, (4), 34-35 *(German)*. Advice is given on straw incorporation and growing of green manure as source of organic matter for the beet crop.

The weed beet menace. *British Sugar Beet Rev.*, 1979, **47**, (2), 5-7, 9-14, 16. – With the help of photographs, various authors discuss the problem of beet bolters and in some cases describe the methods which they have used in an effort to eliminate them. Advice is offered on suitable means of tackling what is described as the biggest single problem facing many beet growers.

Soil acidity. The need for a systematic approach to liming. P. Draycott and A. Messem. *British Sugar Beet Rev.*, 1979, **47**, (2), 21-23. – It is stated that there are still many cases of poor beet growth resulting from a soil pH in the acid range (symptoms generally appearing on mineral soils at $<$ pH 5.8). Symptoms of beet sensitivity to acid are briefly described, and advice is given on measurement of soil pH and on time of application, quantity and form of lime to add to the soil sufficient to bring the pH to 7.

The role of Broom's Barn in research and education. K. Scott and P. Draycott. *British Sugar Beet Rev.*, 1979, **47**, (2), 47-51. – Information is provided on the work carried out at Broom's Barn in beet research, for which the farm was specifically developed as a department of Rothamsted Experimental Station.

Wild beet. A. Vigoureux. *Le Betteravier*, 1979, **13**, (133), 13, 16 *(French)*. – With the aid of photographs, the author describes how best to eliminate bolted beet and shows the stages in which weed beet infest a beet field.

CANE SUGAR MANUFACTURE

Working difficulties of a lime kiln and their remedies. V. P. Yadav. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.1-M.4. – See *I.S.J.*, 1978, **80**, 275.

Studies in primary extraction. A. C. Chatterjee and S. S. Thakur. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.5-M.8. – See *I.S.J.*, 1978, **80**, 275.

Basic boiling house recovery with ideal clarification factor. H. T. Patel. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.9-M.12. – See *I.S.J.*, 1978, **80**, 275.

The performance of Walkonti 8/34° continuous machines on curing of low-grade massecuite. N. N. Joshi, G. G. Singh and P. K. Aren. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.13-M.30. – See *I.S.J.*, 1978, **80**, 276.

C-massecuite boiling, conditioning and curing. I. B. L. Mittal. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.31-M.42. – See *I.S.J.*, 1978, **80**, 276.

Steam utilization in white sugar manufacture. T. T. Oommen. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.47-M.60. – Comparison is made between various quadruple-effect and quintuple-effect evaporation systems, whereby it is shown by calculations, which assume an hourly crushing rate of 100 tonnes of cane, that the latter system with vapour bleeding for pan boiling and juice heating is the best as regards factory steam usage. A steam consumption of 42% on cane is considered possible using the system in a factory of 2500 tcd capacity.

Effective utilization of continuous cooling of A, B and C massecuites in crystallizers. M. Anand, V. B. Bagal and S. K. Kulkarni. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.61-M.72. – See *I.S.J.*, 1978, **80**, 275.

Evaluation of flocculating agents in cane juice clarification. A. C. Chatterjee, S. R. Kalaswad, B. R. Math and V. B. Taware. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.79-M.87. – See *I.S.J.*, 1978, **80**, 246.

Effluents and environmental pollution of a sugar factory. A. C. Chatterjee, B. M. Dutt, S. R. Kalaswad, B. R. Math and V. K. Kelkar. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.89-M.102. Means of effluent treatment are briefly examined and experiments reported in which a colourless, odourless liquid of pH 7.6-8.8 and BOD of 49-96 ppm was obtained by means of oxidation ditches and aerators.

Maxochlor (a viscosity reducer). R. Sivaraman. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.125-M.131. – See *I.S.J.*, 1979, **81**, 52.

How to control the inventory of stores and spares in the sugar industry. R. L. Srivastava. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.21–G.27. – See *I.S.J.*, 1978, **80**, 276.

Enzymatic removal of starch from sugar house products. S. Mukherjee, S. Bose, K. C. Gupta and L. Singh. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.29-G.38. – See *I.S.J.*, 1978, **80**, *276.*

Towards a better quality of sugar – a challenge to be met. B. N. Rao and K. S. R. Rao. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.111-G.118. – See *I.S.J.*, 1978, **80**, 276.

Working of a new integral condenser at Sri Chamundeswari Sugars Ltd., Kalamuddana Doddi, Maddur TK, Mandy Dist., Karnataka. K. K. Menon, A. V. Vallabh, V. L. Rajagopal, P. N. Bhakthavatsalu and D. B. S. Naidu. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.1-E.8. – See *I.S.J.*, 1978, **80**, 247.

A simple method for determining optimum imbibition for lesser pol and moisture in bagasse. T. K. V. Rao. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.9-E.12. – See *I.S.J.*, 1978, **80**, 274.

A useful device for vacuum improvement in the central vacuum system. S. C. Sharma, B. C. Jain and S. N. S. Gupta. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.13-E.23. – See *I.S.J.*, 1978, **80**, 274.

Assessment of cane preparation. S. S. Thakur. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.25-E.32. – See *I.S.J.*, 1978, **80**, 247.

Predrying of bagasse in the sugar factory and its impact on fuel and steam consumption. B. B. Paul. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.33-E.39. – See *I.S.J.*, 1978, **80**, 274.

Modifications made in the design of a vacuum filter and improvement achieved thereby in New Horizon Sugar Mills Private Ltd., Pondicherry, during the season 1974-75. II. L. C. Banerji. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.41-E.43. See *I.S.J.*, 1978, **80**, 274.

Automatic signalling of leveller overloading in sugar factories. R. C. Sharma and R. P. Sharma. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.45-E.49. – See *I.S.J.*, 1978, **80**, 274.

Improved drainage without cush cush fall. B. M. Tiwari. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), E.51-E.53. – See *I.S.J.*, 1978, **80**, 275.

An estimation of loss on account of agola (cane tops) supplied along with the cane. M. K. Sanghi, K. M. Gupta and K. P. Mittal. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), Ag.23-Ag.26. – See *I.S.J.*, 1978, **80**, 274.

BEET SUGAR MANUFACTURE

Results of tests on low-grade yellow sugar treatment in centrifugals at Pochapintsy sugar factory. N. I. Odorod'ko A. P. Kozyavkin, L. D. Bobrovnik, G. K. Gorskii and V. A. Maistruk. *Sakhar. Prom.*, 1979, (6), 23-28 *(Russian)*. – The practice widely used in the USSR of affining low-grade yellow sugar by mingling with dilute *A* raw syrup in a scroll-type mixer, followed later by removal of the molasses and washing of the crystals in centrifugals, was found to be less efficient than affination in centrifugals, a technique which raised sugar yield by 0.02-0.03% on beet, as well as improving sugar quality and sugar house performance. Results of tests are tabulated.

Calculation and designing of basic centrifugal slicer elements. A. M. Shcherbakov and V. G. Belik. *Sakhar. Prom.*, 1979, (6), 28-31 *(Russian)*. – Formulae are presented for calculation of total power rating, throat radius and number of knife frames for a given throughput, and a worked example is appended.

The PSS-15 fluidized-bed dryer/cooler with re-use of heat carrier. S. I. Temper, N. I. Baranik and V. I. Gorobets. *Sakhar. Prom.*, 1979, (6), 31-34 *(Russian)*. Details are given of a fluidized-bed unit in which the sugar passes through four horizontal chambers in series, direct flow of sugar and hot air taking place in the first two chambers, while counter-current flow occurs in the last two; the sugar entering the unit is first tossed by a rocking grid arrangement which prevents lumping. Passage to adjacent chambers is via an aperture in the bottom of each partition. The hot air from the fourth chamber is recirculated to the third chamber, while that from the second and third chambers passes via a wet dust separator to the atmosphere. Dimensions and rated performance are given for the unit, which is also compared with two other Soviet-built fluidized-bed dryers and found to consume less power per tonne of dried sugar while yielding sugar that is no wetter nor warmer than with the better of the two standard models.

Sucrose crystallization in massecuite mixers without water drinks. I. G. Bazhal, L. I. Trebin, V. A. Mikhailik, O. I. Mazur and Yu. D. Rekeda. *Pishch. Prom.*, 1978, **24**, 7-12 *(Russian)*. – Since, it is argued, addition of 1.5% by weight of water to massecuite to improve its curing properties (standard practice in the USSR) dissolves some sugar and thus increases molasses losses by typically 3.55% on massecuite weight, tests were conducted with a model crystallizer in which the artificial massecuite was subjected, during cooling from 80 to 40°C, to temperature fluctuations, whereby the temperature was raised by 20-25°C once or twice per hour in order to dissolve fine crystals, and the massecuite then allowed to cool until the next temperature "shock". At the same initial massecuite crystal content and initial and final temperatures, the system gave larger crystals than the normal method with water addition. Factory-scale tests with low-grade massecuite confirmed the laboratory tests, reducing molasses yield by 4%, its purity by 1.5 units and sugar content by 0.12% on weight of beet.

Molasses desugaring by means of dicalcium saccharate. A. A. Gerasimenko, Z. B. Shaposhnikova, L. M. Khomichak and A. B. Petrushanskaya. *Pishch. Prom.*, 1978, **24**, 12-14 *(Russian)*. – While it was found in tests with pure sugar solutions, that a sugar recovery of 96.6% was possible by precipitation as tricalcium saccharate, the amount of lime added to effect precipitation was 7.3 moles per mole of sucrose, i.e. 4.3 moles more than the theoretical. In order to reduce the amount of lime used, tests were conducted with 6% sugar solutions to fractions of which lime was added in a 2:1 molar ratio to sugar at 3-4°C with 35 minutes' constant stirring. Unreacted lime was filtered off and ethyl alcohol added 1:1 to the cold filtrate during 15 minutes' stirring. The resultant dicalcium saccharate precipitate was dissolved in water and gassed with CO_2 to give a sugar recovery of approx. 94.6%. For a lime: sugar ratio of 2:1 necessary for dicalcium saccharate formation, more than 3 moles of lime per mole of sugar is required; however, this leads to formation of tricalcium saccharate, which is filtered off together with the unreacted lime, so that sugar losses are increased. Hence, subsequent tests were conducted without filtering off the precipitate, the alcohol being added straight after the lime treatment. At a molasses sugar content of 13.5%, addition of alcohol in a 1:1 ratio to sugar gave a recovery of 90.5% at a lime:sucrose molar ratio of 3:1, and 92.4% of the initial content at a 4:1 ratio.

