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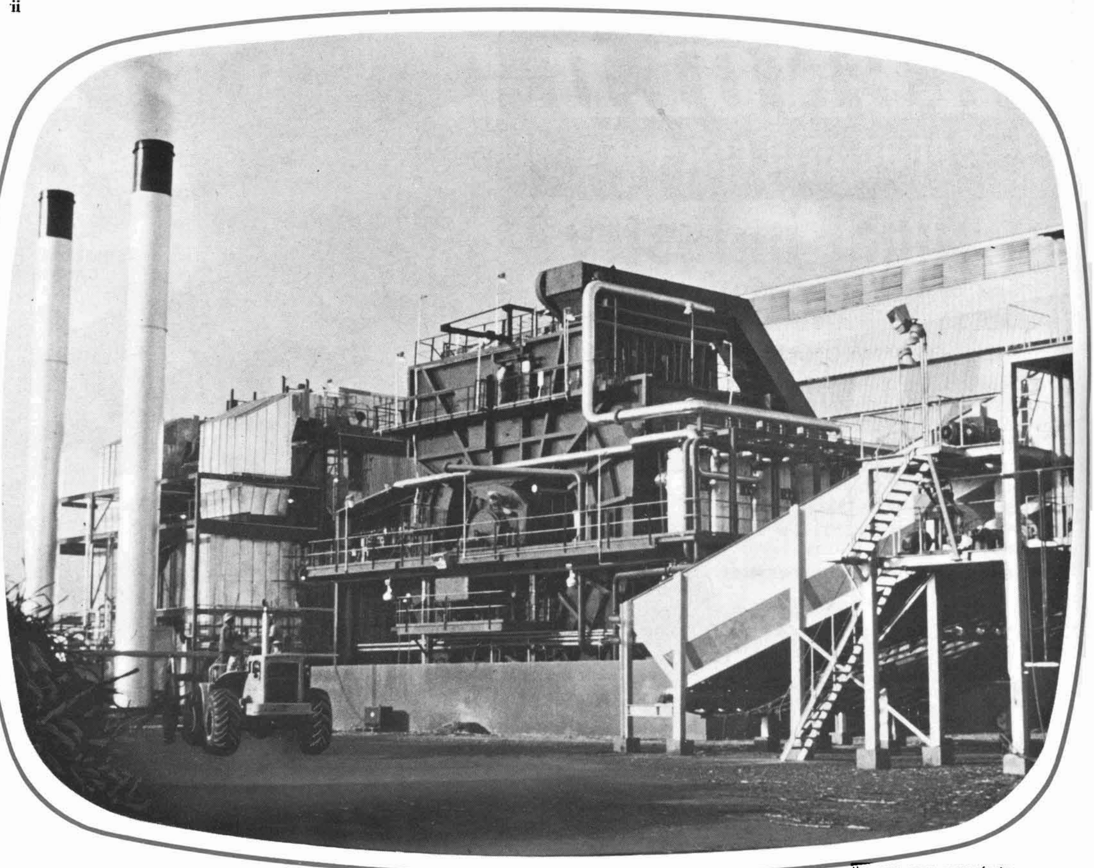

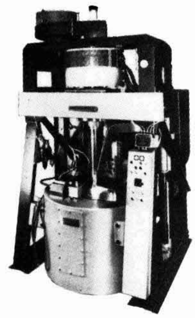

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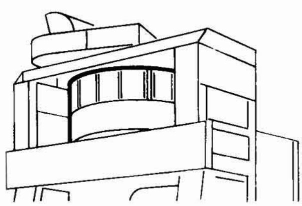

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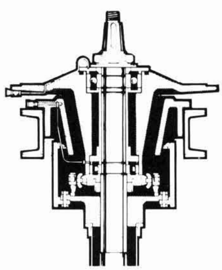

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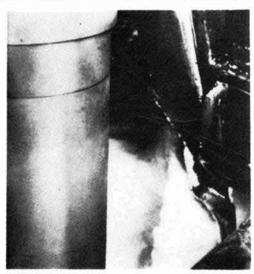

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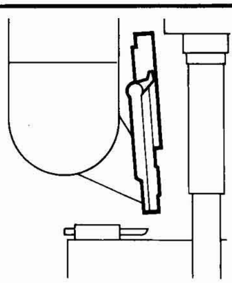

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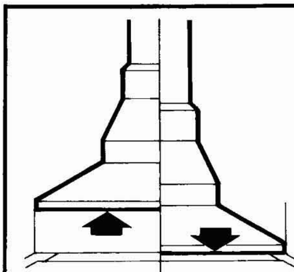

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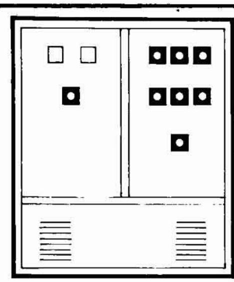

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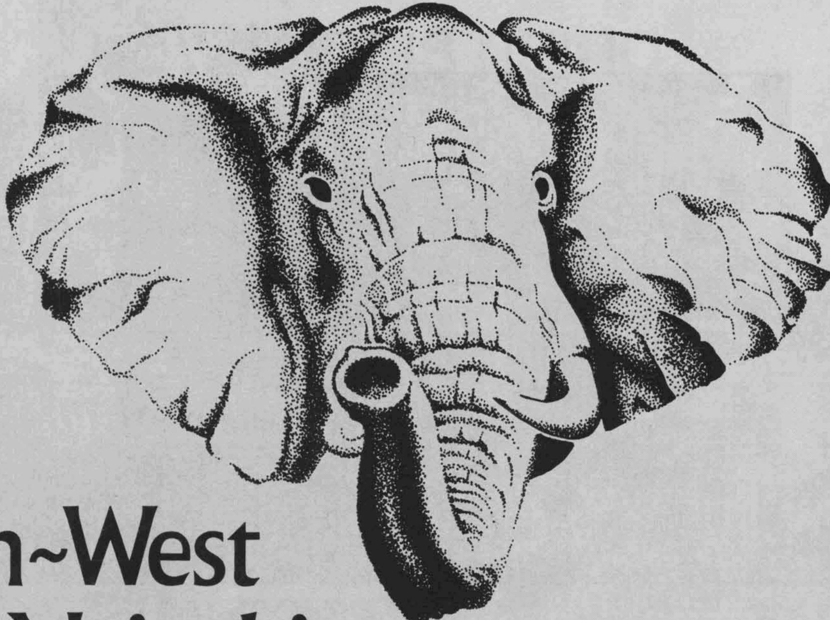

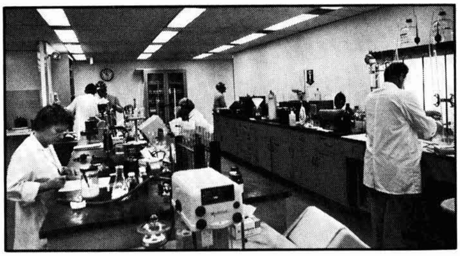
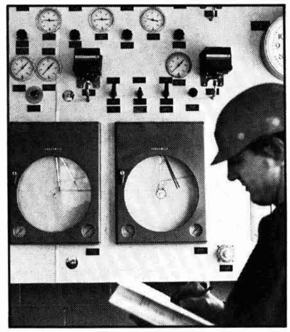
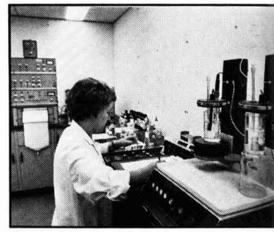
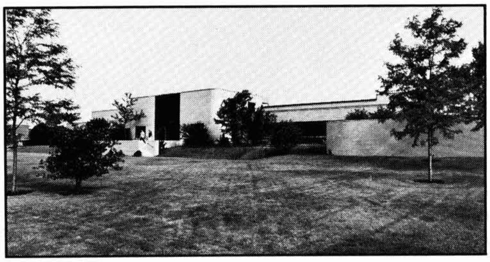
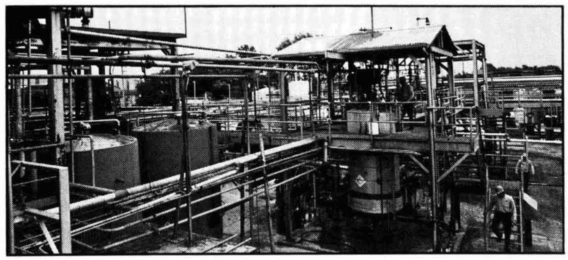
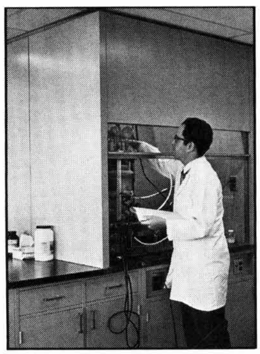
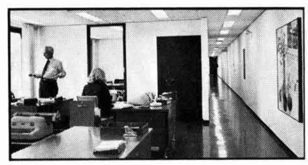

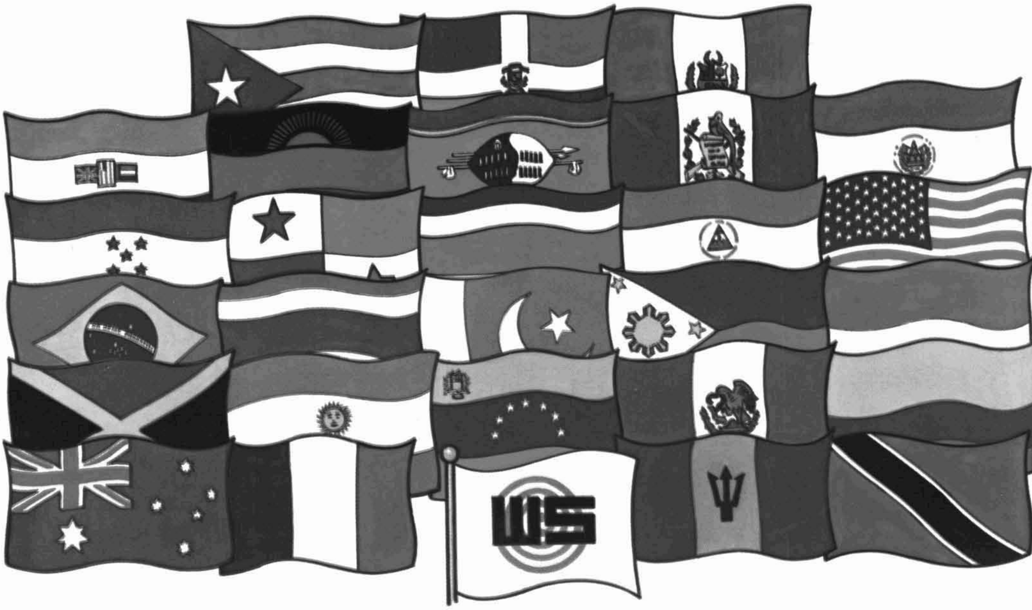

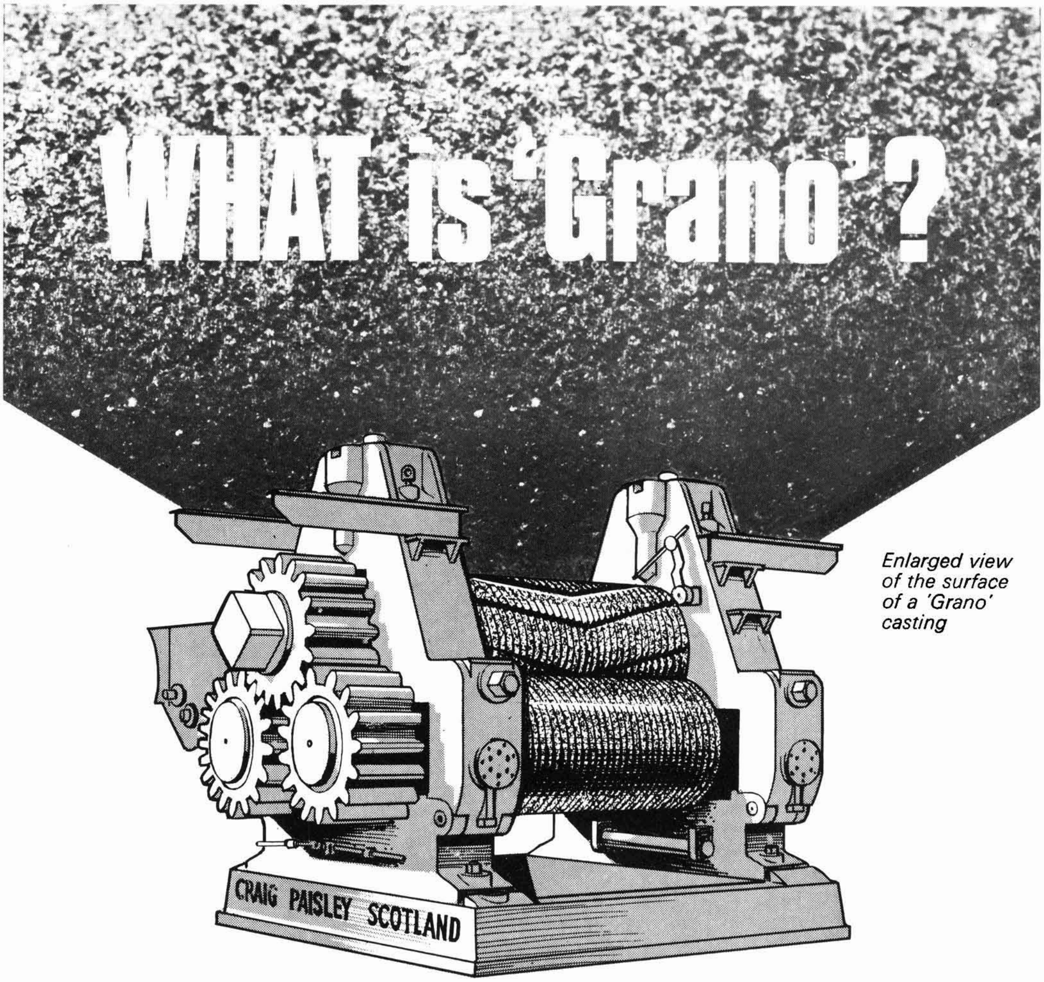

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NOTES AND COMMENTS

International Sugar Council

The first session of the International Sugar Council under the International Sugar Agreement 1977 was held in London from 16th to 24th January 1978.

The session was opened by Mr. A. McIntyre, the Director of the Commodities Division of UNCTAD, on behalf of the Secretary-General of UNCTAD who had convened the session. The session was attended by delegates of 41 of the 43 countries at present Members of the Agreement, and by observers from non-Member Governments which attended the 1977 UN Sugar Conference and international organizations which observed at that Conference.

The Council elected Mr. S. El-Bous, of Egypt, as its Chairman, and Mr. H. Tabio York, of Cuba, as its Vice-Chairman for 1978. Mr. E. Jones-Parry was re-appointed as Executive Director of the Organization. The Council, under article 73, paragraph 2, of the Agreement, extended to 30th June 1978 the time limit for the deposit by signatory Governments of the constitutional instruments with the Secretary-General of the United Nations, and for the submission, in the meantime, of declarations of provisional application referred to in article 74, paragraph 1.

The Executive Committee was elected in the Council which delegated to it all its powers under the Agreement except those expressly listed in article 19, paragraph 1. The Council also appointed the Special Hardship Reserve Committee referred to in article 39, the Price Review Committee in article 62, the Sugar Consumption Committee in article 65 and the Credentials Committee for 1978. It also noted the establishment by the Executive Committee of the Statistics Committee, the Finance Committee and the Stock Financing Fund Advisory Committee for the current year.

The Council invited the EEC, at its request, to observe at sessions of the Council in 1978 and extended a similar invitation to all non-Members which participated at the 1977 UN Sugar Conference which would express an interest in the activities of the Organization. The United Nations, UNCTAD, FAO, IMF, IBRD, GATT and GEPLACEA were extended a standing invitation to observe at all sessions of the Council.

The Council noted with regret an announcement by its Executive Director, Mr. E. Jones-Parry, of his intention to retire on 30th June 1978 and made arrangements for the selection and appointment of his successor. The Council also endorsed the arrangements made for the choice and appointment of the Stock Financing Fund Manager. The Council agreed on certain re-gradings of posts in the Secretariat and adopted a total administrative budget of the Organization for 1978 of £536,000, to be met by governmental contributions at the rate of £265 per vote, the balance being taken from the reserves of the Organization. The Council also approved financial arrangements to cover the costs associated with the operation of the Stock Financing Fund before the latter begins to receive its income.

The Council adopted an estimate of the net import requirements of the free market in 1978 amounting to 15,515,000 tonnes. In the light of its estimates of likely exports other than under quotas in effect of Members listed in annex I, it established the global quota for 1978 at 10,715,000 tonnes.

In this connexion, the Council noted that the total of quotas in effect of Members listed in annex I at 85% of their respective basic export tonnages, together with likely exports by annex II Members, would amount to 12,121,000 tonnes. It further noted that if the prevailing price continues at its current levels, the provisions of article 41, paragraphs 2 and 4, will become operative on 21st April 1978. In those circumstances, total quotas in effect, together with exports by annex II Members, will amount to about 11,775,000 tonnes. The Council called upon its Members not to commit for export at this juncture more than their minimum export entitlements within that total figure.

The Council also recognized that a certain amount of shortfalls will be declared in 1978. In the light of all relevant circumstances, the Council came to the conclusion that there were good prospects for a better balance between supply and demand during 1978.

World sugar production 1977/78

F. O. Licht KG have recently published[1] their second estimate of world sugar production for the crop year ending August 1978 and the details are tabulated elsewhere in this issue. A record level of 92·6 million tons is expected and this compares with a figure of 87·7 million tons in 1976/77 and the first Licht estimate of just under 90 million tons. Compared with the previous year the beet sugar sector is expected to contribute some 3 million tons more and the cane sector 2 million tons, giving a 5 million tons higher crop.

Compared with the first estimate, however, the increase reflects the good development of current sugar crops, particularly in Western Europe, Brazil, India, the Philippines and Thailand, where damage by drought has proven less severe than anticipated.

EEC beet and sugar prices for 1978/79

In mid-December the EEC Commission's proposals for farm prices for the 1978/79 season, starting next July, were published. In general, increases are about 2% and, in the case of sugar and sugar beet, slightly more than 1%. With inflation at current levels such small increases reflect a fall in real values. The recommended minimum price for beets processed into category A sugar is 25·73 units of account per tonne, against the 1977/78 price of 25·43 units of account, an increase of 1·18%. The intervention price for white sugar is proposed at 332·10 units of account against 328·30 u.a., an increase of 1·16%, while the target price is 349·60 u.a. against 345·60 in 1977/78, an increase also of 1·16%. The intervention price for raw sugar proposed is 275·70 u.a., an increase of 1·17% over the 272·50 u.a. of 1977/78.

It is recommended that the combined A and B quotas should be reduced from 135% to 120% of requirements (and 220% in those countries operating the two-year system). It is proposed that the starch subsidy be phased out and that the levy on high fructose corn syrup should remain at 50 u.a. per ton, dry weight basis.

[1] *International Sugar Rpt.*, 1977, **109**, (35), 1–5.

The proposals now have to be considered by the Ministers of Agriculture of the Community member-nations. It will be remembered that proposals last year were rejected and agreement reached only in May.

This year, as is traditional, farmers' spokesmen in some countries have objected to the low level of price increases in the Commission's proposals and the Ministers will undoubtedly be put under pressure to agree only to higher levels. However, under present circumstances, with an even larger surplus of sugar in the EEC and vast expense on subsidies to dispose of it, the Ministers may be more ready than last year to measures which will reduce the Community's excess production.

Australian-Malaysian sugar contract talks

During the past few months, when difficulties—now resolved—arose in respect of the long-term contract for sales of Australian sugar to Japan, there were similar discussions with Malaysia over the long-term sales contract with that country. Following settlement of the dispute with Japan, negotiations have been going on with the aim of the Malaysians to have the contract price reduced from the level specified in the original contract. The latter covers importation of 1,650,000 tonnes over a six-year period, 1975-1980, an average of 275,000 tonnes per year. Statistics show that only 252,000 tonnes were imported in 1975 and 202,000 tonnes in 1976. The contract price is partly linked to costs in Queensland and is said to be currently about US$360 per tonne, around twice the current world price. Malaysia has refused to accept Australian sugar since July 1977 and has spoken of the possibility of buying sugar from Cuba, Thailand and the Philippines instead. A spokesman for CSR Ltd., the marketing agents for the Australian sugar industry, confirmed[1] that talks had been going on but had broken down without agreement. The Malaysian negotiators had agreed to take back some CSR proposals for consideration by the Malaysian Government, however.

Singapore also is reported[2] to be seeking a revision of her long-term contract to buy a minimum of 487,000 tonnes of Australian sugar during the six-year period 1975-80.

World sugar balance, 1976/77

F. O. Licht have recently published their fourth estimate[3] of the world sugar balance for the crop year September 1976-August 1977, some two months after their previous estimate. With final figures now available for a number of important countries the estimates will be so much nearer the actual figures, although because of the lack or partial lack of data from some countries—notably Cuba and the USSR—the totals are estimates instead of official records. There is, as always, a discrepancy between exports and imports owing to the existence of cargoes on their way from one country to another, recorded as exports by the suppliers but not to be recorded by the importing countries until they arrive.

In the case of world sugar production the official Cuban statistic of 6,485,000 tonnes, raw value, has been included, an increase of 485,000 tonnes over the previous estimate; this is offset partly by reductions in the crops of other countries. Consumption estimates have been reduced for several areas in South America but have been increased in Asia, especially China. The net effect on stocks is to raise them substantially, by 5½ million tonnes over the August 1976 level, to 31·41% of consumption requirements. Details of the estimate appear below:

	1976/77	1975/76	1974/75
		(tonnes, raw value)	
Initial stocks	20,578,000	17,449,000	16,036,000
Production	88,580,000	82,853,000	79,600,000
Imports	26,601,000	23,634,000	24,144,000
	135,759,000	123,936,000	119,780,000
Exports	26,866,000	23,400,000	24,674,000
Consumption	82,863,000	79,958,000	77,657,000
Final stocks	26,030,000	20,578,000	17,449,000
Final stocks % Consumption	31·41%	25·74%	22·47%

According to Licht's latest forecasts of production for the 1977/78 crop years for individual countries a further rise inproduction of at least 4½ million tonnes is anticipated for the September 1977/August 1978 period, while a similar rate of consumption increase as between 1975/76 and 1976/77 would give an 86 million tonnes offtake against 93 million tonnes production. Even a greater rate of consumption increase of say 4-5% would leave a surplus of 6 million tonnes. Licht comments: "It remains to be seen how the International Sugar Agreement will be able to cope with the situation".

US sugar legislation

At the request of the President, the US International Trade Commission, on 23rd November 1977, instituted an investigation to determine whether sugars, syrups and molasses imported from foreign countries "were or were practically certain to be imported into the United States under such conditions and in such quantities as to render or tend to render ineffective or materially interfere with the price-support operations conducted by the US Department of Agriculture for sugar cane or sugar beets or to reduce substantially the amount of any product being processed in the United States from such domestic sugar cane or sugar beets".

To this end the Commission has held public hearings in New Orleans in early January 1978, in Minneapolis in mid-January and in Washington in early February. The Commission is to report to the President by 15th March.

In the meantime, considerable opposition has been expressed by foreign suppliers to the complicated variable import fee introduced on 12th November and taking effect on 1st January 1978[4]. Sugar circles in the US guessed that a change to a fixed fee would be introduced and such a change was, in fact, announced by the President on 20th January. From the following day, imported sugar was subjected to a fee of 2·7 cents per pound for raw sugar and 3·22 cents per pound for refined sugar, not to exceed 50% of the value of the imported sugar. At the same time the International Trade Commission was asked to expand its investigation and to complete its report as soon as possible with accompanying specific recommendations for corrective actions.

[1] *Public Ledger*, 10th December 1977.
[2] *ibid.*, 23rd December 1977.
[3] *International Sugar Rpt.*, 1977, **109**, (36), 1.
[4] *I.S.J.*, 1978, **80**, 23.

Effect of dextrans on the viscosity of sugar solutions and molasses

By P. F. GREENFIELD and G. L. GERONIMOS

(Department of Chemical Engineering, University of Queensland, St. Lucia, Australia 4067)

Introduction

THE presence of dextrans (glucans with a majority of α-(1→6)-D-glucosidic linkages) in cane juice has been shown to affect adversely raw sugar processing and quality. The polymer is produced by the action on sucrose of dextransucrases from micro-organisms of which the species *Leuconostoc mesenteroides* is most commonly found in cane samples. Dextrans cause processing problems because of their effect on the viscosity of molasses and massecuites and sometimes filtrability, and quality problems because of their effect on crystal shape. Although Sutherland & Paton[1] and Hidi & Staker[2] have reported on crystal elongation in the presence of dextran, the processing problems are generally regarded as the more serious since throughput and exhaustion are affected adversely. These effects are widely recognized and, with appropriate sampling of the raw juice, dextran levels can be ascertained early in the processing. It is difficult to determine just what effect the dextran will have on further processing because of a lack of quantitative information relating levels of dextran to the viscosity of sugar, molasses and massecuites solutions. Carrazana *et al.*[3] have determined the viscosity of 60°Brix sugar solutions for a limited number of dextran concentrations. They found a relationship of the following form fitted the data well:

$$\eta = ke^{0.26c} \qquad (1)$$

where η = viscosity (poises) and c = dextran concentration (grams per decilitre).

No information is provided concerning the average molecular weight of the dextran. Atherton[4] also found an exponential relationship between solution viscosity and impurity concentration, although no specific reference was made to dextran. Day[5] related the viscosity of sugar solutions linearly to dextran concentration over a very limited range of concentrations.

The viscosities of sugar solutions, molasses and massecuites have been the subject of considerable research. While sugar solutions are newtonian, molasses and massecuite have been found to exhibit newtonian, pseudoplastic, thixotropic, or Bingham plastic behaviour. A power law relationship is most commonly used to relate shear stress to shear rate:

$$\tau = k\gamma^{n} \qquad (2)$$

where τ = shear stress, γ = shear rate, and k, n are parameters.

An apparent viscosity is defined as:

$$\eta_a = k\gamma^{n-1} \qquad (3)$$

Bhattacharyya *et al.*[6] found that the value of the exponent (n) was around 0·9 for molasses from normal cane. For molasses from degraded cane containing high levels of dextran, increased pseudoplastic behaviour was observed with the exponent becoming less than 0·8. They also observed that the value of the exponent was itself a function of shear rate. Smolnik & Delavier[7] determined that cane sugar molasses was non-newtonian in nature but that when the soluble colloids were removed, the samples reverted to newtonian behaviour.

It appears, therefore, that dextrans and other polymeric compounds are the main causes of non-newtonian behaviour in molasses, while in massecuites the problem is complicated by the presence of sugar crystals[8]. Both for molasses and massecuites many of the data have been collected for unspecified and non-uniform shear fields, which are particularly unsatisfactory when measuring viscosities of non-newtonian fluids. Hence, extrapolation of existing results is difficult. In the following sections it is aimed to develop a relationship which predicts the effect of dextran on solution viscosity under known conditions.

EXPERIMENTAL

Equipment: The instrument used to measure viscosity was a Contraves Rheomat 15 viscometer. The viscometer operates by shearing a fluid between two concentric cylinders, the inner one of which is rotating. A range of bobs and cups is available to extend the range of the instrument. The gap between the cup and bob is small so that an approximately uniform shear field is achieved and the bobs are designed to minimize end effects. The torque developed by viscous drag on the inner cylinder for varying cylinder speeds is read from a calibrated gauge[9].

Materials: CSR refined sucrose was used to make up the sugar solutions. Molasses samples were obtained from Qunaba and Racecourse mills in central and north Queensland. They were tested to ensure that measurable traces of dextran were not present. Dextrans from A.B. Pharmacia, of weight average molecular weights ranging from 10^4 to 2×10^6 were used; these fractions were of relatively narrow distribution. For high-molecular weight fractions, a Sigma product (Cat No. D5884) with a weight average molecular weight of approximately 2×10^7 (viscosity determination) was employed.

Procedure: The moisture content of the different dextrans was determined by drying to constant weight. This was of the order of 8–9%.

Sucrose solutions of different concentrations were made up and the various dextrans dissolved to yield the required dextran concentrations on a weight/volume basis. Concentrations of sucrose varied from 100g/100g water to 350g/100g water covering both the undersaturated and supersaturated regions. Dextran concentrations varied from 0 ppm to 10^5 ppm (solution basis). Although some previous workers have expressed dextran concentration in terms of "ppm on Brix" it is the absolute concentration which is of interest from a rheological viewpoint. Care was taken to ensure that the dextran dissolved completely.

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1 *I.S.J.*, 1969, **71**, 131–135.
2 *Proc. Queensland Sugar Cane Tech.*, 1975, **42**, 331–344.
3 *CubaAzúcar*, 1975, (July/Sept.), 45–53.
4 *Proc. Queensland Soc. Sugar Cane Tech.*, 1959, **26**, 45–50.
5 M.Sc. Thesis, Univ. of Queensland, 1971.
6 *Proc. Queensland Soc. Sugar Cane Tech.*, 1972, **39**, 209–216.
7 *Zeitsch. Zuckerind.*, 1972, **97**, 498–506.
8 Awang & White: *Proc. Queensland Soc. Sugar Cane Tech.*, 1976, **43**, 263–270.
9 Middleman: "The flow of high polymers" (Interscience, New York), 1968.

The sucrose-dextran solution was then poured into the appropriate viscometer cup and allowed to equilibrate to the water bath temperature. Temperatures used were in the range 30°C to 65°C. Series of shear stress-shear rate data were then obtained. On most occasions two bob-cup combinations were used to provide data over a wide range of shear rates. The data were then fitted to a power law expression and values obtained for the power law index n, and for the apparent viscosities at the different shear rates. These methods are described in standard polymer texts[9].

For molasses a similar procedure was followed except that an amount of water was evaporated under vacuum and the dextran added to the molasses in the form of a solution to give the appropriate concentration. This was necessary because of the difficulty in dissolving the higher molecular weight dextrans in the molasses. In total, 210 different solution-temperature combinations of sucrose were tested along with 62 molasses-temperature combinations excluding replicates. The apparent viscosity at 100 sec^{-1} was used for comparative purposes; a relative viscosity was obtained by reference to the viscosity of a solution of the same total solids but zero dextran. In this way comparison with the equivalent sucrose solution may be made and viscosity effects attributed solely to the polymer.

RESULTS AND DISCUSSION

Effect of shear rate

The addition of dextrans to sucrose solutions caused mild pseudoplastic behaviour to be exhibited, whereas zero levels of dextran gave rise to the expected newtonian behaviour. A power law expression fitted the data satisfactorily—for all polymers of weight average molecular weight less than 2×10^6 the exponent n lay

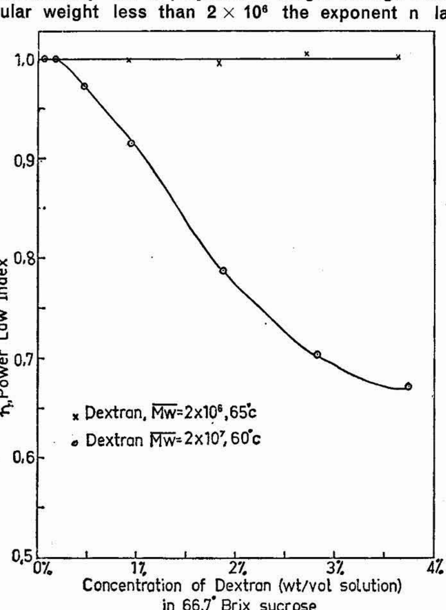

Fig. 1. Effect of dextran concentration on flow behaviour of sugar solutions

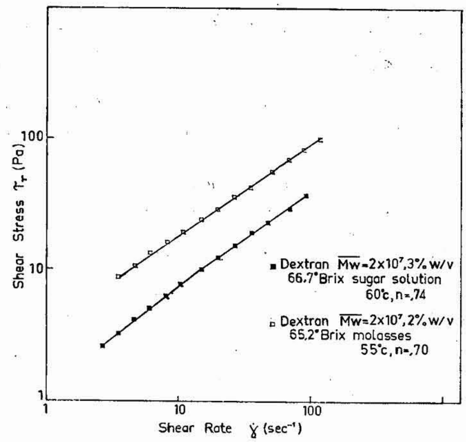

Fig. 2. Effect of shear rate on flow behaviour of sugar solutions and molasses

between 0·95 and 1·0. A marked increase in pseudoplastic behaviour was observed for dextran of molecular weight 2×10^7 with values of n in the range 0·67 to 1·0. There was a concentration dependence of the degree of pseudoplasticity with n tending to decrease at the higher levels of dextran (Fig. 1); this phenomenon was temperature-independent over the range 30°C to 60°C. The non-newtonian effect was more noticeable when dextran was added to molasses, with the power law index appreciably less than 1 even for the lower molecular weight dextrans. It is not clear why the dextrans affect the molasses flow behaviour more significantly than that of sucrose solutions. It is possible that the wider variety of species present in the molasses may cause polymer association or, more likely, there is interaction between the dextran molecules and other polymer species present. Certainly, the data suggest, as did those of Smolnik & Delavier[7], that one of the principal causes of non-newtonian behaviour in molasses is the presence of high molecular weight polymers. It was thought initially that a measure of such non-newtonian behaviour could be used to characterize the polymer concentrations present in molasses. The variability of the results, however, precludes such an attempt although the trend is obvious.

It is noticeable from Fig. 2 that the behaviour of the samples in the presence of dextrans does not alter appreciably over the range of shear rates tested. Although the range of shear rates is relatively small, the power law expression with a constant value for the index n appears to represent the data well. The variation in n shown by Bhattacharyya *et al.*[6] was the result of varying the shear rates over a much wider range of values. For the purpose of determining a relationship to show the effect of dextran on viscosity the apparent viscosity at a shear rate of 100 sec^{-1} was used.

Proposed relationship

The theory of dilute polymer systems is well established. It is found that the limiting viscosity number $[\eta]$ which is defined by equation 4 can be related both to the concentration and average molecular weight of a polymer.

$$[\eta] = \lim_{c \to 0} \frac{\eta_{sp}}{c} \quad \text{.................................(4)}$$

$$\eta_{sp} = \eta_r - 1 = \text{specific viscosity} \quad \text{(5)}$$

$$\eta_r = \eta/\eta_o = \text{relative viscosity} \quad \text{(6)}$$

where η_o is the polymer-free solution viscosity. The values of η and η_r are usually found using capillary viscometers.

Equation 4 derives from the fact that, for low polymer concentrations (<1% wt/vol), a linear relationship between η_{sp}/c and c has been shown to exist[10], viz.:

$$\eta_{sp}/c = [\eta] + k_1[\eta]^2 c \quad \text{(7)}$$

An alternative expression is given by:

$$(\ln \eta_r)/c = [\eta] - k_2[\eta]^2 c \quad \text{(8)}$$

For higher concentrations of polymers, other relationships have been proposed[10].

These equations apply strictly only at zero shear rate. Values of the constant k_1 (Huggins constant) range from about 0·35 to 1 and are a measure of the polymer-solvent interaction. For a monodisperse polymer the Mark-Houwink equation relates the limiting viscosity number to the polymer molecular weight

$$[\eta] = KM^{\alpha} \quad \text{(9)}$$

where K and α are constants for a particular polymer-solvent-temperature combination. K normally ranges from about 0·01 to 0·1 $cm^3.g^{-1}$ and α varies from 0·5 to 0·8. For polydisperse systems such as the dextran samples:

$$[\eta] = K\bar{M}_v^{\alpha} \quad \text{(10)}$$

where $\bar{M}_v$ is the viscosity average molecular weight. $\bar{M}_v$ generally falls between $\bar{M}_n$ and $\bar{M}_w$ the number average and weight average molecular weights, respectively, but closer to $\bar{M}_w$. Often an expression of the following form is used:

$$[\eta] = K_2\bar{M}_w^{\alpha_2} \quad \text{(11)}$$

Such an approach may be applied to the dextran-sucrose-water system. A number of problems arise, however, which include the fact that the parameter α_2 is a function of the molecular weight distribution of the polymer. Hence, for different dextrans, there is no guarantee that α_2 would be constant. The molecular weight distribution is a function of the growth kinetics and reaction time for the formation of the polymer. Further problems arise because estimation of $[\eta]$ requires extrapolation to zero shear rates and very accurate experimentation to establish reliable values of $[\eta]$. The latter point is so because of large relative errors in the term η_{sp}/c at low concentrations.

The above theory suggests, however, that any relationship which predicts the relative increase in viscosity due to the presence of dextran should take into account both the molecular weight of the polymer and its concentration.

Equation 7 may be rewritten as:

$$\eta_{sp} = [\eta]c + k_1[\eta]^2 c^2 \quad \text{(12)}$$

The form of this equation suggests that the concentration dependence of the specific viscosity is of some order between 1 and 2 with higher molecular weight polymers weighting the order towards the latter value since $[\eta]$ is a function of polymer molecular weight. For predictive purposes over a limited concentration range, a relationship is suggested of the form:

$$\eta_{sp} = k_{sp}c^{\alpha_{sp}} \quad \text{(13)}$$

where $\eta_{sp} = (\eta - \eta_{ref})/\eta_{ref}$ and η_{ref} = viscosity of a solution of the same total solids but zero dextran. Both k_{sp} and α_{sp} are functions of an average molecular weight.

Similarly inspection of equation (8) suggests another approximate relationship might be the following:

$$\ln(\eta_r) = k_r c^{\alpha r} \quad \text{(14)}$$

where $\eta_r = \eta/\eta_{ref}$.

The data were fitted to equations (13) and (14) by least squares regression; estimates of the parameters and a measure of their reliability are found in Tables I and II. Figures 3 and 4 show the fit for two of the dextrans; the equations were fitted to both sucrose and molasses data simultaneously.

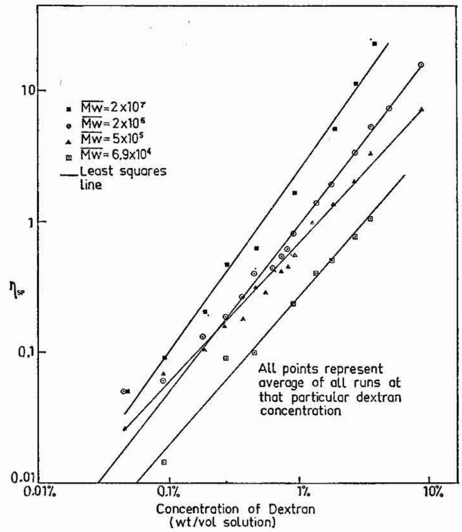

Fig. 3. Effect of dextran concentration on specific viscosity of sugar solutions and molasses (Equation 13)

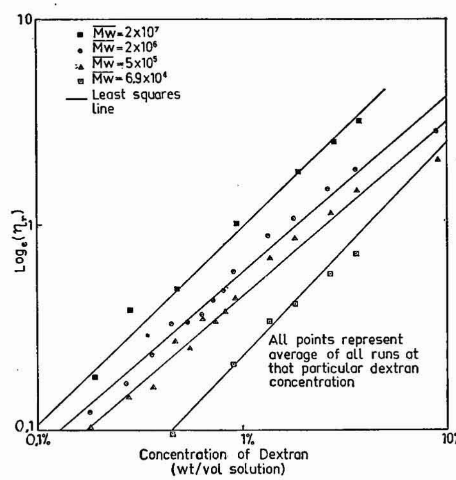

Fig. 4. Effect of dextran concentration on relative viscosity of sugar solutions and molasses (Equation 14)

[10] Rodriguez: "Principles of Polymer Systems" (McGraw-Hill, New York), 1974.

Table I. Prediction of eqation parameters (Equation 13) by least squares regression (Note: concentration is expressed in grams per decilitre of solution)

Dextran molecular weight, $\bar{M}_w$	k_{sp}	95% Confidence limits Lower bound	Upper bound	α_{sp}	95% Confidence limits Lower bound	Upper bound	Correlation coefficient
2×10^7	2·43	0·66	9·0	1·38	1·23	1·53	0·993
2×10^6	0·93	0·51	1·68	1·27	1·20	1·33	0·997
5×10^5	0·66	0·38	1·14	1·07	1·00	1·13	0·995
$6{\cdot}99\times10^4$	0·27	0·08	0·89	1·12	0·99	1·26	0·991
$4{\cdot}04\times10^4$	0·15	*	*	0·25	*	*	0·75

not calculated

Table II. Prediction of equation parameters (Equation 14) by least squares regression (Note: concentration is expressed in grams per decilitre of solution)

Dextran molecular weight, $\bar{M}_w$	k_r	95% Confidence limits Lower bound	Upper bound	α_r	95% Confidence limits Lower bound	Upper bound	Correlation coefficient
2×10^7	0·97	0·51	1·86	0·96	0·89	1·04	0·996
2×10^6	0·58	0·30	1·11	0·85	0·78	0·92	0·991
5×10^5	0·45	0·26	0·78	0·85	0·79	0·92	0·992
$6{\cdot}99\times10^4$	0·23	0·06	0·88	1·03	0·88	1·18	0·987
$4{\cdot}04\times10^4$	0·14	*	*	0·23	*	*	0·750

* not calculated

Table III. Prediction of equation parameters (Equations 15 and 16) by least squares regression (Note: concentration is expresssed in grams per decilitre of solution)

Equation	Parameter	Parameter value	95% Confidence limits Lower bound	Upper bound	Multiple correlation coefficient
$\eta_{sp} = k_1\gamma^{k_2}c^{k_3}$ (Equation 15)	k_1	0·036	0·023	0·057	
	k_2	0·35	0·31	0·39	0·990
	k_3	1·21	1·16	1·26	
$\ln \eta_r = k_1\gamma^{k_2}c^{k_3}$ (Equation 16)	k_1	0·056	0·038	0·081	
	k_2	0·25	0·216	0·278	0·988
	k_3	0·92	0·88	0·96	

The data shown in these two figures represent the average values of viscosity for both molasses and sucrose solutions measured for a variety of conditions. Individual readings are shown on subsequent plots. Except for the lowest molecular weight polymer, where only eight viscosities were measured, the data appear to fit both equations satisfactorily, although there is evidence of curvature at the very high concentration levels. Since these concentration levels lie outside the typical values measured in degraded cane samples, the slight deviation in this region will not be considered further. In the following discussion, the data from the dextran of $\bar{M}_w$ $4{\cdot}04 \times 10^4$ is disregarded; the relative effect of this dextran on solution viscosity is very small.