The Gryllus effect. J. Ponant. *Sucr. Franç.*, 1979, **120**, 263-267, 311 *(French)*. – The "Gryllus effect" is defined as the combination of a shallower slope of the saturation curve with a lower temperature for low-grade massecuite curing as a result of thin juice treatment by ion exchange resin which is then regenerated with *B* raw syrup (containing alkaline ions) so as to avoid addition of Na^+ ions. The author examines mathematically the effect of the Na^+ ion on molasses saturation coefficient and viscosity, and shows how the Gryllus process gives increased molasses exhaustion and hence higher sugar recovery by comparison with juice ion exchange treatment where the resin is regenerated with brine.

Thin juice decolorization. H. Zaorska. *Gaz. Cukr.*, 1979, **87**, 125-127 *(Polish)*. – Tests are reported in which thin juice, thick juice or melt was treated at 90°C with active carbon at 1.5% on Brix in a series of four columns. Spent carbon was regenerated at approx. 500°C in an electric kiln[1]. Average decolorization efficiency was 88% for the melt, 57.7% for thick juice and 60.1% for thin juice, slight purity rises being recorded in all cases. Thin juice should be treated in preference to thick juice, since (on a Brix basis) double the amount can be treated in the same given time.

Automatic charging of a massecuite distribution trough. A. V. Popov and P. A. Khotynenko. *Sakhar. Prom.*, 1979, (7), 28-29 *(Russian)*. – A system for automatic filling of a massecuite distributor, that incorporates a float-type level control, is described.

Equalization of an evaporator. I. J. Řádek. *Listy Cukr.*, 1979, **95**, 131-135 *(Czech)*. – See Řádek & Valter: *I.S.J.*, 1980, **82**, 382.

[1] Zagrodzki *et al.*: *I.S.J.*, 1979, **81**, 314.

NEW BOOKS

Sugar cane diseases in South Africa. 24 pp; 22.2 x 28.4 cm. (The Experiment Station of the South African Sugar Association, P.O. Mount Edgecombe, South Africa 4300.) 1980.

Bulletin No. 9 (revised) is another of the excellent bulletins published by the SASA Experiment Station and is a magnificent reference work on cane diseases found not only in South Africa but also in other cane-growing industries. The diseases covered are: ratoon stunting disease, smut, mosaic, leaf scald, rust, red rot, pineapple disease, basal stem rot, gumming, pokkah boeng, sheath rot, brown spot, ring spot, chlorotic streak, streak, eye spot, *Sclerophthora macrospora* and Fiji disease. Also included are non-pathogenic disorders such as frost damage, ratoon chlorosis (caused by iron deficiency), banded chlorosis, mite injury, sooty mould, lightning damage, hail damage, herbicide injury and chlorotic leaf markings. For each malady, a colour photograph is presented which clearly illustrates the symptoms, although it is stressed that symptoms and disorders can vary considerably, and that the full range of possible symptoms cannot always be illustrated or described, while not all symptoms of a particular disease may be evident in the field; also given are cause, importance, description of symptoms, spread and control plus notes (usually referring to susceptible varieties). The arrangement of the data, clarity of print and lucid explanations make this a most valuable addition to the literature on cane diseases.

The efficient use of steam. Ed. P. M. Goodall. 469 pp; 16.5 x 23.8 cm. (IPC Science & Technology Press, Guildford, England.) 1980. Price: £25.00.

The famous book of the same title written by Oliver Lyle has been out of print for some time and, having been written more than 30 years ago, it had become somewhat dated as a consequence of the changes in equipment and methods since 1947. This new book is not an updated version of Lyle's work; it has been completely re-written and in a much more severe style than the original, while SI units have been used throughout. The General Editor is an engineer of great experience in plant design, construction and maintenance and he has led a team of 30 authors (including W. M. Lanyon of the British Sugar Corporation and J. E. Somner of Tate & Lyle Ltd.), guided by a distinguished Editorial Planning Committee and Advisory Board together representing most of the main professional bodies concerned with steam use in the UK. The book has been produced with the support and cooperation of the Institution of Mechanical Engineers and the Department of Energy of the British government, as well as numerous industrial firms and institutions.

It provides as much as possible of the information that an industrial steam engineer or designer would want concerning safe and cost-effective steam usage and is particularly aimed at engineers operating in the middle range of industrial power, up to about 100 MW. It will undoubtedly prove to be essential reading for all plant and process engineers using steam for heating and power production and should become part of the normal sugar factory library.

Sugarcane crop insurance. A. R. B. Amerasinghe. 30 pp; 21.0 x 29.8 cm. 1979.

This paper is a presentation by the author, Fiji's Commissioner of Insurance, to outline the nature of the hazards facing the cane farmer in Fiji, on the scope and limitations of the commercial and State insurance schemes available and to discuss a proposal for a crop insurance scheme to protect farmers from losses arising through hurricane, flood, drought, fire, pest and disease.

The irrigated sugar cane in India. S. C. Srivastava and D. P. Johari. 75 pp; 18.3 x 24.4 cm (Indian Institute of Sugarcane Research, Lucknow, India 226002.) 1979.

An International Commission on irrigation has been collecting information on a world-wide basis on the water requirements of different crops. As a contribution to providing such information for their own country and for a major crop in it, the All-India Coordinated Research Project on Sugarcane was set up and prepared a questionnaire to secure the necessary knowledge. The authors have prepared an account of sugar cane irrigation in India based on replies to the questionnaire and on background information from the literature. With a country as vast as India, cane growing conditions, geography and climate vary widely from state to state and this is demonstrated by the different degrees of importance of irrigation in cane cultivation, e.g. zero in Assam and 100% in Karnataka. This quite small paperback book collects a great deal of information on yields and irrigated areas in the various states and discusses the agro-climatic zones of the country, varieties grown and the effect of irrigation on them, land preparation for irrigation, irrigation methods, water control techniques, drainage, weed and pest control in irrigated cane, diseases, soil and fertilizer management, water requirements, etc. Suggestions are made for lines of investigations which the authors consider worthwhile in order to achieve improvements, while the whole work provides a solid basis on which Indian cane specialists can establish practices to optimize sugar cane growing and water utilization.

Planalsucar Relatório Anual 1978. N. A. da Glória. 98 pp; 22.5 x 27.0 cm (Instituto do Açúcar e do Álcool, Rio de Janeiro, Brazil.) 1979.

This is a very well printed report, with numerous illustrations, many in colour and with captions in Portuguese and English, of the activities of the National Sugar Cane Improvement Program (Programa Nacional de Melhoramento da Cana de Açúcar, or Planalsucar) during 1978. Because of the interval between the period covered and the present time it is strange to read in the introduction by the General Superintendent about the two facts which characterized the year – the aggravation of the world energy problem – still with us – and the continued surplus of sugar on the world market – now a matter of history. The Program thus devoted considerable effort to support of the Brazilian government's emphasis on alcohol production on a basis of sugar cane. But, in addition to setting up four new cane experiment stations, a great deal of research was carried out on cane breeding and genetics, pathology, entomology, cane nutrition and fertilization, agroclimatology, irrigation and drainage, weed science and physiology, cane

agricultural operations such as planting methods and soil tillage, etc., the setting-up of analytical centres, an information centre and training of technicians. Details are described in Portuguese with an English summary.

Análisis ecotaxonómico de los nematodos de la caña de azúcar *Saccharum* sp. (hibrido) en Cuba. (Ecotaxonomic analysis of the nematodes of *Saccharum* sp. sugar cane hybrids in Cuba.) J. P. O'Relly L. 63 pp; 21.0 x 29.7 cm (Instituto de Investigaciones de la Caña de Azúcar, Academía de Ciencias de Cuba, La Habana, Cuba.) 1979.

This work is the bound copy of a thesis presented by the author as part of the requirements for a doctorate in agricultural sciences. The first chapter is an introduction, with an edaphic and climatic description of the island of Cuba, and is followed by a bibliographic summary of previous studies on nematodes in sugar cane soils, in Cuba and also in other countries. Materials and methods used in the author's study are then described and then the results, including identification of 194 species including nine hitherto unknown. Population dynamics are studied, and a chapter devoted to the parasitic nematodes and phytohelminthosis of sugar cane. The last chapter discusses methods of combating these pests. A bibliography of 125 references is provided.

The world sugar economy. An econometric analysis of long-term developments. J. de Vries. 97 pp; 21.0 x 29.7 cm. (F. O. Licht GmbH, P. O. Box 1220, D-2418 Ratzeburg, Germany.) 1980.

This work, published as one of F. O. Licht's International Sugar Report series, describes an econometric model of the world sugar economy which is used to project sugar supply and demand and sugar prices and to simulate the impact of different sugar policies. The model was based on data available up to October 1979, and makes allowances for many of the complicating factors such as the variability of consumption elasticity between different countries and in the same country at different price levels. Population trends are assumed to follow the projections of the UN.

Consumption is expected to increase to 102 million tonnes in 1985 and 115 million tonnes in 1990, with more than 70% of the increase in developing countries and centrally planned Asia. Production is expected to increase at about the same average rate but more irregularly as a result of the price investment cycle. The share of developing countries is thought likely to increase also but to a lesser degree than consumption. The price of raw sugar is predicted from the model to rise during 1980 (in fact by less than the actual rise) with further increases to 1982, followed by a decline in 1983 and 1984 and a low price in 1985. The considerable width of the price ranges (e.g. 7 – 24 cents/lb at 1980 prices for 1985) shows the volatility of world sugar prices.