Tables I and II indicate that all the parameters are functions of the weight average molecular weight $\bar{M}_w$ or degree of polymerization, although α_{sp} and α_r are weak functions. If this dependence is recognized, the complete data set may be fitted satisfactorily by either of the following relationships:

$$\eta_{sp} = 0{\cdot}036\,\gamma^{0{\cdot}35}\,c^{1{\cdot}21} \quad \text{.............................(15)}$$

$$\ln \eta_r = 0{\cdot}056\,\gamma^{0{\cdot}25}\,c^{0{\cdot}92} \quad \text{.........................(16)}$$

where γ = weight average degree of polymerization, = $\bar{M}_w$/(molecular weight of polymer subunit) = $\bar{M}_w/162$.

The relevant statistical parameters for the least squares regression are found in Table III. It is apparent that the generalized fit of the data by the above equations is very satisfactory considering the wide range of conditions that were used in the various experiments.

If a typical value of the weight average molecular weight of cane dextran is taken as 20×10^6 (this is discussed further in the next section) then a reasonable estimate of the viscosity increase due to cane dextran is given by:

$$\eta_r = 1 + 2{\cdot}2c^{1{\cdot}2} \quad \text{................ (18)}$$

$$\text{or } \ln \eta_r = 1{\cdot}1c^{0{\cdot}9} \quad \text{..............(19)}$$

As an example, a concentration of dextran in solution of 1% v/v would increase the viscosity to about 300% of that of the dextran-free solution at the same total solids concentration. This is of the same order as that predicted by Carrazana *et al.* and referred to earlier. The main source of error is likely to be in the estimate of the weight average molecular weight of dextran produced in the cane.

Effect of dextran concentration and molecular weight

Both the absolute polymer concentration and its average molecular weight affect the increase in viscosity of the degraded cane sugar solution. While concentration is readily measured in first expressed juice, an estimate of dextran molecular weight is difficult to obtain. The molecular weight of dextran produced during cane degradation is considered to be of relatively high order. Bovey[11] found values ranging from 50×10^6 to 120×10^6 for the weight average molecular weight of dextrans ($\bar{M}_w$), produced from cultures of *L. mesenteroides*. In studies of dextrans produced in sugar solutions with B-512 *L. mesenteroides* Jeanes *et al.*[12] measured values of $\bar{M}_w$ around 50×10^6. Covacevich & Richards[13] found a significant fraction of cane dextran with a value of $\bar{M}_w$ greater than 20×10^6, although they did not rule out the possibility of molecular association during the analytical procedure. Along with Tsuchiya[14] they also showed that the molecular weight distributions of dextrans in degraded cane were either bimodal or trimodal.

As mentioned earlier, the average molecular weight and the molecular weight distribution produced by enzymatic synthesis are dependent on the polymerization mechanism and the time for reaction. Bovey[11] presents evidence that the reaction is end-group catalysed involving a single chain mechanism. If this is the case, $\bar{M}_w$ reaches a high value early in the polymerization processes and increases slowly from then on. This is opposed to a stepwise growth process involving a multi-chain mechanism where $\bar{M}_w$ is a much stronger function of reaction time and hence is more difficult to predict for a random cane sample because of the variable nature of this reaction time. Evidence[15,16] suggests that the reaction time is a function both of the burn-to-cut time and the cut-to-crush time, with the relative effects of each open to some argument. A possible hypothesis is that the burn-to-cut time allows an initial

[11] *J. Polymer Sci.*, 1959, **35**, 167.
[12] *J. Amer. Chem. Soc.*, 1954, **76**, 5041.
[13] *I.S.J.*, 1977, **79**, 3–9.
[14] *J. Amer. Chem. Soc.*, 1955, **77**, 2412.
[15] Bacic, Covacevich & Richards: *Proc. Queensland Soc. Sugar Cane Tech.*, 1977, **44**, 11–18.
[16] Wells & James: *ibid.*, 1976, **43**, 287–293.

distribution of micro-organisms and excreted enzyme, dextransucrase, to build up on the exterior of the cane as well as initial deterioration of cane to take place at any defects in the cane exterior. Upon cutting and storing, the micro-organisms are inoculated into the cane billets by the cutting blade of the harvester and by contact with the exterior of adjacent billets. Dextran formation then takes place until the micro-organisms and the enzymes are inactivated during processing or inhibited by the reduced pH values that accompany the reaction. At present there is a lack of evidence to test this hypothesis. The uncertain and highly variable nature of the reaction time means that the prediction of an average molecular weight is to be avoided if possible.

It is noticeable that the above equations suggest that low molecular weight compounds should have little effect on solution viscosity apart from their contribution to total solids. This agrees with the conclusions of Atherton[4] and Awang & White[8].

Effect of dextran structure

It has been found that the dependence of the limiting viscosity number $[\eta]$ on molecular weight for a particular polymer-solvent system is affected by the structure of the polymer molecule amongst other factors; the higher the degree of branching the weaker is the dependence of $[\eta]$ on the molecular weight. Ingelman & Halling[17] showed that, for higher molecular weight fractions, α in Equation 9 decreased significantly, indicating that there is increased branching at these higher molecular weights. Covacevich & Richards[18] showed that dextran from a number of degraded cane samples was essentially linear with only a small degree of branching i.e. of the order of 5%. This suggests that the variation in molecular weight dependence of the viscosity with different dextran samples is likely to be relatively insignificant. In very badly deteriorated cane, where $\overline{M}_w$ reaches extremely high values, this may not be the case. Additionally, cane dextrans will be of broader molecular weight distribution than the samples used in this procedure. This is likely to cause some variation in the values of the predicted parameters.

Effect of sucrose concentration

Table IV indicates that the concentration of low molecular weight components (in particular sucrose) does not markedly affect the relative increase in viscosity due to dextran, although some of the charged components in molasses may exert associative effects. The range of sugar concentrations tested was quite wide and although the number of molasses samples tested at this stage is relatively small, the agreement is

Table IV. Effect of varying sucrose concentration on relative viscosity increase due to dextran

Dextran molecular weight, $\overline{M}$	*Sucrose concentration, °Brix*	*Dextran concentration, grams per decilitre*	*Temp., °C*	*Relative increase in solution viscosity* (η_{sp}) *Measured*	*Predicted (Eqn. 13)*
2×10^6	66·7	0·904	45	0·74	0·83
	66·7	0·904	60	0·79	0·83
	67·7	0·904	60	0·72	0·83
	69·7	0·904	60	0·72	0·83
	71·4	0·904	45	0·74	0·83
	76·0	0·452	60	0·42	0·34
	76·0	0·904	60	0·80	0·83
	76·0	1·81	60	1·71	1·99
	77·6	0·904	55	0·61	0·83
	77·6	0·904	60	0·79	0·83
2×10^7	66·7	0·940	60	1·73	2·23
	67·7	0·940	60	2·17	2·23
	69·7	0·940	60	1·82	2·23
	71·4	0·940	60	1·98	2·23

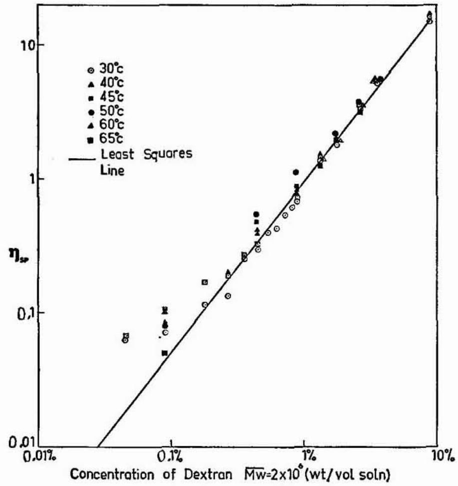

Fig. 5. Effect of temperature on relative increase in solution viscosity due to dextran (Sucrose solution 66·7°Brix)

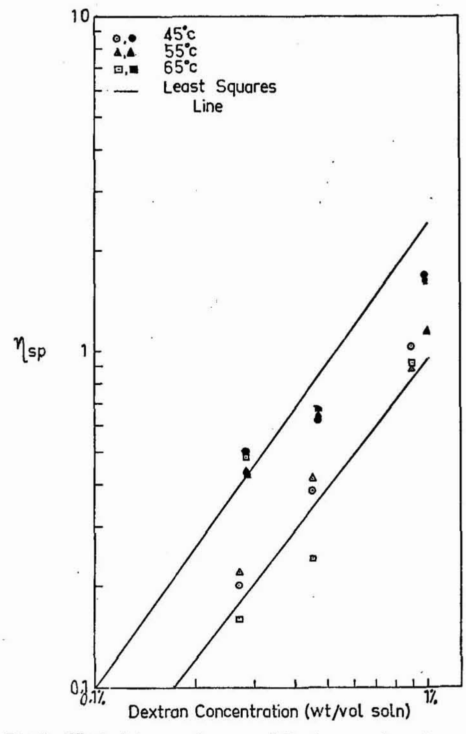

Fig. 6. Effect of temperature on relative increase in molasse viscosity due to dextran

⊙, △, □ $\overline{M}_w = 2\times10^6$

●, ▲, ■ $\overline{M}_w = 2\times10^7$

[17] *J. Phys. Chem.*, 1954, **58**, 953.

[18] *Proc. Queensland Soc. Sugar Zane Tech.*, 1974, **41**, 171–177.

very good between the different samples. The equations have not been tested at the very high solids concentrations found in the latter stages of processing. These studies will be continued using a cone and plate viscometer to overcome the problems associated with highly non-newtonian fluids.

Effect of temperature

Over the experimental temperature range, the data suggest that the relative viscosity increase due to dextran is temperature-independent (Figs. 5 and 6). Olbrich[19] has found that the absolute viscosity of sugar solutions is related to the absolute temperature by an equation of the form

$$\eta = A.10^{B/T} \qquad (21)$$

where A and B are constants.

Dixon[20] has shown that a similar type of relationship exists for dextran-containing sucrose solutions. Because the relative viscosity increase is unaffected by temperature, only the change in the reference viscosity with temperature need be considered in predicting molasses or sucrose solution viscosities.

Effect of dextran degradation

Fulcher & Inkerman[21] have shown that dextran can be degraded successfully by the addition of the enzyme dextranase albeit at a cost to the process. The significance of the above results is that they suggest that there is an optimum processing strategy for such removal, which is dependent on the degradation kinetics. Since degradation does not improve sucrose concentration in any absolute fashion but improves processing performance and final yield, there is little reason to degrade the polymer beyond the point where such improvements become marginal.

This can be illustrated by an example. A reduction in $\bar{M}_w$ from 50×10^6 to 1×10^6 at the same weight concentration (20,000 ppm) produces a much greater change in absolute viscosity than does a further 50-fold reduction to a $\bar{M}_w$ of 20,000. This is slightly simplistic since it does not take into account the degradation kinetics and the possibility of an absolute reduction in weight concentration of dextran[11], but it does suggest that the initial reaction is likely to be of most significance in its effect on solution viscosity. Hence, care should be taken to minimize the dextranase input for a given incubation time. Inkerman & Riddell[22] came to the same conclusion from actual dextranase studies. There are, of course, other considerations such as filtrability and crystal elongation that may be affected in a different manner.

Acknowledgments

The financial assistance of the Bureau of Sugar Experimental Stations and the Sugar Research Institute is appreciated.

Summary

The effect of the polymer dextran on the viscosity of sugar and molasses solutions has been measured and an expression developed to predict the fractional increase in viscosity over a solution of equivalent total solids but zero dextran levels. This viscosity increase can be represented for a typical case of degraded cane molasses by either of the following equations:

$$\eta_{sp} = 2{\cdot}2c^{1{\cdot}2}$$
$$\ln \eta_r = 1{\cdot}1c^{0{\cdot}9}$$

In this expression, a value of 20×10^6 for the weight average molecular weight of the dextran is assumed. It is recommended that work be carried out to specify more exactly this property of degraded cane dextran.

Effet des dextranes sur la viscosité des solutions de sucre et mèlasses

L'effet du polymère dextrane sur la viscosité des solutions de sucre et des mélasses a été déterminé et on a établi une équation mathématique pour la prédiction de l'accroissement fractionné en viscosité par rapport à une solution de matière seche équivalente mais ne contenant pas de dextrane. Pour un cas type de mélasse dégradée de canne, cet accroissement de viscosité peut être représenté par l'une ou l'autre des équations ci-après:

$$\eta_{sp} = 2{,}2c^{1{,}2}$$
$$\ln \eta_r = 1{,}1c^{0{,}9}$$

Dans l'expression on a admis une valeur de 20×10^6 comme poids moléculaire moyen du dextrane.

Der Einfluss von Dextran auf die Viskosität von Zuckerlösungen und Melassen

Die Verfasser haben den Einfluss von polymerem Dextran auf die Viskosität von Zucker- und Melasselösungen untersucht und eine mathematische Formel entwickelt, mit welcher der fraktionelle Viskositätsanstieg gegenüber einer hinsichtlich des Trockensubstanzgehaltes gleichwertigen, aber kein Dextran enthaltenden Lösung vorausgesagt werden kann. Dieser Viskostitätsanstieg kann für den typischen Fall einer teilweise zersetzten Rohrmelasse nach einer der folgenden Gleichungen ermittelt werden:

$$\eta_{sp} = 2{,}2\ c^{1{,}2}$$
$$\ln \eta_r = 1{,}1\ c^{0{,}9}$$

Bei der Formel wurde ein Wert von 20×10^6 für das mittlere Molekulargewicht des Dextrans angenommen.

Efecto de dextrana sobre la viscosidad de soluciones de azúcar y de melaza

El efecto del polímero dextrana sobre la viscosidad de soluciones de azúcar y de melaza sa ha determinado y un expresión matemática se ha desarrollado para predecir el aumento fraccional de viscosidad en comparación con una solución de un contenido equivalente en sólidos totales pero sin dextrana. El aumento en viscosidad puede representarse, para un caso de melaza de caña degradado, por cualquiera de las dos ecuaciones:

$$\eta_{sp} = 2.2\ c^{1{\cdot}2}$$
$$\ln \eta_r = 1.1\ c^{0{\cdot}9}$$

En el expresión se ha asumido un valor de 20×10^6 para el peso molecular medio de la dextrana.

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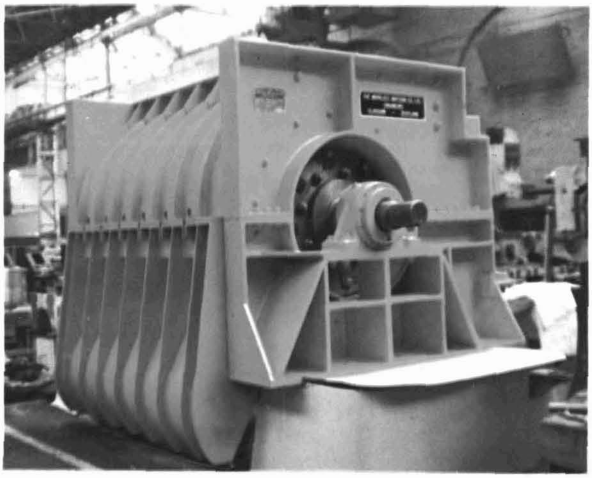
[19] "Principles of Sugar Technology", Vol. 3, Ed. P. Honig. (Elsevier, Amsterdam), 1963, p. 535.
[20] B.E. Thesis, University of Queensland, 1976.
[21] *Proc. Queensland Soc. Sugar Cane Tech.*, 1976, **43**, 295–305.
[22] *ibid.*, 1977, **44**, 215–223.

SMITH MIRRLEES

The Tongaat Shredder

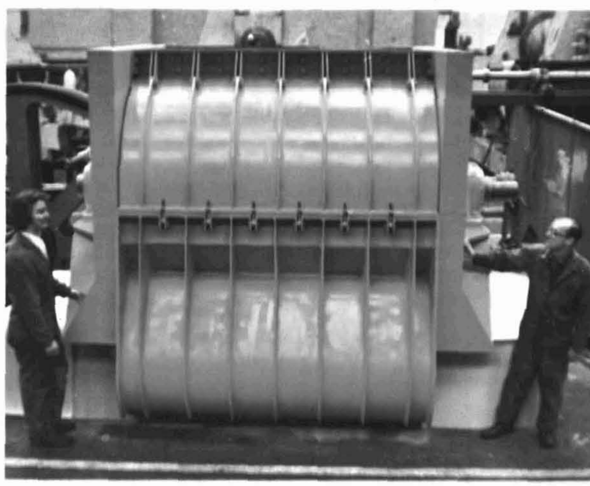


Rotor

Extremely rigid construction, with 350 mm shaft (on 1 500 mm shredder) and no spacer discs.

Rotor elements (discs) are flogged up solid with large through-bolts, then locked together with 'Ringfeeder' double-taper clamps, giving a solid assembly.

The mass of construction renders a flywheel unnecessary. The inertia of the 1 500 mm shredder rotor with hammers is a 2 060 kg m^2.



Hammers

There is more than 100% coverage of hammers across the shredder width (46 hammers, each 50 mm + hardfacing, across 2 100 mm shredder).

Grid

The grid is fabricated completely from steel plate, and stress relieved.

Anvil bar and grid bars are identical and of a simple rectangular section.

Each grid bar comprises two 1 050 mm sections for ease of handling. The rectangular construction allows for 4 wearing corners for each bar.

RESULTS COUNT: Achieving at Tongaat 90% + D.I. (S.M.R.I. METHOD) on 30 TONS (Metric) fibre per hour.

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Exhaustion of final molasses

By R. MORERA and R. MISHCHUK (ICINAZ, Cuba)

Introduction

THE variation of mother liquor purity affects molasses yield less in the later stages of crystallization than at the beginning, according to Mishchuk *et al*[1]. Nevertheless, adoption of an optimum crystallization regime for *C*-massecuite is of great importance because, if crystallization is not optimized, there will result either an increase in the sugar loss to final molasses or an increase in the recirculation of impurities and their retention in the final raw sugar. Both alternatives are highly undesirable; in the first case there is a loss of sugar and in the second a loss of vacuum pan capacity and reduced quality in the commercial raw sugar.

Processing in the crystallizer is a unit operation designed to permit massecuites, which have been evaporated to a maximum working consistency in the vacuum pan under almost isothermal conditions, to continue their crystallization at temperatures that are progressively lowered. The supersaturation which results is the basic motive force for the process. Crystallization will cease when a state of equilibrium is reached where the mother liquor is no longer supersaturated and the molasses from this massecuite is said to be exhausted. The technical object of crystallizer operation is to obtain the maximum exhaustion in a minimum of time.

The rate of crystallization depends on temperature, on the degree of supersaturation, on the sucrose crystal area and on the nature and concentration of the non-sucrose constituents. All these factors influence the viscosity which is the limiting physical property in mechanical handling of massecuite and which, therefore to a large extent, governs the procedure technology.

During the gradual reduction of the massecuite temperature in the crystallizer, the viscosity increases to such an extent that the raw sugar cannot be separated efficiently by centrifugalling. Since, normally, in the massecuite which has reached the minimum temperature, the mother liquor is still supersaturated, the massecuite can be re-heated to the mother liquor saturation temperature in order to spin it without loss of crystal sucrose by dissolution. This can be done by use of a massecuite re-heater installed directly in the centrifugal basket.

Owing to the variability of composition and the complex multiple factors which affect the crystallization, it is very difficult to obtain completely exhausted final molasses. Nevertheless, with appropriate equipment, control based on instruments, and careful attention, sucrose losses in the final molasses can be reduced to a minimum. The object of this paper is to examine the principal parameters and to establish the final massecuite quality as well as the control methodology of crystallization in regard to automation of this most important operation.

Experimental procedure

Our previous researches have shown[2] that the viscosity of mother liquor which is separated by the "Konti 8" continuous centrifugal is about 100 poises (Fig. 1), as measured by the method of Silina & Lyakhtsik[3]. Crystal colour may be used as an indication of the viscosity limiting value[3]. Knowing the "standard viscosity" it is possible to determine the "standard purity" and the "optimum viscosity" of *C*-massecuite.

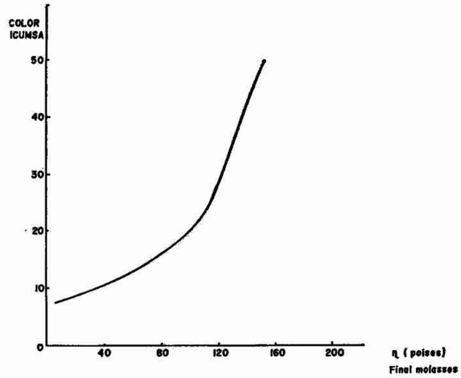

Fig. 1. Quality of the seed as a function of the viscosity of the final molasses

In order to obtain the saturated final molasses a modification of the method described by Silin[4] was employed. A special thermostat was designed (Fig. 2) where the temperature was maintained constant by means of a U-10 ultra-thermostat. Final molasses samples from the Pablo Noriega Experimental Cane Sugar Factory were prepared having different concentrations of soluble solids and were mixed with sieved fine sugar (grain size 0·20–0·50 mm) and the samples agitated during 72 hours while the chamber temperature was maintained constant at 50°C. Before and after submitting the molasses to this treatment, the following parameters were measured: % soluble solids (refractometric method), % sucrose (borax method) and viscosity (using a "Rheotest II" rotary viscometer).

Results and discussion

The "standard purity" was determined as shown in Fig. 3 where viscosity and purity are plotted against % soluble solids, obtained from saturated molasses, taking as "standard viscosity" (η_N) the value of 100 poises. In Fig. 4 are shown the relation of the saturation

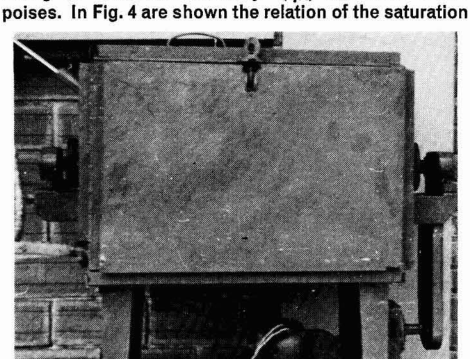

Fig. 2(a). Exhaustibility equipment. Lateral view.

[1] Unpublished work, 1976.
[2] Morera & Mishchuk: Unpublished work, 1976.
[3] *Sakhar. Prom.*, 1972, (8), 44–46.
[4] "Sugar beet factories and refinery technology" (Pishchinformizdat, USSR), 1958, pp. 431, 434, 441.

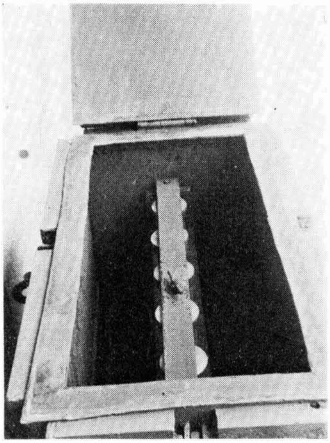

Fig. 2(b). Exhaustibility equipment. Superior view.

coefficient (α) to the non-sucrose present in cane molasses, as well as corresponding data obtained by Zhvirblanskii and Grut with beet molasses[4]. In this graph we can see that the saturation coefficient of the cane molasses analysed is less than unity (0·80–0·99). The values found by Adkins[5] are between 0·70 and 0·84; those of Foster *et al.*[6] are between 0·78 and 0·82 and those

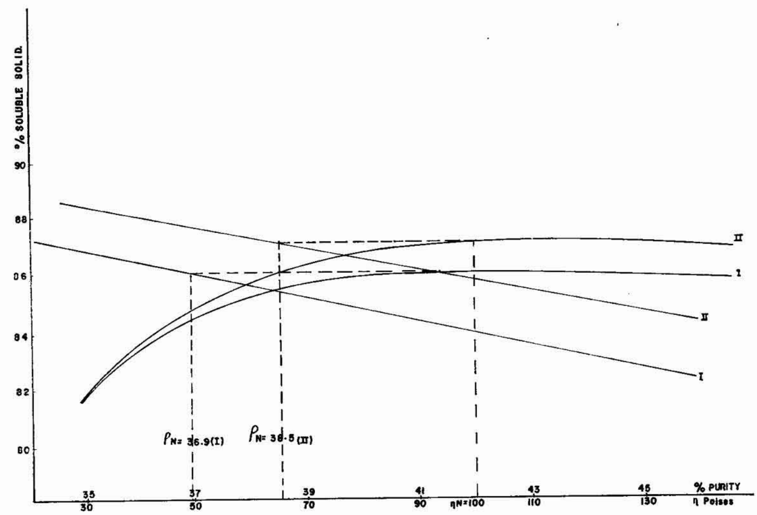

Fig. 3. Graph to determine the normal purity in relation to the normal viscosity

reported by West[7] in 1966 are in the range 0·78 to 0·96. By contrast, the data reported for beet molasses[4] show saturation coefficients greater than unity.

According to Silin[4] and Gromkovskii[8], massecuite viscosity depends both on mother liquor viscosity and on crystal content, and the relation between these parameters is as follows:

$$V_y = \frac{V_o}{a - b\varphi + c\varphi^2} \quad \text{..................(1)}$$

where V_y = *C*-massecuite viscosity in poises, V_o = mother liquor viscosity in poises, φ = crystal content of *C*-massecuite by volume, and *a*, *b* and *c* are constants. According to Silin and Gromkovskii the values of these constants are:

	a	*b*	*c*
Silin[4]	1	3·8047	3·6584
Gromkovskii[8]...	1	3·7855	3·6614

The nomogram presented in Fig. 5 may be used to convert crystal content % massecuite by weight to crystal content by volume. If we know the "standard viscosity" for the centrifugal with which we are working, it is possible to calculate the optimum conditions for the *C*-massecuite. For the calculations we have used the data of Fig. 6 from which it may be deduced that values of over 45% crystal content by weight are not suitable for beet molasses, as has been reported by Silin[4], Gromkovskii[8] and Glygalo & Vlasenko[9]; on the other hand, for cane massecuite, this maximum value is about 48% by weight, as has been shown by Diaz & Lodos[10].

Bearing in mind these values, and using equation (1), we have calculated that the viscosity of *C*-massecuite must not be higher than 2475 poises at the moment of centrifugalling. The *C*-massecuite purity (P_y) is calculated from equation (2):

$$P_y = \frac{1}{1 + \dfrac{(1 - K/S_o.A)}{\alpha_m}} \quad \text{.....................(2)}$$

where K = crystal content of *C*-massecuite by weight (expressed as a fraction), S_o is the ratio $P_m/(1 - P_m)$ where P_m is the purity of the mother liquor, α_m = mother liquor saturation coefficient, and A is a factor which defines the crystal quality, i.e. $A = S_c - \alpha_m N_c$, where S_c is the sucrose content in the crystal and N_c is the non-sucrose content in the crystal, both expressed as fractions. (In the case of pure crystals $N_c = O$ and $A =$

[5] *Proc. Queensland Soc. Sugar Cane Tech.*, 1956, 49–57.
[6] *ibid.*, 1958, 179–188.
[7] *Proc.* 1966 *Meeting B.W.I. Sugar Tech.*, 338–351.
[8] *Sakhar. Prom.*, 1966, (10), 12–17.
[9] *Trudy VNIISP,* 1974, **21**, 52–57.
[10] Unpublished work, 1976.

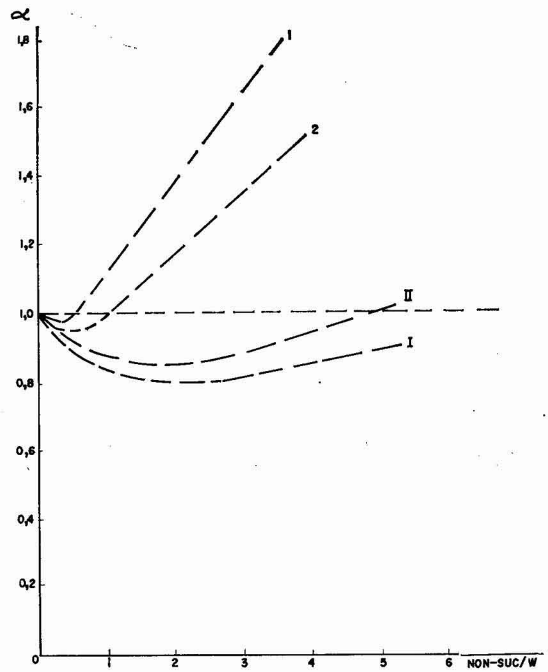

Fig. 4. Relation between the saturation coefficient (α) and the non-sucrose:water ratio of the final molasses

1—Data of Zhvirblanskii (beet) 2—Data of Grut (beet)
I & II—Experimental sugar cane factory "Pablo Noriega"

$S_c = 1$). With these parameters, and using equation (2) the *C*-massecuite purity may be determined.

The content of sucrose in the *C*-massecuite (S_y) is determined by the following expression:

$$S_y = K + (1 - K)\ B_m P_y \quad \ldots\ldots\ldots\ldots\ldots(3)$$

If we know the Brix of "standard" final molasses (B_{mn}), that of the mother liquor (B_m) in the *C*-massecuite at the vacuum pan outlet is given by

$$B_m = \frac{B_{mn}}{B_{mn} + \dfrac{(1 - B_{mn})}{\alpha}} \quad \ldots\ldots\ldots\ldots\ldots(4)$$

where α = the saturation coefficient, which depends on the final temperature of the *C*-massecuite (usually 1·1).

The mother liquor purity is determined from the following equation:

$$P_m = \frac{(1 - B_m)H_o\ \alpha.\alpha'}{B_m} \quad \ldots\ldots\ldots\ldots\ldots(5)$$

where H_o = sucrose solubility in one part of water, α'= saturation coefficient $= \dfrac{P_n.B_{mn}}{(1 - B_{mn}).H_o}$, and P_n = purity of the "standard" final molasses.

It is assumed for the purpose of the calculation that the temperature of the *C*-massecuite is 65°C at the vacuum pan outlet.

From the foregoing equations, when substituting the assigned parameters and assuming the purity of the crystal to be 85%, we find that the final massecuite purity has to be between 60% and 62% if a "standard" final molasses is to be obtained. The saturated final molasses

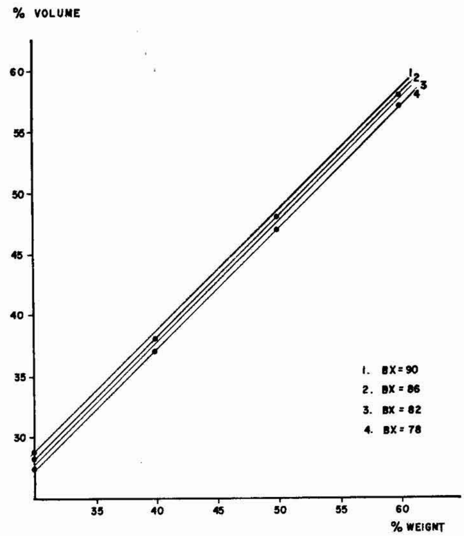

Fig. 5. Nomogram of % in weight *vs.* % crystal by volume of massecuite

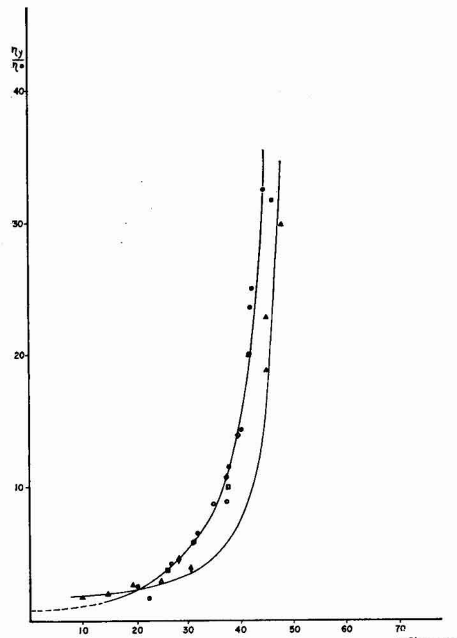

Fig. 6. Relation of *C*-massecuite viscosity to % crystal by volume. Key: o Gromkovskii[6] (beet massecuite); ◊ Glygalo & Vlasenko[7] (beet massecuite); □ Silina[3] (beet massecuite); △ Diaz & Lodos[10] (cane massecuite).

quality is a function of its viscosity and also of the characteristics of the non-sucrose components.

It is also necessary to establish a crystallization regime for the *A*- and *B*-massecuites so that, when the seed grain is mixed with *B*-molasses, the purity of the mixture will not be higher than the planned value for the purity of the final massecuite; otherwise it will not be possible to obtain a "standard" final molasses.

Summary

In the present paper the authors examine the principal parameters (control of crystallization and of final massecuite quality) for operation of the "Konti-8" continuous centrifugal in order to attain standard final molasses characteristics. The optimum viscosity for *C*-massecuite (2475 poises) is calculated for a "standard" final molasses viscosity while characteristics for *C*-massecuite, in order to obtain crystal sugar of required quality and a "standard" final molasses (60–62% crystal content of 85% purity), are also presented.

L'épuisement des mélasses finales

Les principaux paramètres (contrôle de la cristallisation et de la qualité de la masse cuite finale) pour la conduite de l'essoreuse continue "Konti-8" sont examinés dans le but d'obtenir les caractéristiques de mélasses finales standard. La viscosité optimale pour la masse cuite *C* (2475 poises) est calculée pour une viscosité des mélasses finales standard, tandis que sont également présentées les caractéristiques de la masse cuite *C* pour l'obtention d'un sucre cristallisé de la qualité requise et une mélasse finale standard (60–62% de teneur en cristaux à 85% de pureté).

Die Erschöpfung der Melasse

Die Verfasser haben die wesentlichen Parameter (Kontrolle des Kristallisationsprozesses und der Qualität der Nachproduktfüllmasse) bei der Arbeit mit der kontinuierlichen Zentrifuge "Konti-8" mit dem Ziel untersucht, Melasse mit Standardeigenschaften zu erhalten. Die optimale Viskosität für *C*-Füllmasse (2475 Poise) wird für die Standardviskosität der Melasse errechnet. Ferner werden die Eigenschaften der *C*-Füllmasse angegeben, die erforderlich sind, um Kristallzucker einer gewünschten Qualität sowie eine Standardmelasse (60 bis 62% Kristallgehalt bei 85% Reinheit) zu erhalten.

Agotamiento de melaza final

Los parámetros principales (control de cristalización de de calidad de masa cocida final) para operación de la centrífuga contínua marca "Konti-8" se examinan para alcanzar características normales para melaza final. La viscosidad óptima para masa cocida *C* (2475 poises) se calcula para una viscosidad normal de melaza final, y se presentan características de masa cocida *C* (60–62% contenido de cristales y pureza 85%) para obtener azúcar cristal de calidad requerida y melaza final normal. □

New Indian sugar factories[1].—It was announced recently that seven new sugar factories will start operation in Uttar Pradesh during the current crushing season. Three of them—Chandpur in Bijnor, Chata in Mathura and Nandganj in Chazipur district—will function under the State Sugar Corporation, whereas the remaining four—Budeaun and Anupshahr in Bulandshahr and Bilaspur in Rampur and Bislapur in Pilibhit district—will be in the cooperative sector. Each factory has a rated daily processing capacity of 1250 tonnes of cane and all will go into production in the period November 1977–April 1978.

Correspondence

To The Editor,
International Sugar Journal,
Dear Sir,

May I make one or two comments on Dr. Watts' interesting letter (*I.S.J.*, 1978, **80**, 38–39). If I interpret him correctly he would like to change from polarization to the measurement of sucrose for all commercial as well as analytical practices. There is no doubt that this could be made to work perfectly satisfactorily, but there are various important considerations which must be borne in mind.

First, the official bodies of all countries using polarization must be persuaded to accept the change; second, the change would have to be carried out in such a way that there were no commercial implications, and third, the method of measuring sucrose must be such that it can be carried out quickly on a fairly large number of samples in a normal sugar refinery laboratory. I do not believe that we are likely to see these conditions satisfied for a good many years, and until we do we shall have to carry on with polarization.

Here my plea is merely for agreement. Unfortunately the confusion between polarization and sucrose, which has bedevilled discussion on this subject for many years, still seems to exist. Sucrose can be defined with accuracy, polarization is a property which can only be defined in terms of a method and can have no absolute value. As different methods may give different results (e.g. the so-called lead error) the task of ICUMSA must be to define the method so that agreement in readings can be reached by all concerned. At the moment methods giving two different results have equal status, a most unhappy state of affairs which must be resolved. Until this is done there is no point in even considering changing over to sucrose as the problem which exists now would merely carry on in another form. I do not think that Dr. Watts would approve of a system that allowed two different results for sucrose.

Yours faithfully,

J. A. Watson.

Japan annual sugar import quota[2].—Japan has set a raw sugar import quota of 2,360,000 tonnes for the year to 30th September 1978, in an effort to ease its domestic sugar industry out of a prolonged recession, according to the Agriculture Ministry. The quota, effective 1st February, was formally approved last October by the Cabinet and by the Japanese Parliament last November. The Ministry said that the quota is up 8·3% from the 2,180,000 tonnes imported in the year ended 30th September 1977 but down from normal annual imports of 2,400,000 tonnes. The fall in imports in 1977 was due mainly to the delayed settlement of the contractual dispute with Australian suppliers. The quota has been fixed on the assumption that Japan's refined sugar demand in the year would amount to 2,750,000 tonnes, down by 2% from a year earlier, with domestic sugar production at 582,000 tonnes, up by 9% from the previous year's 534,000 tonnes.

Iran sugar factory[3].—The Jovey sugar factory, erected in just seven months by Polish concerns, completed its first campaign a little before Christmas, with 13,000 tonnes of sugar produced from 110,000 tonnes of beet. It is of 2000 tonnes/day beet slicing capacity, whereas the factory being built in the Moghan Valley (the 19th to be supplied by Poland to Iran) will be of 5000 tonnes daily slice.

[1] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (35), 18.
[2] *Public Ledger*, 28th January 1978.
[3] *Zuckerind.*, 1978, **103**, 90.

SUGAR CANE AGRONOMY

Ratoon cane nitrogen usage in the Burdekin. I. T. Freshwater. *Cane Growers' Quarterly Bull.*, 1977, **40**, 134-135.—Trials have shown the benefits of N application to ratoon cane in the form of increased cane and sugar yield, which were maximum at 230 kg.ha^{-1}; at this level, cane sucrose content fell by 0·5% absolute. The economics of N fertilization are examined.

The installation of sub-surface drip irrigation in the Mackay district. W. J. Nicholson. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 139-142.—Trials with mono- and bi-wall drip irrigation tubing on the author's cane farm are reported. Full details are given of the tube "planting" techniques used. The tubes were located either beside the setts or 40 mm below them; 40% of the tubes placed beside the setts showed signs of blocking or crimping, as well as evidence of eating by ants and rodents, whereas there was no evidence of restricted flow, root interference, algae growth or solid particle accumulation when the tubes were 40 mm below the setts. There was no conscious effort to avoid the tubes or sub-mains during ratooning, but no damage occurred. No trouble was experienced with the automatic timer and hydraulic control valves. An excellent ratoon crop was predicted as a result of the system. However, while the running and maintenance costs are little more than the pumping costs, the capital costs are high (the equipment was imported). Costs are set out for the mono-tube system, but no accurate means of calculating the bi-wall system costs exists.

"Sucrows I"—a simulation model of sugar cane growth. D. A. Tovey and T. A. Bull. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 149-154.—Details are given of a cane growth simulation model in which photosynthesis is a major part. Inputs needed to define local conditions and allow latitude in determining possible changes include: daily solar radiation, rainfall, pan evaporation, mean temperature and soil temperature; soil water holding characteristics and vertical and lateral drainage rates; water table level; data of planting or ratooning; planting density, depth and expected strike; and varietal tillering capacity. There are other inputs for particular uses. Good agreement was found between simulated and actual cane growth patterns in one case where no water stress was permitted and all other factors were considered non-limiting. The effect of varying degrees of water stress on final crop yields in the Victoria factory area was examined by means of the model, which predicted a yield below the maximum attainable without water stress (since the model assumed, from certain hypotheses, that the rainfall would be inadequate for maximum yield), but also suggested that factors other than water supply limited yields in the area. The model was also used to quantify the effect of ratooning time on final crop yield, and showed that a full canopy cover which develops sufficiently early to intercept high summer radiation intensities has advantage over one which makes use of summer radiation to achieve a faster cover but which also intercepts winter radiation of lower intensity, so that July ratoon yields were about double those of November.

Study of the soils of the Rampur zone. I. B. Singh, A. C. Shukla and R. N. Ram. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (II), Ag. 1-Ag. 10.—A total of 298 soil profiles were collected from the zone which provides cane for the Raza Buland sugar factory. All fall into four soil types; details are given of the morphological character, mechanical composition, physical and physico-chemical properties and chemical constituents of each.

Studies on the fertilizer requirement of the sugar cane crop in the Tarai tract of Kashipur factory zone, Nainital, Uttar Pradesh. K. Kar, M. Singh and B. Singh. *Proc. 40th Ann. Conv. Sugar Tech. Assoc. India*, 1974, (II), Ag. 33-Ag.37.—Results are reported of trials carried out with 4 levels of N (as urea), 3 levels of P (as single superphosphate) and farmyard manure equivalent to 67·2 kg.ha^{-1}. Recommendations are given on the basis of the results.

Study of the behaviour of some sugar cane varieties in relation to low temperatures. Experiment I. O. Brinholi, E. C. Ferraz, J. Nakagawa, J. R. Machado and D. A. S. Marcondes. *Brasil Açuc.*, 1977, **89**, 71-78 (*Portuguese*).—Ten cane varieties were planted during 1971 and 1972 in experimental plots at an altitude of 1540 metres where they were subjected to temperatures below 0°C on several occasions. The effects on the leaves and stalks were observed and the most resistant to low temperatures identified as N:Co 310, the other varieties being IAC 48-65, IAC 50-134, IAC 51-205, IAC 52-150, IAC 52-179, IAC 52-326, CB 41-76, CB 56-155 and CP 44-101.

Influence of variety and soil on the content of macronutrients in 16 varieties of sugar cane (*Saccharum* spp.) cultivated in large groups of soils. J. O. Filho and H. P. Haag. *Brasil Açuc.*, 1977, **89**, 79-103 (*Portuguese*).—Trials were established on four soil types, using four replications of 16 varieties in a randomized block design to study the varietal and soil effects on the levels of N, P, K, Ca, Mg and S content of the sugar cane leaves, a central 20 cm portion of each +3 leaf being taken less midrib for analysis. The varieties were all planted under the same conditions of fertilization, tillage, age, phytosanitary treatment and source. Twenty leaves were selected per plot at four months of age and the macronutrient content determined on dry weight. From the results it was concluded that: (*a*) there is a varietal effect on the leaf content of the major elements, independent of soil type; (*b*) soil type has an influence on the leaf composition of different varieties; (*c*) the higher nutrient levels in the leaves did not always correspond to the highest production in tonnes pol per ha; (*d*) because of soil and varietal influence on leaf composition, it is difficult to generalize on critical nutrient levels obtained from foliar diagnosis; and (*e*) critical levels of nutrients established for foliar diagnosis for one variety do not represent the same levels for all varieties.