Sugarcane crop logging and crop control:Principles and practices. Harry F. Clements. 520 pp;20.3 x 23.4 cm. (Pitman Publishing Ltd., 39 Parker St., London, England.) 1980. Price: £16.00.

The late Dr. Harry F. Clements, who died in 1979, was Senior Professor of Botany and Senior Plant Physiologist at the University of Hawaii. In addition to this academic background he was closely involved with the practicalities of cane growing and served as a consultant to most of the Hawaiian sugar companies as well as others in other parts of the world. He developed his system, known as crop logging, over a period of 30 years and its application in Hawaii and elsewhere has been instrumental in increasing yield and optimizing the utilization of nutrients and water in many plantations. Basically, his scheme is to use the growing plant itself as an indicator of the nutritional status, and much of the research involved has been in the identification of tissues to sample and analyse, and the interpretation of the analytical data obtained. This new book provides a very detailed account of the development and use of such a log as well as a thorough basis of cane botany, descriptions of vegetative propagation and cane planting and germination. Factors affecting the growth of cane are discussed, with reference to the author's experience in Hawaii, and specific and detailed accounts given of physiological and agronomic functions of water, carbon dioxide, nitrogen, potassium, phosphorus and calcium, with lesser treatments of the effects of sulphur, magnesium, boron and other trace elements.

At present-day prices, the cost of this book would be recouped if, with its aid, sugar production could be increased by approx. 50 kg.

Official methods of analysis of the Association of Official Analytical Chemists. Ed. William Horwitz. 1018 pp;21.0 x 27.8 cm. (Association of Official Analytical Chemists, P. O. Box 540, Benjamin Franklin Station, Washington, DC 20044, USA.) 1980. Price:$78.00.

The Association of Official Agricultural Chemists was founded in 1884 and published its first volume of analytical methods in 1920. The current edition is the 13th and the third since the Association changed its name. It includes 175 new methods which have won approval by the system of refereed testing over a period, while 83 methods have been deleted or replaced. The rate of approval of new methods is lower than for the more recent earlier editions and reflects the growing complexity and investment of resources for modern techniques and equipment. The methods cover a wide range of products, including agricultural liming materials, fertilizers, plants, disinfectants, pesticides, etc., while the section of most interest to our readers is that on sugars and sugar products which occupies only 31 pages of the book. Of this section more than half is devoted to sugars and syrups, molasses and molasses products, and sugar beets, and the text is virtually unchanged from the 12th edition, although the measurement of solids by refractometry has received an introduction, and details are no longer included of the Folin & Wu micro method for dextrose determination in sugars and syrups. A small misprint renders acetic acid as HAOc beneath Table 31.01.

The book has been completely reset in a modern type face and a larger page size. It is curious to see that, while certain pressures have been given in terms of Pascals, not only does the book ignore the SI system, it introduces L as an abbreviation for litre in place of the usual l used in the 12th edition. It is also startling to the reviewer to see "thoroughly" spelt as "thoroly". One new technique, the Association's first collaboratively studied mass spectrometric method, has been developed for the detection of adulteration of honey with high fructose corn syrup; apparently corn syrups from a monocotyledonous plant have a distinctly different $^{13}C:^{12}C$ ratio from that of syrups from most dicotyledonous plants which are the source of most honeys.

LABORATORY STUDIES

Effect of calcium lactate on sucrose degradation. S. Z. Ivanov, Z. A. Mil'kova and Z. K. Roshchupkina. *Izv. Vuzov, Pishch. Tekh.*, 1979, (2), 37-39 *(Russian)*. Laboratory studies of the effect of calcium lactate on sucrose hydrolysis in a boiling water bath showed that the lactate, when first formed by addition of lactic acid to a sucrose solution adjusted to pH 8.5 with lime, caused a sharp fall in pH by comparison with the level in a heated pure sucrose solution and a higher decomposition rate. However, in the case of hydrated lactate the pH did not fall as much, and the initial catalytic effect on degradation of sucrose became an inhibitory one. Hydration also reduced the catalytic effect of the lactate on reducing matter and colour.

Determination of various carbohydrates using an enzyme electrode. I. Sucrose determination. H. Weise, F. Scheller, K. Siegler and D. Pfeiffer. *Lebensmittelind.*, 1979, **26**, 206-208 *(German)*. – For measurement of the oxygen consumed in oxidation of dextrose by glucose oxidase, a special system was used which comprised a pO_2 rod-type measuring cell immersed in electrolyte. Below the cell was a polyethylene membrane permeable to oxygen but not to dextrose or the enzyme, while an outer membrane was permeable to oxygen and dextrose but not the enzyme; a slide carrying the enzyme was inserted between the two membranes immediately below the cell. Dextrose injected into the system diffused into the enzyme layer, and linearity of the current-time relationship was established for dextrose additions up to 0.9 mg per 100 cm^3. The glucose oxidase specifically oxidizes α-D-dextrose, whereas sucrose can be determined only via the β-D-form, conversion to which is brought about by mutarotase. Investigations of the possibility of using the current-time curve showed linearity up to 4 mg sucrose per 100 cm^3, in which case the use of mutarotase was unnecessary.

The chemical composition of sugar beet from the 1978 crop. W. Drewnowska, A. Butwilowicz and J. Wysocka. *Gaz. Cukr.*, 1979, **87**, 102-104 *(Polish)*. – Tabulated details are given of the chemical composition of 15 varieties of beet sampled on September 1 and October 10, 1978, and representing five farms. Comparison is also made between ratios of sugar to specific non-sugars for both dates in each year from 1974 to 1978 inclusive.

Studies on acid formation and elimination in technical sugar juices. I. Formation and detection of saccharinic acids. E. Reinefeld, K. M. Bliesener, P. Kowitz-Freynhagen and E. Brandes. *Zuckerind.*, 1979, **104**, 504-510 *(German)*. – Details are given of a gas-liquid chromatographic method used to determine non-volatile acids, formed by invert sugar degradation under the effect of lime, as well as saccharinic acids in juices. Model solutions containing levulose of known concentration were limed and heated. At a levulose concentration of 0.1%, lactic acid was the main product formed, while glycolic, glycerinic, 2,4-dihydroxybutyric and glucosaccharinic acids were found as well as pentosaccharinic, isosaccharinic and metasaccharinic acids. With increase in levulose concentration to 0.5%, glucosaccharinic acids formed the next most important group after lactic acid. Injection of oxygen as well as lime at 20 and 40°C resulted in the formation of glycolic and arabonic acids as the main products with glycerinic and erythronic acids as secondary products, while lactic and saccharinic acids were present only in trace quantities; with increase in temperature, lactic acid became the main component, followed by arabonic acid. In the presence of formalin, the major acids formed under the effect of lime were lactic, 2,4-dihydroxybutyric and 2-methylglycerinic acids. Under conditions of juice purification, addition of formalin gave mostly lactic acid, followed by hexosaccharinic acids and 2,4-dihydroxybutyric acid. Heating a slightly alkaline levulose solution at 100°C for 4 hours gave mostly glycolic acid, followed by metasaccharinic acids and lactic acid. The same treatment of thick juice gave pyrrolidone carboxylic acid as the chief acid formed, followed by glycolic and metasaccharinic acids.

A note on the solubility of sucrose in water. A VanHook. *Zuckerind.*, 1979, **104**, 511-512. – See *I.S.J.*, 1979, **81**, 134.

Determination of mannose in final molasses. N. Romero and M. Enriquez. *Revista ICIDCA*, 1978, **12**, (1), 33-45 *(Spanish)*. – A technique is described for determination of mannose by separation from cane molasses by paper chromatography using 72:20:23 ethyl acetate: pyridine:saturated sodium acetate for development, followed by quantitative measurement by the Nelson-Somogyi method. Reproducibility was found to be 94% and precision 97%. Amounts in molasses from two years averaged 0.57% (15 samples) and 0.66% (6 samples).

The estimation of lithium in massecuite samples using an atomic emission technique. M. B. Haysom. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 147-150. – Defects in other methods are discussed and a recommended method is described. A 4.0 ± 0.1 g sample of massecuite or molasses containing less than 10 ppm of Li is weighed into a 150 cm^3 beaker and the actual sample weight recorded. The sample is dissolved in 40 cm^3 of warm distilled water, transferred to a 100 cm^3 volumetric flask, 2.2 cm^3 of a 4.4% oxalic acid solution added and the solution made up to volume before being well mixed. A precipitate of Ca oxalate settles out on standing 25-30 min; this is re-suspended by shaking and the solution centrifuged at 2000 rpm for 10 min. The supernatant is decanted and analysed for Li by the automated atomic emission system. The Li content is read from a standard curve and corrected for the initial sample weight. The technique is suitable for measurement of low concentrations, the S.D. being 0.01 ppm at concentrations of up to 5 ppm Li.

On-line detection of dextran in cane juice. I. An enzymatic technique. P. F. Greenfield and G. L. Geronimos. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 151-156. – The standard "haze test" for determining dextran does not lend itself to on-line detection as would be required for automatic monitoring and control, and work has been carried out on another method[1] where two streams, one treated with dextranase enzyme, are used and the difference between capillary

[1] Geronimos & Greenfield: *I.S.J.*, 1978, **80**, 67-72.

pressure determined as a measure of dextran concentration. The system is shown to be practical, and a prototype instrument is to be built. Work is also being done on a calorimetric method in which the heat of reaction between dextran and enzyme is measured.