CANE PESTS AND DISEASES

Assessing the direct losses from Fiji disease. G. N. Turner and E. H. Churchward. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 71-73.—In an effort to find a technique for yield loss, the relationship between stalk length and weight was first investigated. Results showed a direct proportional correlation between the two parameters in the case of N:Co 310 cane. From this relationship, the approximate loss was calculated as (mean stalk length of diseased stools)/(mean stalk length of healthy stools) $\times$ 100. The selection procedure was based on row length, the operator taking a set number of paces and measuring the stool closest to his right foot; the rows were selected at random but in such a way that no major part was left unrepresented. About 2 hours was needed for measurement of the required 100 stools per block. Fifteen blocks were assessed in 1975 and 30 in 1976, both plant and ratoon cane being included. There was considerable variation in losses between blocks having similar levels of disease incidence, and the loss percentage was about one-third of the percentage of infection, although some blocks had much lower losses than could be expected from this trend; subsequent studies showed that these blocks contained more lightly diseased stalks, i.e. having more than 75% of the average non-diseased stalk length, than healthy stools. It was also realised that a non-random distribution of diseased stools and a relatively smaller percentage of stools sampled in large blocks could have affected the loss predictions.

Breeding for resistance and other possible methods of control of Fiji disease at Bundaberg. K. C. Leverington, B. T. Egan and D. M. Hogarth. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 93-95.—The insectary-glasshouse method of testing cane varieties for resistance to Fiji disease[1] is briefly discussed. It is stated that, although the insectary method is open to criticism, it is still the best early-screening test procedure available. There is some evidence to suggest that resistance to the disease may be different in juvenile and mature cane with certain varieties, so that the resistance rating obtained by infecting small plants in the insectary may not apply in the field where most cane is much larger at the time when the leafhopper vector is active. Unpublished data have also suggested that there may be different strains of leafhoppers which behave differently when feeding on cane. It is stressed that the major long-term control measure will be use of highly resistant varieties, and already a number of varieties have shown promise in field trials; however, it is considered unlikely that the first long-term replacement for N:Co 310 will appear within the next five years. Q 87 and CP 44-101 are suitable short-term replacements and should be planted in heavily Fiji disease-infected areas as rapidly as possible. While there is little hope of adequate leafhopper control, the Approved Plant Sources Scheme of the Bureau of Sugar Experiment Stations will continue to be an important method of disease control. Cane inspection and roguing are of little value at present, except in isolated localities.

Sugar cane quarantine procedures in Planalsucar. S. Matsuoka, A. K. Dodson, A. M.C. Rocha and C. A. Wismer. *Brasil Açuc.*, 1977, **89**, 55-62 (*Portuguese*). Planalsucar (the National Programme for the Improvement of Sugar Cane in Brazil) has set up two cane quarantine stations, one in Alagoas State and the other in São Paulo State. The facilities provided and procedures adopted are described. Imported setts are inspected and any rotten portions removed, sterilized and discarded. The apparently healthy sections are planted in plastic buckets filled with sterilized soil and inspected at intervals to detect any pest or disease symptoms. After eleven months the varieties are cut back, young cuttings treated with hot water for 30 minutes at 52°C and mature cuttings treated for 2 hours at 50·5°C before replanting in the quarantine field. Field varieties are grown for 12 months and the bucket ratoon crop grown for 6 months, again with periodical inspection. If free from disease after this time, the variety is released for planting at the experiment stations after the shorter hot-water treatment. Recent exchanges between stations in Brazil have used single-bud rather than three-bud cuttings.

Cane diseases in Réunion. *C.E.R.F. Rpt.*, 1976, 27-34 (*French*).—Elimination of variety R 397 has reduced the incidence of gummosis (*Xanthomonas vasculorum*) while the suspected susceptibility of variety R 567 has not been confirmed. Elimination of H 32-8560 and M 202/46 —susceptible to leaf scald (*X. albilineans*)—has been successful but other varieties are being watched in case of their reaction to the disease. Smut (*Ustilago scitaminea* Sydow) has been observed in certain varieties but at different periods and localities. A number of varieties have been eliminated owing to their susceptibility to smut. Other less important diseases observed include eye spot (*Helminthosporium sacchari*) and yellow spot, while *Fusarium* sp. and *Helminthosporium* sp. have been isolated from cane seedlings. A number of varieties have been tested at Roseville, NSW, Australia, against Fiji disease, and the resistance trials are to be transferred to the Beltsville, MD, USA quarantine station for disease resistance testing. A number of fungicides have been tested against pineapple disease (*Ceratocystis paradoxa*) and the results are tabulated. Further work is to continue to determine the minimum dosage for significant response and to include the ratio of cost to efficacy.

The white pocket louse (*Pulvinaria iceryi*). J. R. Williams. *Rev. Agric. Sucr. Maurice*, 1977, **55**, 405-407 (*French*).—Notes are provided on this cane pest, a type of scale insect, which is fortunately seen only rarely in cane plantations, although in the 19th Century it was reported as having caused serious damage, and it has been identified in several places in Africa, New Guinea, the USA and perhaps in China. A severe infestation occurred in Mauritius and in Réunion in 1976 and is thought to have been due to a (common) climatic factor affecting the pest directly or indirectly through its predators, of which 14 are listed. It is anticipated that a balance will be re-established relatively quickly.

[1] Ledger & Ryan: *I.S.J.*, 1978, **80**, 50.

SUGAR BEET AGRONOMY

New developments in beet loading and in-field transport in Belgium. M. Martens and A. Vigoureux. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1977, **45**, 15-28 (*French*).—Details and illustrations are presented of beet harvesting equipment of recent development which is in use in Belgian beet fields. It is pointed out that, while considerable progress has been made in topping and lifting, with modern harvesters being self-propelled, the weak point in the system has been in-field transport, particularly under very wet conditions; attention has therefore been focused on improving this aspect.

Nitrogen as quality-determining factor in sugar beet metabolism. M. Burba. *Zucker*, 1977, **30**, 173-186 (*German*).—The literature on the role of nitrogen in beet metabolism is reviewed with 168 references, covering the adverse effects of excessive N application on beet processing quality and sugar recovery, N uptake by the beet and its subsequent distribution, nitrate reduction, formation and conversion of amino-acids and amides, transport of nitrogenous compounds in the beet plant, and N metabolism as a function of variety and environmental factors. (While attention is focused on the sugar beet, references are also made to other forms of plant life.)

Results obtained in sugar beet cultivation in 1970-75 and the chief objectives of the present five-year plan. G. Rizescu. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 9-12 (*Rumanian*).—Data for 1970-75, including irrigation and fertilization rates for Rumanian beet as well as plant population and root weights, are briefly discussed. Because of the fall in sugar content in drier years, it is considered important to produce a variety which will accumulate sugar under conditions of reduced humidity, although the need for more rational irrigation is also thought important if 1 million tonnes of sugar is to be produced by 1980. Other aspects of beet agronomy important for increased beet yield and improved quality are also briefly examined.

Effect of sowing time on sugar beet germination and yield. G. Clotan. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 17-20 (*Rumanian*).—Three-year field trials were carried out to determine the effect of sowing time (relative to seedbed preparation), type of seedbed preparation and inter-seed spacing on germination and emergence. Tabulated results indicate that optimum sowing time was as soon after seedbed preparation as practical, while best inter-seed distance was 5 cm. Increase in the distance to 8 and 12 cm caused a progressive fall in field population, as did increase in the interval after seedbed preparation to 7 and 14 days. The best seedbed preparation scheme involved use of a tine harrow, curve-lined harrow and ring roller.

Influence of spacing on sugar beet yield under irrigation in southern Rumania. G. Stefan, O. Stefan and P. Tomoroga. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 21-26 (*Rumanian*).—Results of trials showed that maximum beet and sugar yield were obtained at a plant population of 100,000 per ha after thinning, giving a row spacing of 50/20 cm and permitting optimum fertilizer application. The beet and sugar yield were 15% and 19%, respectively, greater than the results obtained with the lowest plant population of 55,000 per ha. It was also found that the population achieved after thinning fell by 15% up to harvest, while the highest sugar content occurred in roots having a diameter of 8·5 cm and weighing 800 g. The content fell with increase or decrease in root size by comparison with the optimum.

Integrated weed control in sugar beet. A. Ciorlaus and G. Clotan. *Prod. Veget., Cereale si Plante Tehn.*, 1977, **29**, (2), 27-30 (*Rumanian*).—Manual, mechanical and chemical weed control is discussed, with particular emphasis on the use of specified herbicides. Beet yields resulting from trials at six locations on weed control by various pre-and post-emergence herbicides are related to that achieved with three manual and three mechanical cultivations. The data show that "Dual 500" +"Venzar" (4+1 litre.ha^{-1}) as pre-emergence herbicide mixture followed by "Betanal AM" (6 litres.ha^{-1}) as post-emergence herbicide was the best of the chemical treatments, giving 92·3% of the beet yield given by the manual and mechanical treatment. The question of integrating weed control in various crop rotations is discussed, and the more effective herbicides for general weed control under given conditions are briefly indicated.

Sugar factory waste lime. Anon. *Current Topics* (Min. of Agric., Fish. & Food, UK), 30th May 1977.—A note discusses the value of filter cake from beet sugar factories as a soil liming material and as a provider of benefits from its nutrient and organic matter content which, per tonne of 55% d.s., contains about 2·5 kg N, 8 kg phosphate, 3·5 kg Mg and 80 kg organic matter. It also improves the porosity of clay soils.

Elimination of bolted beet. Anon. *Le Betteravier Franç.*, 1977, (316), 15-17 (*French*).—The problem of bolted beet has become noticeable since 1968, since when agriculturalists have become aware of the consequent spread of wild beet in the fields. They are usually vigorous and the seed from them can remain viable in the soil for a long time, even 10 years. Years with a cold spring can stimulate vernalization and bolting of sensitive beets, especially when planted early, and seed of *Beta macrocarpa* in commercial sugar beet seed can give rise to bolters, mainly weed beet with thin roots and tall stalks. Changes in cultivation procedures and elimination of manual work have tended to favour the survival of bolted beet. Equipment has been devised to destroy the bolters, cutting off the flowering tops or burning them with chemicals ("Roundup" or "Gramoxone"), unfortunately never a 100% cure. Details are given of machines used in France for cutting off the flowering tops, and results obtained with them are tabulated. Where beets appear between rows they are "wild" beet and must be eliminated by hoeing. Chemical treatment should be used when bolting is 8-10% or greater, and precautions must be taken to minimize damage to the crop beets. When the number of bolters is small, manual elimination is the only means of completely preventing seed spreading.

BEET PESTS AND DISEASES

Sticky stake traps for monitoring fly populations of the sugar beet root maggot and predicting maggot populations and damage ratings. C. C. Blickenstaff and R. E. Peckenpaugh. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 112-117.—Orange or red sticky stake traps measuring 10 × 1 inches stapled vertically, with the bottoms 1 ft above ground level, on white 2 × 2 in posts facing east or north and located at the margins of beet fields were found to be superior to other colours, heights and exposures in trapping adult sugar beet root maggots *Tetanops myopaeformis*. The colour of the traps is also of advantage in that flies are more easily identified than against darker backgrounds. Since the stakes are placed 1 ft above ground level, they collect less dirt and trash than if they were stuck in the ground, and birds are less likely to remove the flies. The greater number of flies trapped in north and east exposures was possibly due to the fact that in the area of the tests the prevailing winds are from the west or south-west. The number trapped in 1974 and 1975 in the north and east exposures correlated well with maggot populations and beet damage ratings.

Tests with fungicides to control *Rhizoctonia* crown rot of sugar beet. C. L. Schneider, H. S. Potter and D. L. Reichard. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 150-156.—Tests were conducted with a number of fungicides to control *Rhizoctonia solani* in 1972, 1973 and 1974. Spraying was carried out at various dosage rates both into the crowns and at the base of the plants. While certain of the fungicides showed a potential for reducing crown rot incidence by comparison with untreated controls, the results were so variable and inconsistent (e.g. treatments significantly reducing disease incidence in some trials but failing to do so in others) that no recommendation is yet considered justified on the basis of the trials. The inconsistencies were regarded as an indication of the need for more effective ways of application. Although a foam additive was effective with only one of the fungicides by comparison with the untreated controls (causing "Carboxin" to reduce crown rot significantly, whereas the fungicide alone did not), the foam did not impair the effectiveness of the other fungicides. (When a foam additive is sprayed onto the lower leaves of the beet plant, it slowly slides down the blades and petioles to collect at the base of the plant where, presumably, crown rot infection commonly occurs.) Other possible aids to spraying include drift retardants and sticker-spreaders.

Effect of fungus infection on respiration and reducing sugar accumulation of sugar beet roots and use of fungicides to reduce infection. D. L. Mumford and R. E. Wyse. *J. Amer. Soc. Sugar Beet Tech.*, 1976, **19**, 157-162.—It is pointed out that, although covering of beet storage piles greatly reduces losses caused by freezing and thawing, the practice does not reduce losses caused by fungal deterioration of the stored beet; in fact, covering often provides a favourable environment for fungal growth, it is stated. Investigation was made of the effect of fungus on beet respiration rate and reducing sugars accumulation; isolates of *Penicillium* sp. and *Botrytis* sp. obtained from infected stored beet were inoculated into injured beets which were then stored at 15°C and 98% relative humidity. Results showed that the respiration rate increased with increase in the percentage of surface area infected; within a month of storage, beets with 20% of their surface area infected had a 100% higher respiration rate than did injured but uninfected controls. With 15% surface area infected, there was a 3-fold increase in reducing sugars by comparison with uninfected beets, the increase being greatest in the immediate area of the infection, although measurements of reducing sugars in tissue from healthy, mildly infected and severely infected beets showed that the increase could occur throughout the beet. Of 4 fungicides found to have greatest inhibiting effect on fungi (established from growth on an agar medium in a Petri dish), "Benomyl" and "Thiabendazole" were selected for tests on the stored beet. Results showed that complete control of infection was obtained with either fungicide sprayed at 500 ppm concentration, although fungus growth treated with concentrations as low as 100 ppm was greatly reduced by comparison with untreated beets. The observations indicated that injury was essential for fungal infection; many uninjured beets were inoculated with the isolates, but none became infected. It was also found that inoculation was necessary to obtain high levels of infection when the beets had been washed, but was not necessary if the beets were unwashed, indicating an abundance of inoculum present in soil adhering to the beets.

Preliminary studies on the evolution of "Aldicarb" in beet during growth as a function of time and soil type. W. Dejonckheere, W. Steurbaut, R. H. Kips and L. van Steyvoort. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1977, **45**, 1-14 (*French*).—While "Aldicarb" ("Temik 10 G") has generally proved superior to phosphoric esters in controlling aphids and hence virus yellows, it has not been sufficiently effective when applied to beet growing on heavy maritime polder soils such as occur in western Flanders (Belgium). Studies were therefore carried out in 1976 at three locations in western Flanders to gain greater knowledge of the evolution of the insecticide and its metabolites in the beet during the growth period. At two sites the soil was a loamy sand and sandy loam, respectively, while at the third the soil was a sandy clay of the polder type. On the lighter soils, control was excellent with 0·5 kg.ha^{-1} "Aldicarb", whereas on the heavier soil 1 kg.ha^{-1} was not effective in preventing a heavy yellows attack because of decreased absorption of the insecticide. "Aldicarb" was rapidly absorbed by all plants after sowing, followed by a fairly rapid fall in concentration and a subsequent slight increase in concentration (giving a net reduction). The total quantity of "Aldicarb" and its sulphoxide and sulphone metabolites remaining in the leaves tended to increase progressively with leaf growth. The fall in concentration and total content of "Aldicarb" during growth in the trials was attributed partly to a lack of rain during the excessively dry June and August periods, which caused both a reduction in absorption and a loss of "Aldicarb"-containing leaves.

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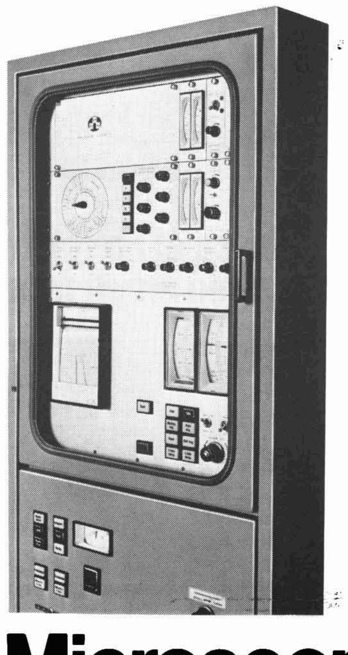

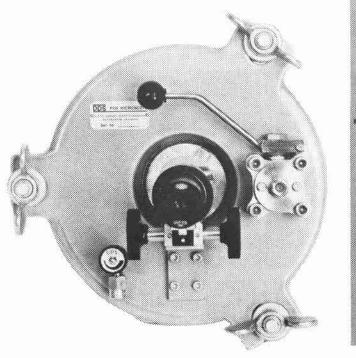

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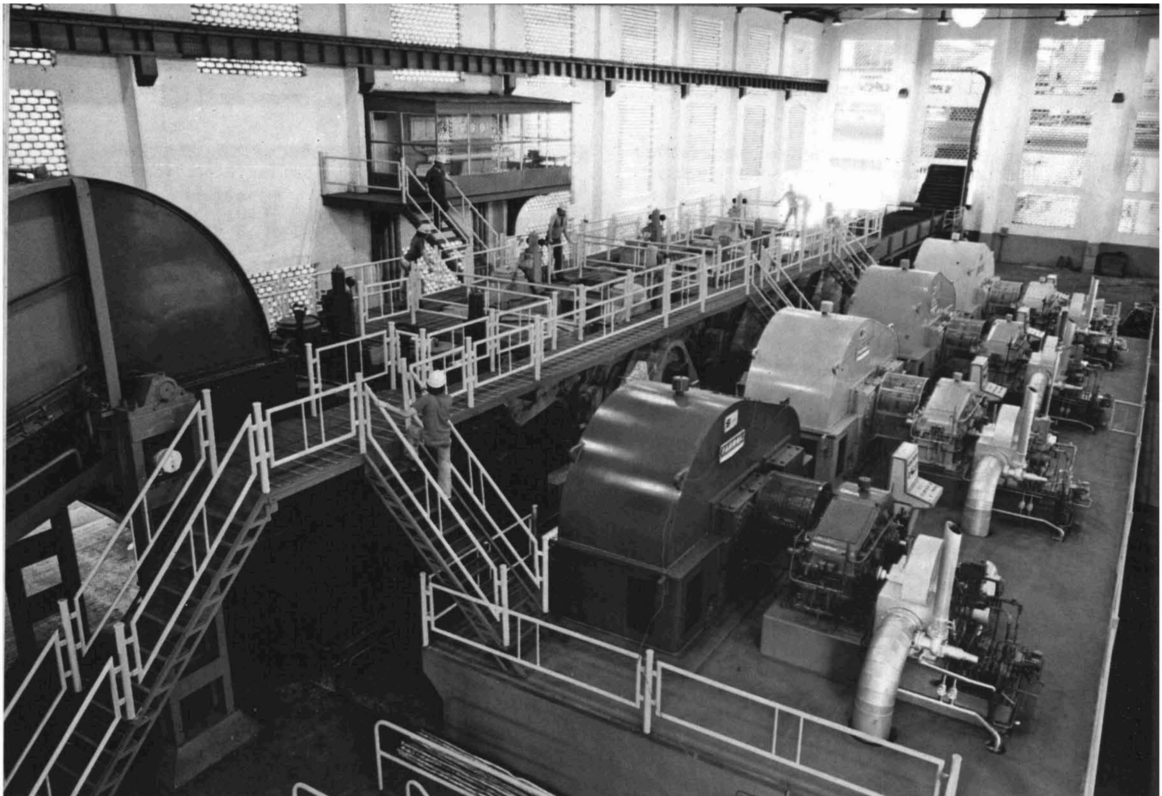

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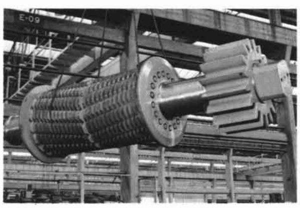

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CANE SUGAR MANUFACTURE

Combustion of bagasse: literature review. B. W. Lamb and R. W. Bilger. *Sugar Tech. Reviews*, 1976/77, **4**, 89-130.—Automation of bagasse furnaces has received little attention because of the variability of combustion quality of the fuel. Considerable research has been done on other cellulosic material combustion, however, and can aid a research programme into bagasse burning. The pyrolysis of cellulose is discussed as is the influence of environmental factors such as sample thickness, heating rate, oxygen concentration and inorganic content. Results of burning rate model tests are summarized and could give considerable understanding of the mechanisms involved in bagasse combustion, but experimental work is needed, particularly under conditions of high moisture content and forced convection.

Implications of recent investigations on shredder hammer tip materials. V. Mason. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 255-259.—Tests by the Sugar Research Institute in conjunction with the Division of Tribophysics of the CSIRO showed that tramp iron and not stones was the main cause of shatter failure of shredder hammer tips, and that the shatter resistance of tungsten carbide tips could be greatly increased by placing chamfers on all exposed edges of the carbide insert and by placing a copper shim below the insert. Comparative tests with a number of metals and alloys showed that tungsten carbide suffered the least wear in handling the equivalent of 40,000 tonnes of cane; the next most wear-resistant materials were hardened high-chromium cast or arc-applied white irons which wore at 3-4 times the rate of tungsten carbide. However, tungsten carbide is so expensive that its use for shredder hammer tips is justified only where a magnetic separator is fitted or the amount of tramp iron in the cane is very low. Cast white iron tips used with newer types of hammers having quick-release heads could reduce the labour expended on maintenance. On the other hand, although cane preparation cannot be quantified, tungsten carbide tips are likely to give higher average preparation than white iron tips and hence increase sugar extraction. It is also pointed out that hard quartz crystals in dirt accompanying cane cause tip wear; if all tramp iron could be removed, harder sintered carbides than at present used could reduce wear still further without significantly increasing shatter failures.

Fatigue failure in mill pinions. H. E. M. Tyzack. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 261-270.—Reasons for the loss of 11 teeth by the 17-tooth top roller pinion on No. 1 mill at Pleystowe are examined (mention also being made of pinion failure at North Eton). It was concluded that a long-toothed pinions of the type used at Pleystowe will have a life of only two seasons at 75% maximum load, while at 100% load it will last less than half a season. Possible means of reducing the average stress levels and improving pinion performance are discussed, viz. lowering the ratio between tooth length an d root thickness, optimizing the number of teeth, and improving moulding techniques to ensure uniform pitch and freedom from taper or misalignment of the teeth, all tooth faces being dressed to eliminate high spots. The question of producing a metal having harder wearing properties and greater strength and toughness than the cast steel normally used is examined. The theoretical fatigue life calculated from load distribution and bending stress curves was sufficiently close to the true life to justify their use as an aid in assessing pinion stresses in a modern hydraulic mill.

Areas for improvement in rotary vacuum screen filter performance. V. Agius, R. Attard, T. Paxton and L. Shuttlewood. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 277-281.—Investigations on the performance of a 63 m^2 rotary vacuum filter were aimed at determining the optimum conditions to give maximum retention, maximum rate of mud solids removal and minimum pol loss. The trials are reported in tabular form. Bagasse quality was found to be of utmost importance for filter performance, and should be very fine ($<0{\cdot}85$ mm in diameter) to give greater area for increased mud solids absorption and high porosity, and should preferably be obtained from pith to give a satisfactory particle shape. Long strands of fibre were found to have a negative effect by lodging in the screens and causing blinding. Even at a high speed of 18·9 rph, good retention and high mud separation were achieved as well as an acceptable pol loss. However, at high speeds the cake must be kept very porous because of the limitation on washing time, so that a fibre:mud solids ratio of about 0·50 is necessary. While a lower ratio gave similar mud separation levels and low pol losses as with the higher ratio, the mud retention was very much lower; on the other hand, excessively high fibre:mud solids ratios may also be detrimental, since they increase the fibre ratio in the cake and thus produce a greater amount of cake for the same mud solids separation. The optimum fibre:mud solids ratio was found to be 0·35. Similar trials on a new Eimco 167 m^2 filter are briefly mentioned. Observations showed that major problems occurred with the feed system, whereby cake thickness varied considerably over a large area if one of the feed pipes became partially choked; a new system was to be installed for the 1977 season.

Supervisory optimizing control at Fairymead mill. G. D. Maclean, A. A. Mooney and J. E. Hendry. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 283-292.—Supervisory optimizing control (SOC), based on periodical adjustment of set points of variables (in contrast to conventional control based on maintenance of variables at fixed set points), is a computerized system which has been introduced at Fairymead. While past applications of SOC have employed either exploratory techniques (in which optimum operation of a process is determined by experimentation using a series of small changes in conditions) or predictive control (whereby optimum conditions are established by means of a mathematical model in conjunction with an optimizing algorithm), the system at Fairymead is based primarily on knowledge of factory operation—use of the more sophisticated predictive control would have necessitated improving the computer facilities. Details are given of the system as applied to cane handling and milling for maintenance of a maximum rate of cane processing from tippler to final mill, subject to: maintenance of a satisfactory extraction level or maximization of extraction when the cane feed rate was limited, prevention of excessive juice supplies to subsequent processing, prevention of overloading of the milling train or bagasse handling system, and prevention of excessive demands on the cane transport system. The control of juice flow from the milling train was controlled by a magnetic meter, while a discharge valve on a surge tank controlled the juice flow through secondary heaters and subsider. A smaller surge tank was used for juice feed to the 1st evaporator effect, in which direct digital control was used for juice level and final Brix. As with the cane handling and milling, the aim of the juice handling control was to maintain a maximum process rate from mixed juice tank to liquor tank. Results obtained with the system have indicated benefits in the form of increased effective milling rates and increased extraction by comparison with the results obtained before introduction of SOC.

Power system design. R. J. McIntyre. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 293–300.—It is stated that electrical power plant has formed a significant part of the investment made in new equipment by Queensland sugar factories in recent years. Turbine generator sets at ratings up to 10 MW and distribution transformers of up to 3 MVA ratings have been installed, and several factories have expressed a need for a further increase in voltage (even where 3·3 kV is used at present). The author briefly outlines the basic concepts of power system design for Queensland factories, particularly with regard to provision for production expansion in the immediate future, covering turbo-alternator selection, voltage levels (in which the author explains when and where low and high voltages are applicable and what is involved in a change from low to high voltage), high voltage distribution, and load centre sub-stations and motor control centres.

Programmable logic controllers—putting control back into the hands of the electrical engineer. D. R. North. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 301–305.—The fundamentals of programmable logic control (PLC), in which the functions are determined by fixed-wire component parts and a programme memory, are explained and contrasted with relay and solid-state systems in which the functions are determined by the wiring of the component parts, so that any change in function necessitates a change in wiring. The PLC is described as having the advantages of solid-state technology, the simplicity of relay techniques and the additional merit of permitting modifications to be made easily and cheaply. Applications of PLC to process control are briefly described.

Conductivity Brix control in syrup. P. J. Pietila. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 307–311.—Advantages and disadvantages of evaporator syrup Brix control on the basis of conductivity are indicated, and a description is given of the system introduced at Babinda in 1975 to replace one based on determination of the Brix of syrup samples and control of the syrup flow from the final effect. The new system necessitates daily adjustment of the controller setpoint and weekly cleaning of the electrodes, but syrup sampling is eliminated and control is smooth within minutes of evaporator start-up, as illustrated by chart samples. Steady-state control response is also excellent. Pulse-to-air interface units are used as control elements.

Electrical measurement transducers. J. R. Spira. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 313–318.—The author, representing an instrument manufacturing company, explains the operation and application of transducers (defined as devices for converting signal energy from one form to another without loss of proportionality) and indicates the requirements for particular roles.

Noise abatement in sugar mills. D. Gotthard and P. R. Powell. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 319–326.—Details are given of development work aimed at reducing the noise produced inside the cab of a diesel locomotive at Macknade factory (brought about by installing a new cab isolated from the chassis) and produced by cane shredders (the results being incorporated in a new shredder at Victoria factory).

Combustion calculations for high ash content bagasse. R. Frew and P. J. James. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 327–334.—CSR sugar factories in Queensland have assumed, in calculation of boiler heat and stoichiometric mass balances, that bagasse "fibre" (defined as dry water-insoluble matter) contains approximately 2·3% ash, whereas the true content is usually much higher. Hence, a new method has been introduced whereby bagasse is analysed for water and ash contents (W and A, respectively) and these subtracted from 100 to give the combustibles content C, after which the $W{:}C$ ratio becomes a good measure of bagasse combustion quality. Examples of boiler calculations are given.

Recent developments in the production of the sugar mill shaft. D. K. Kirkness. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 345–352.—The author describes the present state of the art of steelmaking, casting of the ingots for cane mill roller shafts, and forging, heat treatment and machining of the shafts.

Repair of steam turbines. W. D. Dinnie. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 353–359. The basic engineering techniques used in repair of steam turbines, and the types of failure that can occur are described. It is stressed that major failures to turbines are few, and that, provided reasonable care and attention are given, many years of trouble-free operation can be expected.

Some aspects of maintenance. W. A. Greenwood. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 361–367.—The author states that factory maintenance costs now constitute a greater proportion of total production costs, with the introduction of better and more sophisticated equipment and the associated need for more skilled operation and maintenance, while operating costs form a lower proportion. Hence, there is need to reduce maintenance costs by (i) cutting the amount of maintenance required or by (ii) increasing the productivity of the maintenance work force. Ways in which this can be brought about are discussed.

BEET SUGAR MANUFACTURE

Comparison of filter and thickening units in the carbonatation stations in Greek sugar factories. P. Hristodoulou and A. Eliadou. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (28), 318–342 (*Greek*).—Performances of the filter stations at Platy, Xanthi, Orestias and Serrai sugar factories are compared in detail. Filter-thickeners proved better than filter presses (installed in Serrai factory), while DDS filter-thickeners at Platy were better than Polish FTCZ models installed at Xanthi and Orestias. The heat losses in the filter-thickeners were relatively small (because of the short residence time) in contrast to the considerable losses in settlers at Larissa. The effect of heat loss on steam consumption is indicated.

Possible means of reducing costs of boiler operation. H. Reiche. *Zucker*, 1977, **30**, 215–220 (*German*). The author indicates those aspects of boiler operation which can be automatically controlled so that manual supervision and hence operational costs are minimized. The parameters and operations discussed are: steam pressure, closing of fuel feed when the flame is extinguished, water feed, boiler shut-down when there is a shortage of water, feedwater quality and fire prevention. A complete control scheme for a boiler is shown diagrammatically.

Development of processes and equipment for beet treatment and juice extraction. V. G. Yarmilko, A. K. Buryma, N. D. Khomenko, V. A. Bondarenko, V. P. Zubchenko and V. N. Nechitailo. *Sakhar. Prom.*, 1977, (5), 17–23 (*Russian*).—A summary is presented of research conducted at the All-Union Research Institute of the Sugar Industry (VNIISP) on beet processing up to and including diffusion (as well as pulp pressing). The article, published on the occasion of the 50th anniversary of the founding of the institute, also gives information on Soviet equipment developed during the last 20 years on the basis of the research.

Progress in the technology of juice and syrup purification. Yu. D. Golovnyak, K. P. Zakharov, Yu. V. Anikeev and Ya. O. Kravets. *Sakhar. Prom.*, 1977, (5), 23–28 (*Russian*).—Research at VNIISP on juice purification and filtration (particularly concerned with the handling of juice from low-quality beet), refinery liquor treatment with active carbon, and factory juice and refinery liquor ion exchange treatment is surveyed. Carbon regeneration is also mentioned.

Intensification of sucrose crystallization processes. Yu. D. Kot, L. G. Belostotskii and A. K. Sushchenko. *Sakhar. Prom.*, 1977, (5), 29–33 (*Russian*).—Recent research on boiling and low-grade massecuite cooling is reviewed. Boiling at lower temperatures than normally (72–76° for *A*-massecuite, 65–74° for *B*-massecuite and 55–70°C for *C*-massecuite) has reduced sugar losses. The advantages of 3-massecuite boiling (used at present in only 30% of Soviet factories), especially with use of *B*-massecuite as graining footing for *C*-massecuite boiling, are discussed. However, with a 2-product scheme, it has proved possible to obtain a "standard" sugar from low-purity syrup, provided affination facilities are available and the low-grade massecuite has a purity no lower than 76–78. Advice is given on affination, and mention is made of the benefits of surfactants added to massecuite in the vacuum pan. The advantages of massecuite stirrers and multi-sectioned pans (reductions in boiling time, steam consumption and sugar degradation) are also discussed.

Problems of sugar drying and storage. A. F. Zaborsin and A. A. Dmitryuk. *Sakhar. Prom.*, 1977, (5), 33–35 (*Russian*).—Research at VNIISP on white sugar drying and storage is summarized, with particular mention of the advantages of fluidized bed dryer/coolers over conventional drum-type equipment.

Development of mechanization in loading, unloading, conveying and storage within the sugar industry. V. A. Novikov. *Sakhar. Prom.*, 1977, (5), 48–55 (*Russian*).—Research and progress made in beet loading, unloading and piling and sugar conveying and storage in the USSR are discussed.

Reception and storage of beet at a modern level of scientific and technological development. M. Z. Khelemskii and V. A. Knyazev. *Sakhar. Prom.*, 1977, (5), 60–65 (*Russian*).—The development of beet reception and storage techniques in the Soviet Union is surveyed and future areas of research are discussed.

The science and development of heat and power engineering in the sugar industry. V. N. Gorokh, M. L. Vaisman and I. L. Sharf. *Sakhar. Prom.*, 1977, (5), 65–69 (*Russian*).—The development of heat and power engineering in Soviet sugar factories is surveyed.

Development of lime sections. N. P. Tabunshchikov, E. T. Aksenov and L. D. Shevtsov. *Sakhar. Prom.*, 1977, (5), 70–74 (*Russian*).—Developments that have been made in the equipment used in lime production and treatment are surveyed.

Optimization of a sugar beet reception plan. F. Leitold. *Cukoripar*, 1977, **30**, 41–48 (*Hungarian*).—Yield data are tabulated for the five regions and farms in them which supply beet to Petőháza sugar factory in Hungary. These show differences in commercial ripeness between locations on given dates over the period 1971–75. A programme was therefore worked out mathematically for rationalization of beet delivery so as to obtain maximum sugar recovery. Application of the scheme is calculated to increase sugar yield at the factory by 0·4–0·8%. The method is suitable for delivery schemes at other factories.

Novi Sad juice purification at Mezőhegyes sugar factory. F. Turi. *Cukoripar*, 1977, **30**, 61–63 (*Hungarian*). Details are given of the Novi Sad carbonatation system introduced at Mezőhegyes because of the excessive molasses sugar content occurring at the factory (averaging 2·54% on beet during 1960–72 in contrast to 2·43%

for the whole of the Hungarian sugar industry). As a result of the new scheme, the average molasses sugar content during 1972-76 was below the national average.

Increasing white sugar yield and improving thin juice quality by means of ion exchange. E. Gryllus. *Cukoripar*, 1976, **29**, 230-234; 1977, **30**, 27-31, 73-76 (*Hungarian*).—Details are given of laboratory and factory trials on thin juice treatment with strongly basic ion exchange resin. Tabulated data for the latest trials in 1975-76 (covering a 70-day period) indicate an average purity rise from 88·48 to 89·40, a reduction in CaO content from 0·303 to 0·184 g/100°Bx, a colour reduction from 26·6° to 22·5°St and a 7-10% reduction in the α-amino N content; these results were obtained by treatment with "Varion AT 400" resin at a daily throughput in the range 276-371 tonnes of juice. The unit comprised 5 columns each containing 1·6 m^3 of resin. After 149-160 cycles per 10-day period, the capacity of the resin fell from 0·65-0·70 to 0·30-0·35 equivalents per litre and regeneration was necessary with NaOH solution of 1186-1274 OH^- equivalents. After resin treatment, 20% of the juice was recycled to filtered 1st carbonatation juice. During 2nd carbonatation, excess calcium of an amount equivalent to the separated anions was removed in the form of $CaCO_3$.

White sugar classification. H. Dabrowski. *Gaz. Cukr.*, 1977, **85**, 75-78 (*Polish*).—The requirements of a suitable classification system for white sugar are explained and means of classification surveyed, viz. screening, separation in an electrostatic field and pneumatic classification. Factors affecting the classification process are discussed, and types of screen drives (mechanical and electromagnetic) are examined. Results achieved with vibratory, gyratory and step-type screens were found to differ from laboratory classification results, as demonstrated by graphs; even those obtained with a special West German model having disc screens rotating on vertical axes were still below the required standard. Possible means of improving screen performance and factors to be considered in choosing equipment are discussed.

Sugar factory waste water treatment in high-load filter beds. J. Boćko, H. Matusiewicz and I. Pytel. *Gaz. Cukr.*, 1977, **85**, 80-81 (*Polish*).—Rebuilding the drainage system of a filter bed and building it up with clinker, as well as placing further layers of clinker across the main drainage port, improved the performance of the bed at a Polish sugar factory after long use had reduced its efficiency. It is recommended that such work should be carried out on filter beds every 4-5 years, particularly in view of the heavy loads resulting from greater factory throughputs and modern processng.

Corrosion control in the beet sugar industry. G. Trabanelli, G. Mantovani and F. Zucchi. *Sugar Tech. Reviews*, 1976/77, **4**, 131-208.—The various types of chemical and electro-chemical corrosion are discussed and the economic importance of minimizing corrosion in the beet sugar factory emphasized. Design can be of significant influence by elimination of heterogeneity, of mechanical stresses and overheating as well as prevention of air ingress. Other aspects of corrosion discussed include precautions during assembly and erection (correct welding, proper surface preparation, etc.) and in processing (use of special alloys, proper coatings or metallization, cathodic protection, degasification of feed water, use of inhibitors, etc.). Instances of corrosion in sugar factories are given, particular attention being given to evaporator tubes, and the causes and protective measures discussed.

The microbiology of beet sugar manufacture. Practical considerations on operational checks and measures against micro-organisms. F. Hollaus. *Paper presented to Int. Sugar Tech. Staff Conf. Irish Sugar Co. Ltd.*, 1977.—The various stages in beet sugar manufacture from beet storage, fluming and washing to bulk storage of sugar in a silo are tabulated with the corresponding values of temperature, pH and % dry substances (factors affecting growth of micro-organisms) and an indication of microbial status—active, live but inactive, and dead; the micro-organisms are classified into moulds, yeasts, mesophilic and thermophilic bacteria. The status of these during the process are discussed and their effects on the materials concerned, especially in connexion with sugar losses in juice, examined. The most economical use of disinfectants requires tests to determine the optimum point and dosage of application, and a number of such tests used in Austrian sugar factories are described. Formalin is used in the factories, and an account is given of the practices employed.

Experiences with an oil-fired lime kiln in Carlow. A. A. Connolly and V. G. Duigan. *Paper presented to Int. Sugar Tech. Staff Conf. Irish Sugar Co. Ltd.*, 1977. A new lime kiln was required because of capacity expansion at Carlow, and a Study Group chose an oil-fired kiln in 1973 on the basis of the then economic advantages of ease of handling and availability as well as cheapness per kcal. The various types of kiln are described as are the reasons for the choice of a West's Pyro kiln. The kiln was installed in time for the 1975 campaign and is described in detail with an account of its operation, control and integration with sugar factory operations.

Prelime sludge separation. R. A. McGinnis. *Sugar J.*, 1977, **39**, (11), 8.—The history of the development of this beet juice clarification technique is described up to the Novi Sad version developed in Yugoslavia and since adopted in that and other countries. After return of 1st carbonatation mud to raw juice this is prelimed to pH 10·5-11 when the colloids present are coagulated. A little more lime is added and the suspension gassed. The juice is clarified by means of a tray-type thickener and the mud filtered on a rotary filter. The juice, minus colloids, is then sent to 1st carbonatation to give a high-purity juice and an easily-settling mud which is returned to preliming. Two variants were developed in the US, one at the Mini-Cassia factory of Amalgamated Sugar Co. where the 1st carbonatation mud was separated using hydrocyclones for return to preliming, and the second at Moses Lake factory of U & I Inc., where Enviro-Clear clarifiers were used for separation of preliming sludge and the mud from 1st carbonatation. in both instances the process was abandoned after a short time.

NEW BOOKS

The South African sugar year book 1976-77. 200 pp; 22×28 cm. (The South African Sugar Journal, P.O. Box 1209, Durban, South Africa.) 1977. Price: R5.00

In 1976-77 the South African sugar industry produced more than 2 million tonnes of sugar for the first time in its history, despite an abnormally high cane:sugar ratio which was the worst ever recorded. Against this background, the 47th edition of the South African sugar year book presents a wealth of material, including special articles and features, industrial reviews and reports concerning all aspects of the sugar industry in that country as well as details of sugar enterprises (among which are a number of cane by-products manufacturers) and sugar manufacturing companies (with information on the factories and their equipment and processes, including the agricultural side of operations) in South Africa. Information is also given on the sugar companies in Mauritius and Réunion as well as a number of other African countries, although the extent of the information varies with the country concerned. A statistical section at the end of the book includes data on cane crushed and sugar produced by individual mills in the period 1972-73 to 1976-77, sugar production in South Africa in the period 1914-77, cane production 1954-77, crop data 1955-77, sugar price 1951-77, per caput sugar consumption, etc. This is a well-produced book with a mass of information on one of the foremost cane sugar producing countries of the world, and for the reader interested in South Africa it is a worthwhile acquisition.

The industrial utilization of sugar and mill by-products (a literature survey). M. J. Kort. 190 pp; 20×29 cm. (Sugar Milling Research Institute, University of Natal, King George V Avenue, Durban, South Africa 4001.) 1977.

This is the 15th report in the series and covers work published in scientific journals during 1976 on: by-products from sugar manufacture; livestock feeding; industrial uses of refined sugar; recent developments in sucrochemistry; nutrition and toxicology; other sweeteners (natural and synthetic). The relevant references are appended to each chapter.

It is pointed out that, while the literature continues to expand, the 1942 references given in the report represent an increase of only 3·9% over the number in the 1976 report[1] in contrast to the 23% increase in the 1976 report relative to the 1975 report, which contained 30% more references than did the 1974 report. While there is still great interest in the use of cane sugar factory by-products, there have been no startling new developments, although the high oil prices are causing more and more attention to be devoted to the utilization of cane by-products as fuel. No new major discovery has been made or is anticipated with regard to industrial uses of refined sugar, nor has any new direction of sucrochemistry research appeared, although there are many papers and patents listed which are concerned with the use of sucrose ethers and esters. The section on nutrition and toxicology includes many references to the controversy surrounding the suggested role of sugar in disorders such as heart and circulatory diseases, diabetes, etc. The final section contains a record 555 references to natural and synthetic sweeteners other than sugar, an indication of the considerable interest in this field; the chapter is followed by an index to no less than 104 sweeteners.

Once again, Dr. Kort has produced a highly commendable work which is undoubtedly outstanding in its field.