Grain size determination in low-grade sugar. R. J. Swindells and E. T. White. *Proc. Australian Soc. Sugar Cane Tech.*, 1979, 231-237. – Selection criteria and sizing methods for crystal size distribution measurement are surveyed, and a simple, reliable and relatively inexpensive technique described. This involves removal of the molasses from the crystal, by mixing with golden syrup and sugar-saturated water, and centrifugalling in a laboratory machine, followed by washing with sugar-saturated aqueous methanol solutions of increasing methanol content and finally with *iso*-propanol. The crystals are stored in a sealed container under *iso*-propanol until a wet sieving can be carried out with *iso*-propanol as the liquid carrier for the crystal suspension.

The effect of mono- and oligosaccharides on the results of polarimetric measurements in quantitative determination of sucrose. H. Gruszecka and E. Waleriańczyk. *Gaz. Cukr.*, 1979, **87**, 121-124 *(Polish)*. – The effects of non-sucrose sugars on the pol value of pressed beet juice as well as intermediate factory products, sugar and molasses, were determined. The concentrations of the sugars were determined by gas-liquid chromatography. Tabulated results indicate the errors caused by arabinose, galactose, dextrose, levulose and raffinose, the extent of the error depending on the quality of beet and of the specific product.

Determination of nitrogen in sugar products. S. Rydel. *Gaz. Cukr.*, 1979, **87**, 128-130 *(Polish)*. – Details are given of various commercial systems (and the methods used) for determination of Kjeldahl and total nitrogen in sugar factory products, and their merits and demerits discussed.

The potential of liquid chromatography for the analysis of sugar cane. J. Wong-Chong and F. A. Martin. *Sugar J.*, 1979, **41**, (12), 22-25. – Details are given of a high-pressure liquid chromatographic method used for separation of cane juice sugars on Aminex Q150S resin in K^+ form and for sucrose determination in juice of three quality grades (fresh, moderately deteriorated and badly deteriorated). Comparison with polarimetric measurement gave correlation coefficients ranging from 0.97 on the day of best agreement to 0.76 on day of poorest agreement, the overall coefficient for a 27-day period being 0.91 (under ideal harvesting conditions). Comparison between HPLC values and pol values at various sampling points in a factory showed greatest disagreement where the product was of low purity such as in the case of molasses. It is concluded that for high-purity products HPLC is no more accurate than polarimetric measurement, whereas for low-purity products the chromatographic method is clearly more accurate.

Topography of the chemical composition of the sugar beet root. III. Topochemistry of the root according to its anatomical structure. J. Zahradníček, M. Ondráček and O. Šebíková. *Listy Cukr.*, 1979, **95**, 121-130 *(Czech)*. – The topographical distribution of sucrose, α-amino-N and ash was examined in two beet varieties which were divided, according to the arrangement of the vascular bundles, into 52 zones (AJ Poly) and 51 zones (Dobrovická A). The lowest sugar content in both varieties was found in the middle section of the epicotyl and at sites where the vascular bundles of the youngest leaves emerge in the crown. In the hypocotyl, the lowest sugar content occurred in the hypodermis, while the highest content was found in the middle sections. The maximum sugar content in the entire root was found in the middle part of AJ Poly but in the upper part of the root in the case of Dobrovická A. A negative correlation was found between the sucrose content and non-sugars content. The spacial distribution of α-amino-N was less regular than for sucrose and ash.

Residual juice purity determination by using a Rapi-Pol extractor. P. F. Jain and B. D. Sidnale. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.73-M.78. – See *I.S.J.*, 1978, **80**, 283.

The role of EDTA in the sugar industry (analytical aspect). R. Sivaraman and S. C. Ray. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.105-M.122. – The use of EDTA as organic reagent for determining total hardness of water, zinc in condensate, boiler scale, Ca, Mg and Fe in limestone, CaO in sugar factory products, sulphate in water and juice, and total lead in basic lead subacetate is discussed, and details are given of the analytical procedures used. Also mentioned is the possible use of EDTA as low-grade massecuite additive to increase molasses exhaustion.

Study of starch in sugar and intermediate products. A. C. Chatterjee, S. R. Kalaswad and B. R. Math. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.9-G.19. – See *I.S.J.*, 1978, **80**, 252.

Hydros and sulphur dioxide as reducing and bleaching agents for colouring matter present in sugars. S. K. D. Agarwal, L. P. Tiwari, P. C. Joharry and S. K. Gupta. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.97-G.110. – See *I.S.J.*, 1978, **80**, 283.

Fundamentals for improving molasses exhaustion. E. Reinefeld, A. Emmerich, N. Fantar and M. Gerlach. *Zuckerind.*, 1979, **104**, 599-608 *(German)*. – See *I.S.J.*, 1980, **82**, 348.

Determination of turbidity in sugar industry products. A. Rodríguez, M. V. Peña, E. L. Ramos and J. A. Cremata. *ATAC*, 1978, **37**, (5), 26-37 *(Spanish)*. – The colloid content of mixed juice and other factory products has been measured by comparison of the transmittancy of filtered and unfiltered juice or where the colloids are removed by dialysis, and a method has been tested which uses separation by chromatography on Sephadex G-200. The colour and colloid fractions are well separated when the Separan is eluted with 14% sugar solution and the method is applicable to juices, syrups, molasses and raw sugar. It is precise, reproducible and thus suitable for routine control.

Graphico-analytical determination of sugar components in boiling schemes. O. Bia. *Ind. Sacc. Ital.*, 1979, **72**, 61-68 *(Italian)*. – The Hattink method of representing boiling schemes is explained and illustrated by three examples. Based on Cartesian coordinates and vectors representing constant dry solids but varying sugar:non-sugar ratios, and so having different angles of slope from the origin to the coordinate, the method is a rapid means of establishing a boiling house balance by making use of computers to calculate the variables.

BY-PRODUCTS

Effluent treatment of molasses-based fermentation wastes. H. Skogman. *Process Biochem.*, 1979, **14**, (1), 5-6, 25; through *S.I.A.*, 1979, **41**, Abs. 79-527. – Stages and features of the Anamet process for the treatment of vinasse and other food industry effluents are described. A decrease in BOD of > 99% has been achieved.

Kinetic study of the prehydrolysis of (sugar cane) pith. I and II. R. López P. *Rev. CENIC, Ciencias Fisicas* (Cuba), 1976, **7**, (2), 193-206, 207-220; through *S.I.A.*, 1979, **41**, Abs. 79-550. – Reducing sugars formation and pentosan degradation were monitored during hydrolysis of cane pith in unstirred batch and stirred semi-batch reactors at various temperatures and H_2SO_4 concentrations C_S; most of the tests used 5-10% H_2SO_4 at 75-90°C, or ⩾ 1% H_2SO_4 at 120-140°C. Kinetic parameters were calculated, assuming simultaneous rapid and slow degradation of hemicelluloses *A* and *B*, respectively, to the same soluble oligosaccharides, followed by formation and degradation of monosaccharides. Rate constants *k* were found to the various stages, and parameters in their respective Scholler equations $k = HC_S^M e^{-E/RT}$ were deduced. Graphs obtained for degradation of bagasse and of pith at 80°C in 16% H_2SO_4 were approx. identical.

Study of the kinetics of chemical prehydrolysis of bagasse with concentrated acids. R. López P. *Rev. CENIC, Ciencias Fisicas* (Cuba), 1976, **7**, (2), 221-234; through *S.I.A.*, 1979, **41**, Abs. 79-551. – Bagasse samples from two seasons were dry-depithed, milled to various particle sizes, then hydrolysed in factorial-planned experiments with 16-66% H_2SO_4 at 40-80°C or with 2.285N or 5.08N HNO_3 at 60-80°C; xylose degradation by these acids was measured at 80 or 93°C. Parameters *H, M* and *E* (see preceding abstract) were found for hydrolysis of both types of pentosan in each acid, and for xylose in H_2SO_4; at 93°C, HNO_3 caramelized xylose, making analyses impossible. Results show that from the viewpoint of obtaining xylose for fermentation, high concentration and probably low temperature are favourable. Most or all of the lignin in bagasse dissolved in HNO_3, causing darkening and making analysis for reducing sugars difficult; this is a disadvantage from the fermentation viewpoint, but the lignin elimination could be of great value in producing cellulose, paper and microbial protein. In hydrolysis of bagasse with H_2SO_4, furfural % reducing substances gradually increased with time but remained below the acceptable limit for fermentation under workable conditions.

Laboratory production of fungal protein on cane bagasse. T. J. B. de Menezes, L. A. Duchini and I. B. Figueiredo. *Rev. Brasil. Tecn.*, 1976, **7**, (4), 439-446; through *S.I.A.*, 1979, **41**, Abs. 79-553. – Nine cellulolytic fungal strains were incubated at 30°C for four days on a medium of stated composition including 5 g comminuted bagasse/litre; the best protein yield was obtained with *Myrothecium verrucaria*; prior treatment of bagasse with 4% NaOH (2 cm^3/g dry bagasse) at 121°C for 10 min increased the protein % biomass from 7.7% to approx. 15% (compared with 46% on a dextrose substrate). In these conditions, 77.7% of the initial cellulose content was digested, and the protein yield was 28.2% on cellulose consumed. The average hourly productivity slightly exceeded 1 mg protein/g bagasse if the bagasse concentration was 5-10 $g.litre^{-1}$, but was approx. 0.9 $mg.g^{-1}$, for 2.5 or 15 $g.litre^{-1}$; 20 g bagasse/litre gave 16.5 mg protein/hr. The amino-acid composition of the protein is tabulated and briefly discussed. Inclusion of 10 g $(NH_4)_2HPO_4$ and 10 mg $Na_2S_2O_3$/litre in the basic medium increased the biomass yield but decreased the cellulose consumption and protein content of biomass.

Studies on bagasse storage. I. Deterioration of bagasse during storage and quality of bagasse particle boards. H. Nakasone and K. Oda. *Wood Ind.* (Japan), 1976, **31**, (3), 104-107; through *S.I.A.*, 1979, **41**, Abs. 79-705. Bagasse from milling and diffusion was stored (a) at constant temperatures of 20, 40 and 60°C for 12 months, (b) in the open air for 8 months. In the bagasse stored at constant temperature, the fibre length, cellulose content and pH progressively decreased, while the material extractable by 1% NaOH progressively increased. Particle boards were made each month from bagasse stored in the open air; the bending strength was fairly constant until the bagasse had been stored for 4-5 months, after which it rapidly decreased. Diffuser bagasse deteriorated faster than mill bagasse as measured by each of the above properties.

Utilization of cellulosic wastes. T. Kausar, B. A. Mahmud and F. H. Shah. *Pak. J. Sci. Ind. Res.*, 1976, **19**, (1), 36-38; through *S.I.A.*, 1979, **41**, Abs. 79-708. – The effects of various treatments of bagasse on the release of sugars during extraction with water, acid or alkali were studied. Reducing the bagasse particle size from 60 to 120 mesh, dry heating at 125°C or soaking in 2N HCl for up to 2 hours led to some increase in the concentration of sugars, which was 0.6 mg per g for the untreated bagasse. Maximum release of sugars, 282 $mg.g^{-1}$, was obtained by preheating the bagasse at 125°C and refluxing for 40 min.

Relationship between deformation of dried beet pulp and pressing parameters. V. P. Borodyanskii, V. L. Kegeles and V. I. Sentsov. *Izv. Vuzov, Pishch. Tekh.*, 1979, (2), 107-109 *(Russian)*. – From experiments with beet pulp, mathematical expressions have been derived for calculating the various types of deformation that take place with pressing as functions of applied pressure, moisture content and temperature. For minimization of the after-effect of elasticity and reduction of power costs, the pulp should be pressed at 40-60°C.

Tests on solvent extraction of citric acid from fermentation solutions. S. Kamiński and M. Kutermankiewicz. *Gaz. Cukr.*, 1979, **87**, 107-108 *(Polish)*. – Laboratory tests are reported on solvent extraction of citric acid. Results showed that none of the three organic solvents used (ethyl acetate, cyclohexanone and tri-*n*-butyl phosphate) was to be recommended because of inadequate yields, complex apparatus and considerable difficulties which would arise on a production scale. High solvent losses would result from volatility and

vacuum distillation (necessitated by the high b.p. of the solvent), while organic compounds extracted with the citric acid inhibit crystallization. Adequately pure citric acid can be readily extracted with chlorinated solvents. More suitable for extraction than fermentation liquors of high impurity content was 3rd crystallization run-off.

Sugar cane bagasse: a potential source of energy for ruminants. A. P. Deshmukh. *Maharashtra Sugar*, 1979, **4**, (6), 53. – Bagasse treatment for use as animal fodder is briefly described.

Technology of beet pulp pelleting. M. Todini. *Ind. Sacc. Ital.*, 1979, **72**, 33-40 *(Italian)*. – The advantages of pelleted pulp, e.g. convenience of nutriment addition, smaller volume for the same weight, easier handling, are discussed, and types of plant described with notes on the mathematics of the process, horizontal and rotary presses, cooling and drying of pellets and types of coolers.

Turbidity and filtrability in viscose from bagasse dissolving pulp. G. Aguilar and M. Fontanies. *Revista ICIDCA*, 1978, **12**, (1), 18-32 *(Spanish)*. – Measurements of filtrability and turbidity were made on viscose prepared from bagasse dissolving pulp with variation between two levels each of four variables. The results were processed by computer and showed that filtrability was strongly influenced by the amount of carbon disulphide used in xanthation and by the concentration of caustic soda used for steeping. Turbidity increased with the cellulose content in the viscose. The degree of polymerization of the pulp influenced both as the result of interaction with the cellulose in viscosity and caustic soda concentration, respectively. The inverse relationship between filtrability and turbidity for the two cellulose levels is illustrated in graphs.

Do pulp dryers need to recycle flue gases? R. Gontier and J. C. Giorgi. *Sucr. Franç.*, 1979, **120**, 231-237 *(French)*. – From examination of various beet pulp drying parameters and calculated values of heat consumption at various flue gas temperatures and a constant pulp equilibrium relative humidity, it is found that, if a dryer is operated at its rated charge or above, flue gas recycling can provide considerable fuel savings. On the other hand, if the dryer is operated at below its rated throughput, the fuel saving would be very small, as demonstrated by practical results, although it must be remembered that the amount of water to be evaporated will be smaller with the smaller charge, so that there is already some energy saving to be added to the small amount resulting from flue gas recycling.

Pressed pulp ensilage. J. P. Vandergeten and R. Vanstallen. *Le Betteravier*, 1979, **13**, (132), 9-11 *(French)*. Recommendations, based on examination of large numbers of samples taken on alternate days in the first month from each of 15 selected sites (plus four samples taken when the silage was opened up), are given on optimum ensilage of pressed beet pulp.

Control of foam and scale in the alcohol industry. M. L. Pulido, M. A. Massey and V. Ferrer. *Sugar y Azúcar*, 1979, **74**, (4), 21-25. – The formation of foam and scale during alcohol manufacture from cane molasses or juice is discussed and information given on Buckman Laboratories products suitable for dealing with the problem: Busperse 48 and Busperse 53P defoamers which also have anti-foaming properties, and Busperse 49 scale inhibitor.

Microbial protein produced from bagasse pith. III. Production of SCP (single cell protein) on a pilot plant scale. M. C. Hsie. *Rpt. Taiwan Sugar Research Inst.*, 1978, (82), 41 - 47 *(Chinese)*. – Investigations were conducted on batch culture of *Cellulomonas* T-582 in a 14-litre stirred fermenter and a 400-litre stainless steel fermenter. The effects of oxygen transfer rate and bagasse pith concentration were studied; it appeared that the specific growth rate and yield constant were unchanged at an oxygen transfer rate greater than 3.8 min^{-1} but fell with increase in pith concentration. The protein content of the product from which the undigested pith was not removed was 26%. Maximum crude protein yield was 5.32 $g.litre^{-1}$ where the substrate contained 3% bagasse pith (w/v) pre-treated with 2% NaOH. Protein productivity was 126.7 x 10^3 $g.litre^{-1}.hr^{-1}$ under these conditions.

Studies on the fermentative production of L-lysine. I. Induction and isolation of L-lysine-producing mutants. Y. T. Liu. *Rpt. Taiwan Sugar Research Institute*, 1979, (83), 51-67 *(Chinese)*. – Details are given of experiments on production of lysine-producing mutants from *Corynebacterium glutamicum* ATCC 13032, *Brevibacterium flavum* ATCC 15168 and a new glutamic acid-producing B strain. Treatment of *C.glutamicum* with N-methyl-N-nitro-N-nitrosoguanidine (NTG) gave a number of mutants of which only the homoserine mutants of 52- 4 H161 and H162 accumulated any appreciable level of lysine (9 mg L-lysine.HCl per cm^3 of medium). Treatment of the new isolated B strain with NTG gave homoserine mutants, of which several strains accumulated over 25 mg lysine.HCl per cm^3, valine being produced as main by-product. Treatment of these strains again with NTG gave a number of strains that produced no valine or other amino-acid as by-product in a molasses medium, and accumulated up to 20 mg lysine.HCl per cm^3. Fermentation tests yielded 32.7% lysine.HCl on total sugar (39% on sugar consumed).

Fermentation improved by phosflotation. A. C. Chatterjee and B. M. Dutt. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), M.43-M.46. – Brief reference is made to an experiment in which the alcohol yield from molasses was increased by aeration and addition of 100 ppm 10% phosphoric acid to the wort, under otherwise identical conditions of fermentation.

Recovery of wax from press mud. B. S. Rao, M. V. Joglekar, P. M. Mathakari and S. M. Unune. *Proc. 27th Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1976, (1), G.1-G.8. – Of various organic solvents used to recover cane wax from filter cake, turpentine proved the most suitable. In laboratory experiments, 100 g of filter cake was mixed with turpentine at 100°C in a 1:7 ratio and stirred for 1 hour. The extract was then decanted, centrifuged and distilled. Recovery ranged from 9 to 11% according to filter cake source. Purification of the wax, using (1) HNO_3 with or without HCl, (ii) H_2O_2, (iii) potassium chromate with HCl and HNO_3, and (iv) potassium dichromate with H_2SO_4, was tested, and results are given for each treatment.

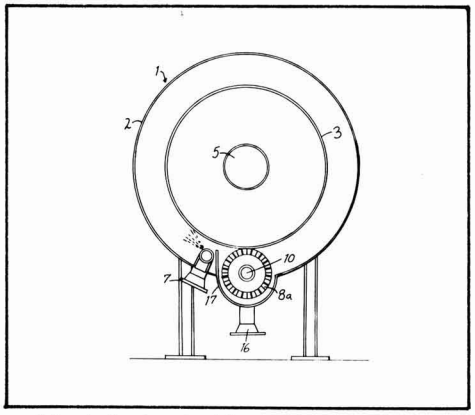
PATENTS

UNITED STATES

Alanine derivatives as sugar cane ripeners. R. W. A. Leach, of Sittingbourne, England, *assr.* Shell Oil Company. **4,056,385.** November 16, 1976; November 1, 1977. – Ripening of sugar cane is effected by application to the growing plant of an N-benzoyl-N-(3-chlorophenyl)-2-aminopropionic acid or its C_1 – C_6 alkyl ester or alkali metal, alkaline earth metal, ammonium or alkyl-substituted ammonium salt, where the chlorophenyl group is also substituted in the 4 position with Cl or F.

Beet pulp catcher. H. Sanxer, S. Matusch and U. Hemminghaus, of Braunschweig, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **4,056,475.** July 21, 1972; November 1, 1977.