Bureau of Sugar Experiment Stations 77th annual report 1977. 64 pp; 20×27 cm. (Bureau of Sugar Experiment Stations, P.O. Box 292, North Brisbane, Australia 4000.) 1977.

The BSES report includes a review of the weather and crops in 1976-77, cane pests, diseases and varieties and brief details of factory plant changes. Research on soils and agronomy, entomology, pathology, plant breeding and mill technology is described, and details are given of agricultural and factory extension work, followed by news from the individual experiment stations. There are many interesting photographs of equipment and activities. As pointed out in the introduction by the BSES Director, Mr. Owen Sturgess, 1976 saw the production of 3 million tonnes of sugar for the first time in Queensland; this is a significant feat, all the more in view of the serious outbreak of Fiji disease and the occurrence of leaf scald (the first outbreak of this disease in the recorded history of Queensland).

Variations in world sugar prices. G. B. Hagelberg. 32 pp; 15×21 cm. (Institut für Zuckerindustrie, Amrumer Strasse 32, Berlin 65, Germany D-1000.) 1977. Price: DM 10.--.

This, research report No. 8 of the institute, is an analysis of the trend in world free market prices as well as cyclical, seasonal and irregular price movements based on monthly sugar prices in 1950-76. While a small but statistically significant seasonal fluctuation has been found, whereby the prices in April and May are on average 7% higher than in August and September, the author finds that the main cause of the well-known instability in world prices are cyclical variations; a significance but non-linear relationship was also established between the average price variation in a given year and the ratio of final stocks to consumption in the previous year (expressed as a percentage). While irregular fluctuations are of smaller magnitude and are more normally distributed than the cyclical variations, the scale of these irregular movements greatly increased in the second half of the period under review. While the reasons for this need to be investigated, it is suggested that the increased irregularity points to greater uncertainty, and that as a result of structural and institutional changes, the world sugar situation has become less transparent (or the lack of transparency has come to be more keenly felt). In any event, world sugar prices have become less predictable. There is thus a need for better information on both the current position and future supply and demand—if not, it is considered that the ISA is unlikely to succeed in its task of price stabilization.

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[1] *I.S.J.*, 1977, **79**, 324.

LABORATORY STUDIES

Flow characteristics of continuous crystallizers and model testing. T. Strickland, E. T. White and L. K. Kirby. *Proc. 44th Conf. Queensland Soc. Sugar Cane Tech.*, 1977, 189-195.—Experiments were conducted with a 1:24 scale model of a Burnett crystallizer having eccentrically-mounted cooling coils and four compartments. The working volume was 5·5 litres. Diluted glucose containing 1-mm diameter black PVC particles as tracer was fed from a drum mounted above the crystallizer at a controlled rate; it was screened at discharge to remove the tracer particles, the number of which was recorded at 5-min intervals to give residence time distributions. The residence time distribution pattern was similar to that reported by Broadfoot for Stork Werkspoor crystallizers[1]. The curve corresponded to 6–8 tanks in series, indicating some degree of plug flow (the ideal residence time distribution to give maximum exhaustion), which is roughly represented by 12-15 tanks in practice. Where the coils were mounted concentrically, there was much more by-passing (some material leaving the crystallizer earlier and some later than the average), and the curve corresponded to only 4 tanks in series. Since, however, the fit of the "tank in series" model was unsatisfactory, a spread factor S was introduced; this is given a value of 0 for plug flow and of 0·69 for a well-mixed tank. The values obtained with the eccentric and concentric coils were 0·11 and 0·22, respectively, compared with 0·30 for the Stork Werkspoor crystallizer[1]. At $S = 0{\cdot}2$ the sugar recovery is 93% of that obtained with plug flow, while it drops to nearly 80% at $S = 0{\cdot}6$. Changes in viscosity had no marked effect on the value of S, while performance was adversely affected if the under- and over-flow baffles were removed. Heating of the massecuite before crystallization caused by-passing and a wider spread of residence times. Trials with factory crystallizers were carried out independently of the model series and confirmed the validity of the model.

New methods and devices for chemical control in sugar manufacture. A. Ya. Zagorul'ko. *Sakhar. Prom.*, 1977, (5), 75-79 (*Russian*).—Descriptions are given of chemical control methods introduced in Soviet sugar manufacture during the last two decades.

A comparison of two types of automatic saccharimeters—quartz wedge *vs.* rotatable analysing. J. V. Lopez-Oña, W. F. Altenburg and R. F. Spanier. *Paper presented to the 36th Ann. Meeting Sugar Ind. Tech.*, 1977. The first part of this paper describes the basic difference between the two types of instrument, viz. the method of compensating for rotation of polarized light by a sugar solution interposed in the optical path; in the first case, the wedge is moved across the path and the linear movement measured as a function of the sugar polarization, while in the second case, the analyser prism is rotated to the optical balance point and the angle of rotation measured. The second part of the paper describes a series of determinations made using 40 raw sugar samples of between 95 and 99 pol with two specimens each of the Schmidt & Haensch "Saccharomat I" and the Rudolph Research "Autopol" automatic saccharimeters. Details are given of the techniques employed and the polarization readings are tabulated. The third part is a statistical analysis of these determinations, from which it is concluded that there was no significant difference in precision or reproducibility between examples of each instrument and between the two types of instrument. As a consequence, the price of the rotating analyser instrument, being significantly lower than that of the quartz wedge saccharimeter, was the deciding factor in a decision to purchase it.

High purity fructose via continuous adsorptive separation. D. B. Broughton, H. J. Bieser, R. C. Berg, E. D. Connell, D. J. Korous and R. W. Neuzil. *Sucr. Belge*, 1977, **96**, 155-162.—The "Sorbex" process, developed and used in the petrochemical industry, bas been tested in a pilot plant for the separation of levulose from HFCS. The levulose is preferentially adsorbed on an unspecified non-resin, non-swelling adsorbent with a structure free of organic components (selected after preliminary screening of a large number of adsorbents). It is then eluted with water (2-2·4 vol/vol of HFCS) to yield a product stream containing a 94% pure levulose solution. The process is continuous and the effect of a continuous counter-current supply of adsorbent is achieved by use of a rotary valve, by means of which addition of HFCS feed is directed to successive levels down the column at intervals, while the water feed and withdrawal of fractions are to and from the appropriately displaced levels and are also moved down the column in synchronization with the HFCS feed movements. The liquid draining from the bottom of the column is pumped to the top, and when the HFCS or water feed or fraction discharge reaches the bottom of the column, it is moved up to the top. On the basis of the results achieved, a large-scale pilot plant is to be used for further trials.

Study on the soluble proteins of cane juice. J. G. Revilla, N. González, J. Kopecky and I. Votruba. *Rev. Icidca*, 1976, **10**, (1), 3-9 (*Spanish*).—Cane juice was centrifuged at 3000 rpm for 30 minutes using a refrigerated centrifuge at 4°C, and the proteins in the supernatant isolated in two ways: (*a*) by bringing to 90% saturation with ammonium sulphate and re-centrifuging under the same conditions, dialysing the sediment against water and then concentrating with dry "Sephadex G-50", and (*b*) dialysing the supernatant against water and then using ultrafiltration through a nitrocellulose membrane of 0·40 μm pore size. The protein solutions were then subjected to polyacrylamide gel electrophoresis. In another scheme, the cane juice was centrifuged after adjustment to pH 8·3 with 0·01M TRIS-HCl and the proteins in the supernatant adsorbed on DEAE-"Sephadex A-50". This was washed with 0·01M TRIS-HCl at pH 8·3 and the proteins eluted with a 2·0M NaCl solution in 0·1M TRIS-HCl at pH 8·3, precipitated by 90% saturation with $(NH_4)_2SO_4$ and dialysed against 0·01M TRIS-HCl at pH 8·3. The concentrates were analysed by polyacrylamide gel chromatography. The total content was 0·07% on cane juice, and 13 bands were isolated for proteins of different molecular weight; all but three of these, however, were eliminated by the ultrafiltration step. [TRIS is trishydroxymethyl aminomethane—Ed.]

[1] *I.S.J.*, 1974, **76**, 148.

Determination of amino-acids. E. L. Ramos and S. Kara-Murza. *Rev. Icidca,* 1976, **10,** (1), 10–19 (*Spanish*). A method has been developed which is more sensitive than those using ninhydrin or trinitrobenzene sulphonic acid and is not affected by excess sucrose, dextrose or coloured polymers of sugar products or proteins. A cupric chloride solution is added to the sample and forms a complex; after filtration, the remaining Cu^{++} forms a coloured complex with DTC (sodium diethyldithiocarbamate) which is extracted with chloroform or stabilized in aqueous solution with "Tween 20" surface-active agent and measured spectrophotometrically at 435 nm. Reproducibility is within ±2·4%.

Influence of temperature on conductimetric determinations in raw sugar solutions. L. Carrazana, C. Pérez and N. González. *Centro Azúcar,* 1975, **2,** (2/3), 1–8 (*Spanish*).—The influence of temperature on conductivity of raw sugar solutions was examined by measurements at 25, 26, 27, 28, 29, 30, 31 and 32°C using 58 samples of sugar. The results are tabulated and values derived for the constants in an equation developed to relate conductivity and temperature.

Non-sugars present in the ash of different products of the sugar manufacturing process. M. Darias P., R. Fajardo G., H. Wong C. and G. Núñez T. *Centro Azúcar,* 1975, **2,** (2/3), 9–15 (*Spanish*).—Ash obtained with and without sulphation from mixed juice, clear juice, syrup, sugar and *A*-molasses was examined by spectrographic analysis. A total of 24 elements was identified, of which 10 (Si, Ca, K, Mg, Na, Fe, Al, Cu, Mn and Pb) were present in all. Many of the remainder were detectable only as traces (less than 0·003% on total ash). Analysis of the variation of the different elements was studied in relation to the process.

Isolation and identification of micro-organisms in samples of raw and refined sugars stored in bags. T. Sais H and A. Shevchenko. *Centro Azúcar,* 1975, **2,** (2/3), 17–28 (*Spanish*).—Samples of raw sugar stored for 5 and 8 months and white sugar stored for 5 months were examined and counts of bacteria, yeasts and moulds per 10 g of sugar recorded, with identification of the genera and chemical analysis of the corresponding sugars. The counts are tabulated for the various types of sugar. In non-deteriorated raw sugar Gram-positive bacteria of the *Bacillus* genus predominated, followed by moulds such as *Aspergillus glaucus* and lastly yeasts of the *Pichia* genus. Sugars with imperfect crystal structure, both raw and white, showed the highest number of micro-organisms.

On-stream analysis by liquid chromatography. R. A. Mowery and L. B. Roof. *Analysis Instrumentation,* 1976, **14,** 19–23; through *Anal. Abs.,* 1977, **32,** Abs. 5J8.—The application of liquid chromatography to process-stream analysis is discussed with reference to instrumentation, reliability, sample preparation and dilution, column selection, and cost. Examples given to illustrate the technique include the separation of D-glucose and fructose in sugar concentrates.

Determination of α-amino acids on the basis of colour measurement. J. Nedelkovits and K. Fábián. *Cukoripar,* 1977, **30,** 49–54 (*Hungarian*).—After a short discussion of the adverse effects of amino-acids on beet processing quality, a brief survey is presented of methods for their determination as α-amino N. The Stanek & Pavlas "blue number" method was examined, using model solutions, with the aim of establishing optimum pH (found to be 6·3-6·5), wavelength (620 nm) and buffering capacity as represented by the L-glutamine:sodium acetate concentration ratio. (1·3571 g of L-glutamine is dissolved in 1000 cm³ of distilled water and corresponds to 130 mg of α-amino N, giving a "blue number" of 100. The reagent comprises 260 g of sodium acetate dissolved in 500 cm³ distilled water, to which is added 10 g of copper nitrate dissolved in 200 cm³ distilled water, then made up to 1000 cm³ with water.) Results obtained spectrophotometrically for α-amino N in beet, raw juice, thin juice, thick juice and molasses agreed with iodometric results to within ±3–4%.

Simple thin-layer chromatographic technique for the separation of mono- and oligo-saccharides. J. W. Walkley and J. Tillman. *J. Chromatog.,* 1977, **132,** 172–174.—A method is described in which commercial precoated plates are used and only two solvent runs in the same direction are required. The solvent used is 50:50:10:5:5 ethyl acetate:pyridine:water:glacial acetic acid: propionic acid; the spots are revealed by spraying with diphenylamine:aniline:orthophosphoric acid in acetone and heating. R_G values are given for 18 sugars, 11 of which were well separated from a mixture.

Investigation of the effect of frosts on beet quality. W. Trzciński and L. Urbanowicz. *Gaz. Cukr.,* 1977, **85,** 82–84 (*Polish*).—For evaluation of frozen beet quality, the method of Oldfield *et al.* for invert sugar determination[1] and the method developed by Zagorul'ko *et al.*[2] based on measurement of the electrical resistivity (found to be 3–9 ohm in thawed beet, 9–20 ohm in frozen beet and 60–85 in fresh beet) were investigated. The invert sugar method was also compared with that of the Institut für Zuckerindustrie (Berlin); the latter, although giving more accurate results, takes some hours as opposed to only 3 minutes for the method of Oldfield *et al.* The equipment needed for the resistivity method is easy to construct and is inexpensive, while permitting a large number of samples to be measured rapidly. Both this method and that of Oldfield *et al.* were found to be highly suitable as a means of determining frozen beet quality.

White sugar quality—distribution of ash and Crystal Regularity Index. D. Hibbert, R. T. Phillipson and W. Woodwark. *Paper presented to Int. Sugar Tech. Staff Conf. Irish Sugar Co. Ltd.,* 1977.—The location of ash within the white sugar crystal is discussed with reference to early work on affination of outer layers and the relationship of ash distribution with the CRI (which is a measure of uniformity and hence of the presence of crevices which can retain mother liquor and so give pockets of high ash content). With the use of stirrers in pans and improved boiling techniques, the CRI of white sugar produced in recent years has increased markedly, and repeating the early work showed that, while crystal samples of lower CRI had a higher ash content, the amount of ash in the outermost layers was a much lower proportion in the recently produced sugar than in 1951.

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[1] *I.S.J.,* 1971, **73,** 68.
[2] *Sakhar. Prom.,* 1974, (7), 39–44.

BY-PRODUCTS

Introduction to the technology, application and marketing of concentrated vinasse from the molasses fermentation industry. W. Lewicki. *Zeitsch. Zuckerind.*, 1977, **102**, 302-303 (*German*).—A brief survey is presented of concentrated vinasse application as feed supplement or fertilizer, with mention of the various commercial forms available in Western Europe, marketing potential and optimum use in both applications mentioned. Up to 10% of the daily feed of ruminants can be in the form of vinasse, which has a digestibility of 50-60% and a feed value of 65% of that of molasses. For pigs, vinasse should be not more than 2-3% of the daily feed. Vinasse has proved to have no adverse effect on the odour or taste of dairy products. Reference is made to the treatment of vinasse with ammonia or ammonium sulphate to yield a high-protein product.

Method for determining the force of compression during rolling of dry beet pulp in an annular press. V. P. Borodyanskii and V. L. Kegeles. *Izv. Vuzov, Pishch. Tekh.*, 1977, (1), 116-119 (*Russian*).—The development of an empirical formula for calculation of the magnitude and direction of the resultant of the forces imposed on beet pulp during briquetting in an annular press is explained. The formula can be used to calculate the optimum distribution of forces with variation in briquetting parameters.

Briquetting beet pulp with "OTI" preparations. L. V. Kaprel'yants and M. S. Dudkin. *Izv. Vuzov, Pishch. Tekh.*, 1977, (1), 120-122 (*Russian*).—Experiments are reported in which optimum briquetting conditions were established for beet pulp to which 10% "OTI" preparation had been added. The preparation contains molasses (or beet pulp), glycosylurea, nitrogen and phosphorus, and has proved of value as ruminant feed in place of protein. Briquettes with the additive stored longer than with molasses additive and underwent virtually no change in chemical composition after 18 months. Mycofloral growth was inhibited, in contrast to mould development on molassed pulp briquettes after only 2 months.

Whole sugar cane plant, other ingredients pelletized to make complete cattle feeds. D. Natz. *Feedstuffs*, 1974, **46**, (17), 31; through *S.I.A.*, 1977, **39**, Abs. 77-617.—A process in operation on a pilot scale at Clewiston, Florida, and on a commercial scale at Ciudad Valles, Mexico, is described. Cane is chopped, dried to remove 40% of the moisture, and mixed with molasses, grain, fishmeal, urea, vitamins and minerals. The mixture is further dehydrated, passed through a hammer mill and pelleted. Cattle fed on rations of this type containing approx. 60% cane, 20% molasses and 20% grain gained about 3·5 lb per day; for maintenance rations, a 50:50 cane:molasses mixture is suitable.

Study of the production of hardboard from some indigenous agricultural residues. Y. A. Fahmy and N. A. Fadl. *Egypt J. Chem.*, 1974, **17**, 293-301; through *S.I.A.*, 1977, **39**, Abs. 77-619.—Bagasse, cotton stalks and kenaf were converted to high-yield semichemical pulps by three different processes, and hardboard was made from these pulps with and without addition of 1·5 or 3·0% phenol-formaldehyde resin. Yields of pulps made by steaming (water pulps) were higher than those of soda or sulphite pulps. In the case of bagasse, hardboards made from the resin-impregnated water pulps had higher bending strength and water resistances than those made from the other pulps.

High-yield vapour phase NSSC (neutral sulphite semichemical) pulping of bagasse for newsprint. I. Chemical analysis and pulping. H. S. Dugal. *Appita*, 1976, **29**, 262-266. **II. Bleaching and newsprint manufacture.** *idem ibid.*, 267-271; through *S.I.A.*, 1977, **39**, Abs. 77-621, 77-622.

I. Chemical analysis of and pulping tests on whole and depithed bagasse confirmed that the presence of pith had an adverse effect on pulp quality, resulting in papers of lower strengths. Pulp quality improved when small amounts of Na_2CO_3 were added to the Na_2SO_3 liquor, but deteriorated when the liquor:bagasse ratio was decreased from 4·0 to 1·5. It is recommended that depithed bagasse be pulped at 170°C for 1 hr with 16% Na_2SO_3 and 1% Na_2CO_3 at a liquor:bagasse ratio of 3·5-4·0. This method gave pulp in 61·6% yield, containing 0·9% lignin and with Elrepho brightness of 51%. Handsheets prepared from this pulp had breaking length 5000 m, tearing strength 136 g, folding endurance 1020 and bursting strength 5·1 kg.cm^{-2}.

II. The possibility of using this pulp for newsprint was investigated. Single-stage hypochlorite bleaching gave adequate brightness. A fibre furnish containing 40% bagasse pulp, 60% groundwood and some kaolin gave a newsprint similar in properties to commercial newsprint; a very small amount of water-soluble blue dye was needed to overcome the yellow tint. As the amount of bagasse pulp in the fibre furnish was increased from 20 to 60%, all strength properties increased and, except for tearing strength, they were within or better than the acceptable ranges. To obtain tearing strength equal to that of commercial newsprint, $>$60% bagasse pulp would be needed in the furnish. The opacity decreased with increasing bagasse content, but there was no noticeable change in brightness.

Screw press for beet trash and press water fines. P. Mathismoen. *Sugar J.*, 1977, **39**, (11), 22-23.—The author, Chief Engineer of Stord Bartz Industri A/S, describes the use of his company's presses for beet leaves and tops and tails, this material being added to pressed pulp before drying, as well as fines separated from pulp press water which were also pressed before addition.

Some aspects of the use of unrefined brown sugar in poultry nutrition. D. Fielding. *Rev. Agric. Sucr. Maurice*, 1977, **55**, 400-404.—Use of a raw sugar-based feed for poultry (35% sugar plus 10% maize flour, 12% groundnut flour, 15·85% lucerne meal, etc. to provide amino-acids, vitamins, etc.) was found to be suitable as an alternative to whole-maize feeds and could be of advantage in developing countries as providing a protein source for the population's diet.