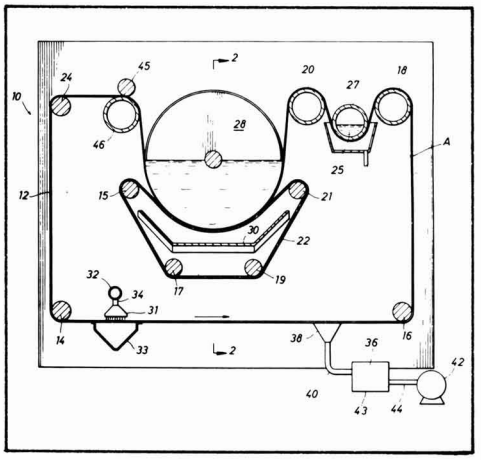
Within the cylindrical housing 2, a perforated drum 3 with closed ends is located and supported by an axial stud arm which passes through a seal and bearing in the side wall of the housing 2 and is connected to a drive mechanism, and at the other end by a hollow shaft 5 communicating with the interior of the drum which passes through a sealed bearing in the other end wall of the housing and is connected to a juice removal pipe.



Juice to be de-pulped is admitted through nozzle 7 and passes into the interior of drum 3, pulp collecting on the outer surface of the drum. It is removed by the action of a helical brush 8a mounted on a shaft 10 within the housing which also passes through seals in flexible connexions to the end walls of the housing so that the shaft ends and so the brush may be spring loaded against the surface of the drum 3. The spiral brush is contra-rotated and removes pulp from the drum, conveying it to the discharge pipe 16. A separation wall 17 prevents fresh juice/pulp mixture creating a current in the region of the brush. An alternative form uses a brush roller without a spiral form and this removes pulp from the drum, while a third longitudinal shaft carries a screw which carries the falling pulp towards the discharge pipe 16.

Continuous belt filter. A. C. Kracklauer, of Conroe, TX, USA, *assr.* Sparkler Mfg. Co. **4,057,437.** June 9, 1976; November 8, 1977.

The filter 10 employs an endless filter belt 12 stretched in any convenient way around a series of rollers such as those shown as 14, 16, 18 and 24 one of which may be driven. A precoating slurry is maintained in tank 25 and precoats the belt as it passes over roller 27. The belt passes over two solid wheels mounted on a central shaft and thus defines a filter chamber 28 below which is a trough 30. Fresh liquid is introduced into chamber 28 and filtrate passes through the belt into the trough from which it is led out of the filter. The belt passes between a compression roller 45 and a vacuum roller 46 which draws juice out of the cake on the belt and so out of the filter.



Cake is removed from the belt by means of a blast of compressed air, delivered through blower 31 from a compressed air source 32 through line 34, and the cake is collected in hopper 33. The surface of the belt is then cleaned by a vacuum collector head 38 and solids deposited in vessel 36. The belt then continues back to the precoating device. In this chamber 25 may also be formed by the belt itself passing over two spaced discs in the same way as the filter chamber 28. A vacuum roller 20, similar to roller 46, may be located between the precoat and filter chambers to ensure that loose precoat particles are sucked onto the roller and are not likely to be sloughed off into the filtrate. A highly porous backing belt 22 is also provided which is carried on the rollers 15, 17, 19 and 21 and supports the filter belt 12 where it forms the filter chamber 28.

Beet diffuser. W. Dietzel and S. Matusch, of Braunschweig, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **4,058,410.** February 25, 1977; November 15, 1977.

Between the scroll sections 11 mounted on the central shaft 3 of a tower diffuser are baffles 40 which are stationary to cooperate with the sections 11 and

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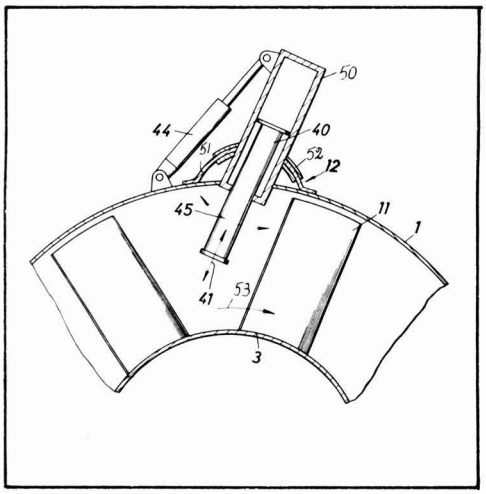
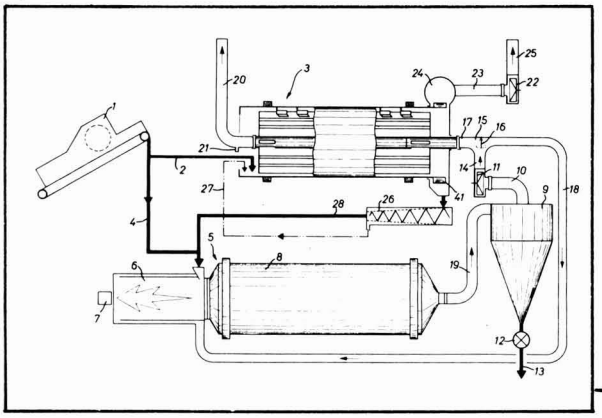


ensure transport of cossettes in the tower. The baffles may be circular, elliptical or of aerofoil section and are adjustable by means of hydraulic cylinder 44 to vary their angle with the radius of the tower, i.e. movement in the direction of arrows 45. The extent to which the baffle projects into the tower, i.e. in direction 41, is also adjustable hydraulically and the baffle itself may be in the form of a number of concentric telescopic portions each of which may be adjusted by separate hydraulic pressure units.

Beet pulp dryer. W. Kunz, of Lenzburg, Switzerland, *assr.* W. Kunz AG. **4,058,634.** March 31, 1976; November 15, 1977.

Pulp from conveyor 1 is delivered by transport device 2 to a pre-dryer 3 or by another transport device 4 to the main dryer 5. Exhaust air from the main dryer enters the pre-dryer over stub 17 into a centre tube which is fitted with a baffle so that the air is directed outwards through slots in the pipe into heating elements within the interior of the pre-dryer drum. This rotates, carrying the wet pulp towards the other end, being partly dried during its passage. The cooled exhaust gas leaves the pre-dryer by passage into further slots in the other end of the central shaft and so passes into discharge duct 20, while fresh air introduced with the wet pulp is discharged by the action of fan 22.



The pulp falls into collector 24 and is transferred to a press 26. Liquid expressed from the pulp is returned through line 27 to the entry of the pre-dryer while the pressed pulp is mixed with fresh pulp and delivered to the main dryer 5. This possesses an oven 6 having a heating device 7 and includes a rotating drum 8 through which the pulp passes co-current with the hot gases. The mixture is carried through conduit 19 to a cyclone 9 where the dried pulp is separated and discharged through valve 12. The exhaust gases are withdrawn by means of fan 11 via conduit 10 and, depending on the position of vane 16, is directed either into pre-dryer 3 or back along conduit 18 to the feed side of the main dryer.

Production of dextran isomerase. J. L. Meeers, of Stockton-on-Tees, *assr.* Imperial Chemical Industries Ltd. **4,059,489.** July 11, 1975; November 22, 1977. – See UK Patent 1,492,258[1].

Selective herbicide for sugar cane. A. W. Evans, of Memphis, TN, USA, *assr.* E. I. Du Pont de Nemours and Co. **4,060,404.** August 9, 1976; November 29, 1977. Undesired vegetation in cane crops is prevented and controlled without damage to the crop by pre- or post-emergence application of an effective amount [0.25 – 4.0 (0.5 – 1.0) kg.ha^{-1}] of 1-methyl-3-cyclohexyl-6-dimethylamino-*s*-triazine-2,4 (1H,3H)-dione.

Dextrose isomerization. M. E. Long, of Winston-Salem, NC, USA, *assr.* R. J. Reynolds Tobacco Co. **4,060,456.** October 14, 1975; November 29, 1977. – Microbial cell material (from *Arthrobacter* or *Streptomyces* spp.), having a dextrose-isomerizing enzyme associated with it, is subjected to flocculating conditions [treatment with 0.5 – 5.0% of a (cationic and/or anionic) polyelectrolyte flocculating agent] to produce a flocculated aggregate (of 10 – 30 mesh particle size when dry), and the material dried (to < 15% moisture) and sieved. A dextrose solution is partly isomerized to levulose by passing it through a bed of the aggregates at 50-90°C and pH 6-10.

Preparation and use of dextrose isomerase. C. K. Lee, of Winston-Salem, NC, USA, *assr.* R. J. Reynolds Tobacco Co. **4,061,539.** October 20, 1976; December 6, 1977. *Flavobacterium arborescens* (ATCC 4358, NRRL B-11022, B-11023) is cultivated in a nutrient medium under suitable conditions for production of the dextrose isomerase, the enzyme recovered, and brought into contact with a dextrose solution (at 45 – 90°C and pH 6 – 10) to convert dextrose to levulose.

Beet molasses sugar recovery. R. Pieck, of Tienen, Belgium, *assr.* Raffinerie Tirlemontoise. **4,062,695.** May 7, 1976; December 13, 1977. – Diluted molasses is treated with quicklime and cooled to precipitate Ca saccharate. The suspension

[1] *I.S.J.*, 1980, **82**, 353.

is filtered and the filtrate heated to precipitate more Ca saccharate. For this purpose one or more surface heat exchangers in contact with part of the hot limed molasses are used to bring its temperature to such a level that, when added to the cool filtrate, the temperature of the latter is raised to the desired level where Ca saccharate is completely precipitated.

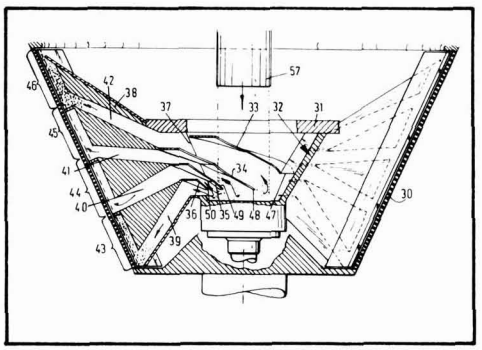
Animal feed block. S. A. de Santis, of Rolling Hills, CA, USA, *assr.* D. Appleman. **4,062,988.** July 22, 1976; December 13, 1977. – An animal feed block comprises 25 – 75% by weight of molasses, 0.5 – 10% of hard soap and sufficient (at least 20%) of a natural protein source to make up to 100%.

Continuous centrifugal. W. Dietzel, S. Matusch and V. Hentschel, of Braunschweig, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **4,063,959.** August 18, 1976; December 20, 1977. – See UK Patent 1,490,323[1].

Treatment of sugar cane. L. A. Paley, of Aurora, IL, USA. **4,063,960.** May 2, 1972; December 20, 1977. Cut cane on a conveyor is sprayed with steam in order to melt and remove wax and field dirt from the surface. The melted wax and condensed steam are removed below the conveyor (and the wax purified and moulded into cakes) while the cane is processed for the direct manufacture of white sugar and edible molasses (See US Patent 3,994,743[2]).

Producing a carbon source for fermentation. S. Asai, T. Matsuishi, K. Matsushita, S. Ikeda, K. Kobayashi and H. Maruyama, *assrs.* Ajinomoto Co. Inc., of Tokyo, Japan. **4,066,502.** April 19, 1976; January 3, 1978. A molasses hydrolysate (obtained by hydrolysing at pH 1.5 – 2 for 0.5 – 4 hr at 60° – 100°C) containing dextrose and levulose is neutralized, cooled to below 10°C and mixed with $Ca(OH)_2$ to give a Ca-levulose addition product. This is filtered off and the mother liquor neutralized and Ca ions simultaneously removed (by treatment with CO_2 or H_2SO_4) when the remaining liquor may be used as a carbon source for fermentation with a *Brevibacterium, Corynebacterium, Micrococcus* **or** *Microbacterium* sp.

Continuous centrifugal. D. Hoks, of Hengelo, Holland, *assr.* Stork-Werkspoor Sugar B. V. **4,066,547.** July 22, 1976; January 3, 1978.

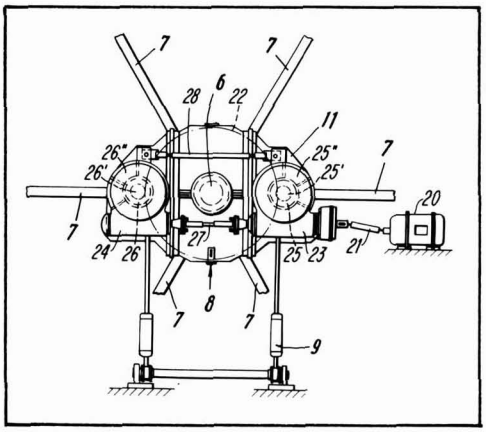


The conical basket 30 is attached to a driven shaft and by suitable means a slightly different speed is applied to a coaxial shaft carrying the distributor arms 38. Feed material is delivered through pipe 57 and is guided by blades 33, 34, 35 and 36 on the wall of pot 32 into slots 37 in the wall and so through ducts 39, 40, 41 and 42 in arms 38 discharging onto annular zones 43, 44, 45 and 46. Mother liquor passes through the basket 30 while the sugar crystals remain within until disturbed by the scraper mounted on the leading edge of the distributor arm; they are then carried by the conicity of the basket to its upper rim and discharged.

Dextrose isomerization to levulose. S. A. Barker, P. J. Somers, R. R. Woodbury and G. H. Stafford, *assrs.* Imperial Chemical Industries Ltd., of London, England. **4,069,104.** June 17, 1976; January 17, 1978. – Dextrose (as a 30 – 50% solution) or a derivative is isomerized to levulose, either enzymatically [with (immobilized) (*Arthrobacter*-derived) dextrose isomerase] or chemically (at pH 6 – 10) (at 50 – 100°C) in the presence of (200 – 800 mM of) a complexing reagent which is an oxyanion or mixed oxyanions of Ge or Sn (a germanate, a stannate) which forms a stronger complex with levulose than with dextrose. The solution is then separated from the complexing reagent which is then recycled. The presence of the reagent during the isomerization shifts the equilibrium towards a greater conversion to levulose, e.g. 63 – 80% instead of 45 – 59%.

Dryer. W. Dietzel and S. Matusch, of Braunschweig, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **4,071,961.** July 21, 1972; February 7, 1978.

Drive to a rotary drum sugar or beet pulp dryer or sugar cooler is through an axial shaft 6 connected to the drum by radial arms 7. The shaft is rotated by motor 20 through a flexible shaft coupling 21 which connects with gear 23 and (through shaft 27) with gear 24. These drive worm gears 25, 26 in housings 25'', 26'' which are held in defined position by guide rod 28 so that the worm gears mesh with a primary gear 22 located on shaft 6.



The drive mechanism is thus able to move with the shaft 6 but is prevented from rotating by being linked to a fixture through arms 9, each of which is provided with a shock absorber to allow for shock loads.

[1] *I.S.J.*, 1980, **82**, 259.
[2] *ibid.*, 225.

BREVITIES

French-Yugoslavian agro-industrial engineering cooperation agreement. – A technical and commercial cooperation agreement has been signed between Agrotechnip and the "Beograd" agricultural combine (PKB), the main Yugoslavian state agency for agricultural production. The aim of the agreement is the pooling of know-how and resources of the two groups for the mutual development of large integrated agro-industrial complexes in third countries, as well as the transfer of French technology to Yugoslavia, particularly in the field of solar energy, biomass and alcohol fuel. PKB employs about 25,000 people and has 250,000 acres of cultivated land providing cereals, sunflowers, fruit, grapes and animal feed as well as 160,000 tonnes of sugar beet. Agrotechnip is concerned with the development of integrated projects on an international scale and is backed by the resources of the Technip Group. The company has a team of highly qualified specialists and management technicians which enables it to take responsibility for preliminary studies; technical, economic and financial feasibility studies; finance; complete project management, engineering and construction; training of operating personnel, and assistance with the complex management. Among its current foreign projects, Agrotechnip is working on sugar complexes in Niger, Mali and Guinea, and a 350,000 tonnes/year plant in the Sudan.

Italian sugar factories reopening[1]. – A new sugar company, Società Meridionale Saccarifere Agroalimentara, has been found to take over the state-owned Termoli and Avezzano sugar factories. The two plants, which did not operate in the 1979 campaign, are to be reactivated. There is a possibility that the company will also take over the Strongoli Scalo factory.

Portugal departure from ISA[2]. – In early October Portugal gave notice to the United Nations Organization of its intention to leave the International Sugar Agreement. Portugal, in fact, had never ratified the Agreement but it is thought probable that the recent introduction of a stock financing fund levy of $0.50 per tonne was the main factor influencing the move.

Nigeria sugar consumption[3]. – In 1970/71 annual sugar consumption in Nigeria was recorded as 118,250 tonnes, raw value, and by 1975/76 had increased to 185,000 tonnes. By 1979/80, however, it had risen steeply to 525,000 tonnes and estimated consumption in 1980/81 is 540,000 tonnes. Domestic production was 26,639 tonnes in 1970/71 and production in 1980/81 is estimated at 40,000 tonnes. It will be seen that only a small proportion of the increased consumption has been met from domestic sources, and about 90% of sugar requirements have been met recently by imports from the EEC. The most likely explanation is the fact that Nigeria is an oil exporter and has been able to secure substantial foreign exchange earnings which have enabled the country to afford increased imports of sugar.

Zambia caneland expansion[4]. – An agreement has been signed under which a total of 14 million Kwacha (approx. £7.5 million) will be raised to finance the development of 1885 hectares of irrigated sugar cane at Kaleya, near Mazabuka in the Southern Province. Two-thirds of this area will be farmed by some 300 smallholders who will be settled there over a period, the remainder being farmed as a nucleus estate. The project will be adjacent to the Nakambala Sugar Estate and the cane will be sold to the Zambia Sugar Co. for processing, making it possible to utilize spare milling capacity. The scheme was due to commence towards the end of 1980, with completion of cane planting in 1983.

Peru sugar imports[5]. – Peru plans to buy 80 – 100,000 tonnes of sugar on the world market to cover domestic requirements in the six months to end-March 1981. The drought which has affected the cane areas since 1978 has continued and 1980 sugar production is not likely to exceed 580,000 tonnes, tel quel, against 639,633 tonnes in 1979. The Peruvian authorities are therefore entering into buying commitments to ensure adequate supplies.

New Syrian sugar factory[6]. – The country's fourth sugar factory is to be erected at Dei ez Zor on the Euphrates in Syria. Like the other three factories, it will be supplied by Czechoslovakia and it will be served by a beet area of 12,000 ha, slicing 4000 tonnes per day and producing white sugar, partly for export.

Swedish sugar industry survey[7]. – At the request of Parliament, the government has established a parliamentary commission to survey the future size, direction and structure of the Swedish sugar industry, according to the US Dept. of Agriculture. The directives to the committee emphasize that the report and proposals of the governmental ethanol commission may lead to a reconsideration of the size of the sugar beet area – currently 52,000 hectares, normally yielding 310,000 tonnes of sugar, raw value – and also of the direction of sugar beet production in terms of expected end uses. The growing interest in agriculture as producer of energy, also manifested internationally, is a key reason for analysing the future size and direction of the sugar industry from certain other standpoints than hitherto. The increased interest in sugar as raw material for industrial products of various kinds, in addition to ethanol, also motivates such an analysis. The commission is to, among other things, survey the possibility of using sugar beets for increased production of products other than sugar and discuss how this may affect the future position of the industry. The importance of the sugar industry from regional policy aspects is also to be considered.

Egypt sugar expansion requirement[8]. – According to a report prepared by the Industrial Committee of the National Council for Economic Affairs, Egypt's sugar needs are likely to double in the next twenty years. The report points to the fact that in 1979/80 only 657,000 tonnes, raw value, of domestic sugar was available, compared with a domestic consumption of 1,088,000 tonnes. The difference of 431,000 tonnes had to be imported. The report maintains that, in order to meet Egypt's sugar needs, eleven new processing plants should be built, each producing about 100,000 tonnes of sugar per year. Furthermore, the existing cane area should be expanded by 12,600 hectares to supply the existing factories at Kom Ombo, Kous, Deshna and Edfu.

Mexico sugar production, 1979/80[9]. – Sugar production in 1979/80 reached 2,595,133 tonnes, tel quel, an almost 10% decrease from the 2,874,681 tonnes, tel quel, produced in 1978/79. The shortfall amounts to 279,548 tonnes, and has required importation of sugar; initially, official sources declared that 400,000 tonnes would be needed, then 600,000 tonnes, then 740,000 tonnes, with the final figure set by the National Sugar Commission at 800,000 tonnes. Cuba is providing 600,000 tonnes and Brazil 200,000 tonnes. However, a representative of the National Union of Cane Growers did not exclude the possibility of imports in 1980 reaching the neighbourhood of 1,000,000 tonnes. According to industry sources, production will not be much higher in 1981 unless the government gives substantial financial incentives to expand cane and sugar production; moreover, some areas are suffering from drought which makes it even more unlikely that production will increase substantially next year. Reports from Tamaulipas indicated that eight mills in the Huastecas region will be unable to produce 150,000 tonnes of sugar owing to drought conditions this year. In the long term, most observers are agreed that the situation looks more healthy; the officially sponsored sugar industry integral development program will overhaul mills, install modern machinery and build seven new factories, the majority in the central and southern parts of the country where cane supplies are assured. The area sown to cane is to be expanded by 175,000 hectares and it is expected that this program will boost production by 600,000 tonnes a year within four years, which means that sugar output should rise to around 4,500,000 tonnes over the next five years. This should be more than sufficient to satisfy domestic needs. In order to achieve this ambitious project, Mexico has already obtained half the required funds (US $825 million) from financial sources in the UK, France, Canada and West Germany, with loans arranged through the National Sugar Financing Company.

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1 *Zuckerind.*, 1980, **105**, 874.
2 C. Czarnikow Ltd., *Sugar Review*, 1980, (1513), 201.
3 *World Sugar J.*, 1980, **3**, (3), 19.
4 *Standard Chartered Review*, October 1980, 5.
5 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 530.
6 *Zuckerind.*, 1980, **105**, 875.
7 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 525.
8 *World Sugar J.*, 1980, **3**, (4), 28.
9 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 549.

BREVITIES

Nigeria sugar expansion[1]. — In order to cover domestic requirements it is proposed to erect three new sugar factories; one near Sunti will produce 100,000 tonnes of sugar per year while a second will be built at Hadejia in Kano State and the third will be located in the south of the country, although it has not been decided where.

Puerto Rico sugar production[2]. — Sugar outturn from the 1979/80 crop in Puerto Rico continued its decline, reaching only 175,000 short tons, raw value, against 193,000 tons in 1978/79. In 1970/71 sugar production was 324,000 tons and 308,000 tons was produced in 1975/76, but productions have fallen successively each year since then.

Mexican smut-resistant cane[3]. — Mexican agronomists are reported to have successfully produced a variety of sugar cane that is resistant to the strain of the fungus *Ustilago scitaminea* which has been causing concern and loss to growers in the Caribbean area ever since its discovery in Jamaica in 1975.

New Indian sugar factory[4]. — A Rs. 60,000,000 sugar factory is to be commissioned in Ferozepore district in the next crushing season, according to the Deputy Commissioner. The factory will be supported by a 4200-acre cane growing area.

Mexico sugar expansion moves[5]. — About $1600 million is to be invested in the sugar industry in the period to 1982, according to the plans of the country's National Sugar Commission. It is hoped to raise total sugar output to 4.5 million tonnes/year by the 1984/85 season. Of the total investment, about $650 million will be used to improve existing plantations and mills and the balance for the construction of new plants. Cane growers have received an approximate 34% increase as a production incentive and special concessions have been made to the mills. Apart from payment of 7.80 pesos ($0.3432) per kg in the 1980/81 season, mills will also be reimbursed for increases in the costs of raw materials, labour, energy and spare parts for machinery. As a production incentive, mills increasing yields will receive a premium of 10 centavos (about 0.4 US cents) per kg for additional sugar produced, to be shared equally with cane growers.

US beet sugar factory sale possibility for alcohol production[6]. U & I Incorporated have reported that an option agreement has been signed for potential purchase of the former Idaho Falls beet sugar factory by promoters of Northwest Processing Corporation, a new company to be formed to manufacture alcohol for fuel. The agreement provides for completion of the transaction at any time within the period to March 1981. The purchase price was not disclosed but the sale includes the factory buildings and land used by the factory when it was in operation making sugar plus approximately 170 additional acres of land owned by U & I. The Idaho Falls plant processed its last sugar in the spring of 1979.

Spanish sugar imports possibility in 1980/81[7]. — The President of the Compañía de Industrias Agrícolas S.A. recently stated that Spain will be forced to import between 100,000 and 150,000 tonnes of sugar in the period to June 1981. This is likely because of a fall in the stocks held by the Government agency, FORPA, from 700,000 tonnes a year ago to 150,000 tonnes. The government announced in September that it is launching a three-year plan with the target of increasing sugar production to 1,150,000 tonnes by 1984. Estimated production during the 1980/81 campaign is 945,000 tonnes, raw value, and stocks at the beginning of the marketing year on July 1 amounted to 295,000 tonnes, giving an availability of 1,240,000 tonnes. With consumption requirements estimated at 1,125,000 tonnes, and assuming necessary carryover stocks of 190,000 tonnes, there will be a net import requirement of some 75,000 tonnes. These calculations refer only to the Spanish peninsula and Balearic Islands; if sugar production is not sufficient to cover domestic requirements there could arise additional import requirements for the Canary Islands.

Thailand raw sugar exports resumption[8]. — Exports of raw sugar from Thailand will be resumed in 1981 according to reports from that country. Sugar factories are to be instructed to ensure that adequate white sugar is made available to meet domestic demand but it is expected that some 650,000 tonnes of raws will be available to be shipped to overseas markets.

Poor Japan sugar crop prospects[9]. — Following several field tests, the Japanese Agriculture Ministry estimates that 1980 sugar production will total only 637,000 tonnes, raw value, 11.8% below the 722,000 tonnes produced last year. The fall in sugar output reflects lower yields and also a smaller area sown to sugar. The poor yields were a product of cool weather on the northern island, where beet sugar is predominant, and a drought in the main cane growing area to the south.

Fuel alcohol development affiliation. — ABA International Inc. of Hawaii and Process Engineering Company (PEC), a member of the Chemap Group, of Männedorf, Switzerland, are to cooperate as consultants for the utilization of biomass in production of fuel. The Swiss firm has patented a process whereby yeast cells can be totally or partially removed from a fermentate before evaporation of the alcohol, thereby eliminating or reducing fouling of the evaporator surfaces. The stillage slops are subjected to an anaerobic treatment for methane production as an energy source. A feasibility study by ABA and PEC personnel is currently under way for a major sugar factory in Africa.

Cane trailer contract for Tanzania. — The F. W. Pettit Division of Geest Industrial Group Ltd. has recently commenced shipment of a fleet of sugar cane trailers to the Kagera Sugar Estate in Tanzania under a contract worth more than £500,000. The trailers are being shipped in s.k.d. form for assembly at Kagera where the new sugar factory of Sugar Development Corporation of Tanzania is due to start production next August. The trailers will be operated in trains of three and incorporate the Pettit weight-transfer coupling.

Energy from biomass. — A conference on this topic, organized by the European Commission and the UK Dept. of Energy, assembled workers in the field from many countries who were concerned with the production of energy from renewable sources including particularly agricultural wastes. One paper described experience in Brazil, Dr. S. Trindade pointing out that the 10.7 million m^3 of ethanol planned for 1985 will generate vinasse having a B.O.D. equivalent to the sanitary waste of 63 million people. But production of methane from such vinasse could provide a cheap and effective abatement of pollution while also giving a saving of 30–40% in alcohol production energy requirements. In a review of ethanol production, Dr. J. Coombs of Tate & Lyle Group Research concluded that production of fermentation ethanol for fuel use will not be as important in Europe as in many other parts of the world, and that, particularly where lignocellulose was the biomass substrate, processes leading to methanol would be more likely to become commercial than ethanol fermentation.

Intersuc, 1981. — Intersuc, the 24th international confectionery, chocolate and biscuit trade exhibition, will be held during February 15 — 18 at the Parc des Expositions in Paris.

Ion exchange business acquisition. — Agreement has been reached in principle for Dia-Prosim, the ion exchange and water conditioning division of Diamond Shamrock Europe, to acquire the Imacti ion exchange business from Akzo Chemie B.V. of Amersfoort, Holland. The transfer is expected to be completed by March 1 and will include patents, trademarks, production and application technology.

PERSONAL NOTES

Mr. Geoff Mitchell, General Manager of Fairymead Sugar Company in Australia, has been appointed Manager of a new Project Development Division of Bundaberg Sugar Company which is to assess and report on future investment relative to both extension of the group's current business and on new ventures. **Dr. L. Muller**, Assistant General Manager (Distillery and Refinery) of Millaquin Sugar Company, has been appointed Chief Technologist of the new division.

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1 *Zuckerind.*, 1980, **105**, 876.
2 *Lamborn*, 1980, **58**, 126.
3 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 595.
4 *Maharashtra Sugar*, 1980, **5**, (10), 68.
5 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 595-596.
6 *Lamborn*, 1980, **58**, 135.
7 F.O. Licht, *International Sugar Rpt.*, 1980, **112**, 589.
8 C. Czarnikow Ltd., *Sugar Review*, 1980, (1516, 213.
9 *Public Ledger's Commodity Week*, November 1, 1980.

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