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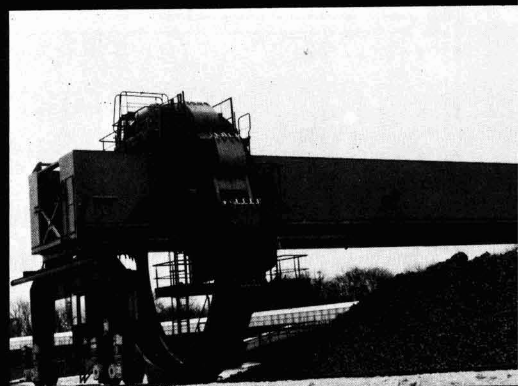

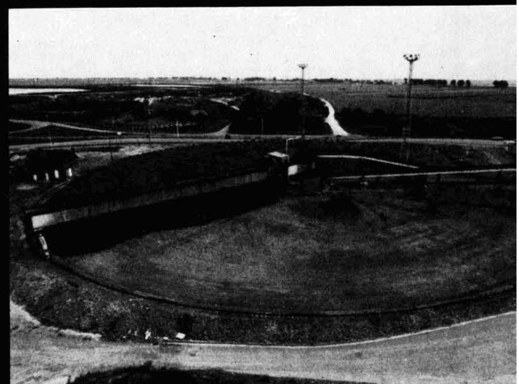

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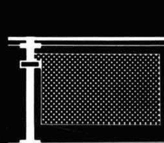

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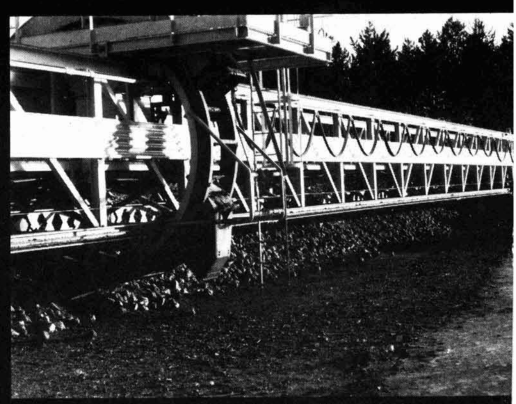

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PATENTS

UNITED KINGDOM

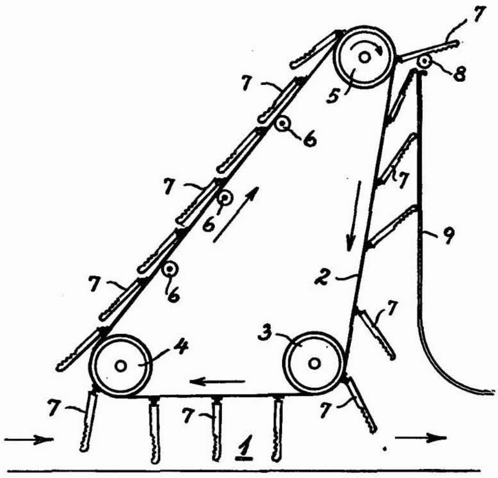
Polysaccharide production. Tate & Lyle Ltd., of London, England. **1,394,413.** 24th May 1973; 14th May 1975.—A fermentation polysaccharide which consists of a partially acetylated variable block copolymer of 1-4 linked *d*-mannuronic acid and 1-guluronic acid residues, similar in nature to alginic acid (used in acid or salt form as emulsifier, stabilizer and thickener) is prepared by inoculating with *Azotobacter vinelandii* (NCIB 8660, 8789 or 9068) an aqueous final culture medium of pH 7·0-8·2 and containing at least one monosaccharide or disaccharide (sucrose, dextrose, invert sugar or molasses), at least one phosphate source in 0·1-0·8 mM (0·2-0·6 mM) concentration, and sources of Mo, Fe, Mg, K, Na, Ca and SO_4 (a source of 0·2-0·6 mM Ca). The bacterium is cultivated (at 25-30°C) under aerobic conditions at pH 7·0-8·2 (7·3-7·9) until substantial formation of polysaccharide has occurred.

Bagasse preservation. BP Chemicals International Ltd., of London, England. **1,394,477.** 20th March 1974; 14th May 1975.—Bagasse to be stored is preserved and simultaneously pre-digested by slurrying with an aqueous solution of a lower saturated carboxylic acid (formic acid, acetic acid, propionic acid or *n*- or *iso*-butyric acid or a mixture of two or more of these), maintained at pH 3-5 (3·5-4·0). The slurry is transferred to a zone (a storage area providing a sterile surface) where excess solution is drained, the bagasse mixed with fresh acid solution and recycled to the first zone.

Cultivation of yeast. Lachema Narodni Podnik, of Brno-Reckovice, Czechoslovakia. **1,395,842.** 26th March 1973; 29th May 1975.—*Torulopsis utilis* is cultivated in a nutrient medium including 2·5-7% sugar and substances other than citric acid produced during the citric acid fermentation of *Aspergillus niger* (on molasses) i.e. waste liquor (plus the mycelium) from the citric acid fermentation (in an amount of 40-60% v/v, i.e. 10-15% w/v on a basis of 25% dry matter content) [and also additional growth stimulants (one or more of the B vitamins)].

Beet flume leaf catcher. Sukkerfabriken Nyköbing Limiteret, of Nyköbing Falster, Denmark. **1,397,707.** 19th September 1973; 18th June 1975.

Above the flume 1 is mounted an endless rubber belt 2 passing over idler pulleys 3, 4 and driven pulley 5 which causes the belt to move in the direction of the arrows. Between drum 4 and pulley 5 the belt is supported by rollers 6. On the outside of the belt are rows of pick-up arms 7 attached by means of rubber links bolted to the belts and the arms, the latter being able to rotate about the bolt. The arms have a series of serrations on their leading edges, pointing upwards toward the belt as the latter moves horizontally between drums 3 and 4 against the flow of beet in the flume.

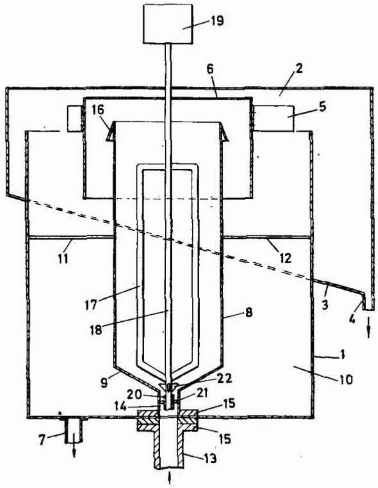


The heavier beets and solid objects such as rocks pass under the arms but leaves float on the water and are caught by the serrations. The rubber mounting of the arms also allows lateral movement which avoids jamming which might occur with blocking objects were the mountings rigid. As the belt passes round drum 4 the arms move to the position shown whereby the serrations continue to hold the leaves. When the belt passes over pulley 5 the arms are flung through an angle of nearly 180° to strike a roller which is either made of or thickly coated with rubber. The leaves are thrown off the arms into the container which has a rubber or rubber-coated shield 9. The use of rubber cuts down the noise of the catcher, reduces corrosion and minimizes the effect of ice in cold weather which can cause such arms to lock in a non-operating position.

Sugar liquor clarification. Tate & Lyle Ltd., of London E.C.3, England. **1,397,927.** 22nd June 1971; 18th June 1975.

The clarifier comprises a cylindrical open-topped tank 1 with a surrounding annular trough 2 having a sloping bottom 3 with a solids outlet 4 at its lowest point. Also at the top of the clarifier is a scum scraper plate 5 and a liquid deflector cap 6. An outlet pipe 7 for clarified liquor is provided at the bottom of the tank. Centrally in the tank is mounted a cylindrical flocculating chamber 8 with an upper anti-shear lip 16 and an inverted conical bottom 9, the chamber being held steady by bars 11, 12. A liquor feed pipe 13 beneath the centre of the tank is connected to bottom 9 by way of pipe 14 and flanges 15. Within the chamber 8 is a stirrer 17 on shaft 18 which is rotated slowly at say 1 rpm by motor 19. The shaft 18 is carried in bearing sleeve 20 supported by webs 21 and itself carries flow distributors 22, to smooth out the flow of liquid entering the chamber. The motor 19 also rotates the liquid deflector cap 6 and the scum scraper blade 5, preferably with intermediate gearing.

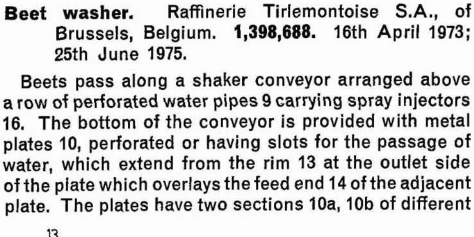
Copies of specifications of United Kingdom patents can be obtained on application to The Patent Office Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 95p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., USA 20231 (price 50 cents each).



Melt liquor is treated with a cationic surfactant and an inorganic flocculating agent, e.g. lime and phosphoric acid, to give a primary floc. It is aerated and (1–40 g/1000 litres on liquor of) [1–20 (5–15) ppm on liquor solids of] an organic polymeric flocculant added [as a 0·025–0·25 (0·05–0·15)g/100cm^3 suspension) for secondary floc initiation. This liquor is fed into the clarifier through pipe 13 and flows upwardly in chamber 8 where the degree of agitation by the stirrer is sufficient to keep the growing flocs mixed with liquor but not such as to break them up or cause turbulence. After the required residence time [0·25–5 min (0·5–3 min)] the liquor overflows into the separator chamber 10 of tank 1, where the flocs rise as a scum which is pushed into trough 2 by scraper blade 5, while clarified liquor is withdrawn through pipe 7. The cationic surfactant may be a [dialkyl (dioctadecyl, dihexadecyl) dimethyl] quaternary ammonium (chloride) surfactant and the organic polymeric flocculant an anionic polyacrylamide of M.W. at least 500,000.

Beet washer. Raffinerie Tirlemontoise S.A., of Brussels, Belgium. **1,398,688.** 16th April 1973; 25th June 1975.

Beets pass along a shaker conveyor arranged above a row of perforated water pipes 9 carrying spray injectors 16. The bottom of the conveyor is provided with metal plates 10, perforated or having slots for the passage of water, which extend from the rim 13 at the outlet side of the plate which overlays the feed end 14 of the adjacent plate. The plates have two sections 10a, 10b of different



inclinations and are mounted on transverse tubular bars 15 which are secured to the frame of the conveyor. As the conveyor moves reciprocally in the directions of the arrows, beets are carried from the feed to the discharge end, being tumbled by their movement over rim 13. They are washed by the sprays, wash water and dirt draining through the gap 12 between the plates and also through the perforations or slots in the plates themselves.

Surface-active sucrose esters. Tate & Lyle Ltd., of London, England. **1,399,053.** 16th March 1973; 25th June 1975.—Solid particulate sucrose is reacted with (an equimolecular amount of) at least one triglyceride [having 16–18 C atoms (tallow)] at 110–140°C (120–130°C, 125°C) at atmospheric pressure, in the presence of (5–12% of) a basic transesterification catalyst (K_2CO_3) in the absence of any solvent [but in the presence of (5–10% of) (a mono- or di-glyceride or surfactant product of the reaction as) an emulsifier].

Animal fodder. Produits Chimiques Ugine Kuhlmann, of Paris, France. **1,399,176.** 25th January 1973; 25th June 1975.—A liquid sugar-containing (24–53% total sugars) waste product (molasses) is mixed with 0·25–5·25 (0·96–1·12) parts of a mixture of inorganic salts which provide P and Ca in conjunction with urea such that there is a 0·68–2·4:1 Ca:P ratio and a N:P ratio of 0·9–2·7:1 [urea phosphate (44–44·5% P_2O_5 and 17·3–17·5% N) plus (hydrated) lime (95–96% CaO) (and including $CaCO_3$, N or ammonium salts, $CaSO_4$, dolomite or Mg salts to adjust the Ca:P, N:P and/or Ca:Mg proportions as desired)]. The mixture may be dried and powdered, granulated, tabletted or extruded.

Making dextrose isomerase and converting dextrose to levulose. Anheuser-Busch Inc., of St. Louis, MO, USA. **1,399,408.** 1st October 1973; 2nd July 1975. An *Actinoplanes* sp. (*A. missouriensis, A. philippinensis, A. armeniacus* or *A.* sp ATCC 23342) is grown (for 24–168 hr) (at 16–40°C) in a culture medium [corn steep liquor, distiller's solubles, casein hydrolysate, soybean hydrolysate, peptone, yeast extract or fish protein (hydrolysate) (corn steep liquor which has been neutralized with NaOH, KOH, $Ca(OH)_2$ or NH_4OH to pH 6–8·5 and the sludge removed) of 0·5–7% dry solids content] (containing 0·05–0·5 mM cobaltous ion and 0·01–0·1 mM Cu^{++} and 0·5–1% of D-xylose or 0·1–2% of D-levulose) and the dextrose isomerase produced is recovered. The isomerase is then used to isomerize D-dextrose to D-levulose in the presence of 0·1–9 mM Mg^{++} or 0·05–0·6 mM Co^{+} at 40–90°C, pH 5·5–9 and dextrose concentration $>$0·1 M.

Bagasse paper pulp. Process Evaluation and Development Corp., of New York, NY, USA. **1,399,736.** 24th May 1972; 2nd July 1975.—Lignocellulose material (depithed bagasse) is [prehydrolysed (for 5–10 min) at pH 4–5·8 (4·5–5·5) in a continuous digester in the presence of 70–100% moisture on dry weight (under autogenous steam pressure at 170–188°C, 170°C) and then, under the same conditions and in the same digester] digested (at 7–8·8 kg.cm^{-2} pressure for 10–40 min, 5–10 min) with an aqueous alkali metal (Na) hydroxide solution of pH 8·5–11·5 [9·0–10·5 (at least 10)] which includes 4·5–7% (6–7%) of alkali metal bisulphite and 0·9–1·5% (1–1·5%) alkali metal carbonate on bagasse weight expressed as alkali metal oxide (the total alkali metal oxide equivalent used being 8–12% on bagasse). To the pulp may be added 0·8–1·3% on bagasse of an alkali metal (Na) silicate.

UNITED STATES

Spray drying apparatus. R. E. Meade, of Stillwater, MN, USA, *assr.* The Pillsbury Co. **3,615,723.** 15th April 1970; 26th October 1971.—A liquid material, e.g. a 50% sucrose solution, is sprayed into a chamber against a perforated surface in the form of panels mounted on an endless conveyor. The chamber is provided with a drying atmosphere and the minute droplets of liquid are dried to a tacky condition and form a porous lacy mat on the panels which continue to be subject to the drying atmosphere until the desired degree of dryness is reached. The mat is separated from the panel and part is powdered, and returned to the stream of solution sprayed into the chamber.

Smoking tobacco substitute. J. D. Hind and M. F. Kelley, *assrs.* Philip Morris Inc., of New York, NY, USA. **3,703,177.** 13th August 1970; 21st November 1972.—An aqueous slurry of beet pulp in comminuted form is cooked with a hydrolysing agent, e.g. mineral acid solution, to release its pectins content, the slurry then comminuted to shorten fibres and break up fibre bundles, and demethylated by reacting with an alkaline demethylating agent (NaOH or KOH) at the same time or before adding an alkaline earth metal cross-linking agent [CaO, $Ca(OH)_2$, MgO or $Mg(OH)_2$] to cross-link the pectin molecules into a gel-like binding substance before drying the product (and combining with tobacco).

Reactivation of spent powdered carbon. F. L. Corson, of Brookfield, IL, USA, *assr.* CPC International Inc. **3,816,338.** 8th February 1971; 11th June 1973. Spent carbon having a particle size less than 100-mesh is suspended in water to give a solids content of 20–35% (22–32%) by weight, the suspension atomized by mixing with external steam and passed in a substantially oxygen-free atmosphere through a radiantly heated reactor vessel having a wall temperature of 1200–1900°F (1500–1800°F) for 5–30 seconds (5–15 sec) to pyrolyse the impurities present. The reactor vessel comprises a first zone where the suspension is raised to 1200°C within 3–15 sec to convert it to a mixture of carbon and steam and a second zone to maintain a temperature of 1200–1900°F for the remainder of the residence time. A convection tube within the first zone (in the upper portion of the reactor and occupying 1/10–1/3 of its length) is in the form of an elongated open-ended tube providing an annular space between it and the inside surface of the reactor vessel sufficient to permit circulation of gases introduced into the space from an external source. The recovered carbon has a reactivation efficiency of at least 80% and is recovered in at least 90% by weight.

Cane diffuser. J. Farmer, of Honolulu, Hawaii, USA, *assr.* Ward Foods Inc. **3,827,909.** 23rd June 1971; 6th August 1974.—Diffusion bodies are very similar in form and operation to those described in UK Patent 1,244,046[1] but are provided with rollers for compression of the bagasse at the top of each unit, for squeezing the bagasse at the bottom of the unit to aid extraction and also to control the discharge of the exhausted bagasse into the presses.

Prehydrolysis and digestion of bagasse fibres. E. J. Villavicencio, of New York, NY, USA, *assr.* Process Evaluation and Development Corp. **3,832,278.** 28th February 1973; 27th August 1974.—Bagasse pulp suitable for newsprint is produced by prehydrolysing depithed bagasse fibres in a continuous closed digester at pH 4·5–5·8 in the presence of 70–100% by weight of moisture on bone-dry fibre and at 340–370°F for a sufficient time to remove about 40–60% of the original xylan content. The pH is then raised to at least 8·5 by addition of alkali metal bisulphite alone or with alkalis to give the required pH, and the fibres heated in the same digester at the same temperature until the total hemicellulose content is reduced to 20–22% and the G.E. brightness brought to at least 55. Thereafter, just before blowdown, sufficient alkali metal silicate is added to give 0·8–1·3% by weight on the original fibre feed. After blowdown the pulp is removed, refined, screened and washed.

Clarifier for sugar liquor. J. T. Rundell and P. R. Pottage, *assrs.* Tate & Lyle Ltd., of London, England. **3,834,541.** 19th June 1972; 10th September 1974.—The clarifier is the same as that described in UK Patent 1,397,927[2].

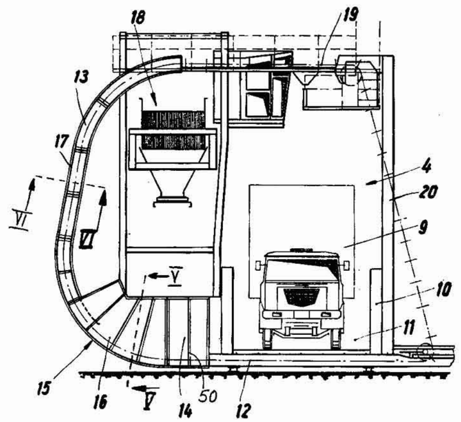
Method of refining an enzymatically produced levulose containing solution. K. Khaleeluddin, R. F. Sutthoff and W. J. Nelson, *assrs.* Standard Brands Inc., of New York, NY, USA. **3,834,940.** 30th October 1972; 10th September 1974.—An enzymatically-produced solution of 30–60% dextrose and 10–54% levulose, containing up to 50% of polysaccharides and up to 1% (0·5%) psicose, colour (up to 2 colour units), colour-forming bodies and salts (at pH 3–5) is treated with activated carbon at acidic pH to remove most of the colour and colour-forming bodies and the solution treated first with a strongly acid cation exchange resin in the H^+ form and then a weak base resin in the free base form to remove the remaining colour, colour forming bodies and salts.

Purification and reduction of lime salts in beet juice. K. W. R. Schoenrock, C. L. Hsieh and H. G. Rounds, of Ogden, UT, USA, *assrs.* Amalgamated Sugar Co. **3,834,941.** 17th May 1972; 10th September 1974.—In the first, main carbonatation, the limed juice is over-saturated to reduce the alkalinity to below 0·065% CaO (0·03–0·065% CaO) (0·0–0·02% CaO) equivalent and then realkalized (with MgO)/[to 0·07–0·15% (0·01–0·03%) CaO equivalent] before separation of precipitated solids and proceeding to second carbonatation. The liming is carried out at 50-100°C (50-90°C) during 0·5-15 (5-15) minutes. The second carbonatation after realkalization with CaO may also involve over-saturation to 0·0-0·02% CaO equivalent and realkalizing to 0·01-0·03% CaO equivalent with MgO followed by final separation of precipitated solids.

Device for reception, pre-cleaning and piling of beets. H. Hartmann, S. Stelter and H. G. Trelewsky, *assrs.* Braunschweigische Maschinenbauanstalt, of Braunschweig, Germany. **3,835,997.** 22nd March 1973; 17th September 1974.

A laden truck is driven up a ramp onto a tipping platform where it is secured. A horizontal section next to the rear of the platform is raised and the platform tipped so that the beets in the truck fall into a receiving area formed by the raised section and side walls 10, with a base formed by scraper conveyor section 12. The beets are carried by the conveyor into an intermediate bin 14 at the side of the ramp and, when the receiving area is

[1] *I.S.J.*, 1972, **74**, 283.
[2] *ibid.*, 1978, **80**, 89.

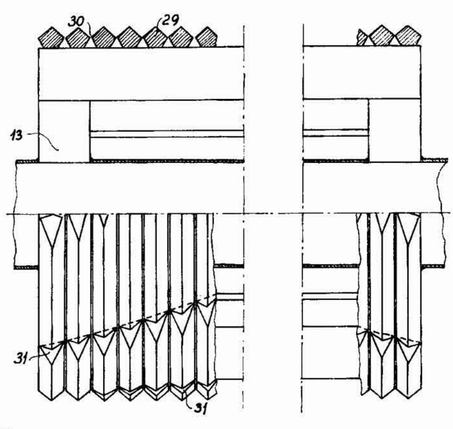


empty, the platform is returned to the horizontal and the section lowered.

Beets in the bin 14 are removed by the scraper conveyor 13 (of which conveyor 12 is a part) and carried through channel 17 to be discharged into pre-cleaner 18. The conveyor then passes through upper area 19 to a descending area 20 and returns below the platform. The beets are passed over a screen in the pre-cleaner and pass to a conveyor for piling while separated dirt is collected in the hopper below and either discharged separately or, more usually, sent through a duct into the emptied truck for return to the grower.

Bagasse dewatering. H. A. Brüniche-Olsen, of Gentofte, Denmark, *assr.* A/S De Danske Sukkerfabrikker. **3,836,337.** 3rd August 1971; 17th September 1974.

Wet exhausted bagasse from a diffuser is discharged into a dewatering device which includes cylinders suitably held together, i.e. an upper pressure cylinder and a lower one 13 allowing liquid to flow through it to collect in a tray for return to the diffuser. Cylinder 13 is in the form of a drum carrying rows of pentagonal sectioned rings 29 having gaps 30 between adjacent rings to allow flow of expressed liquid, and with grooves

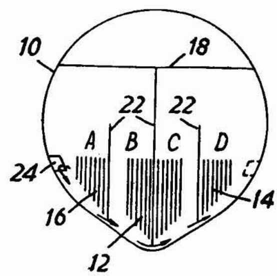


31 cut in the rings to grip the bagasse. The grooves in the upper pressure cylinder correspond to the rings 23 and its weight and pressure loading express part of the water content of the bagasse which is then sent to a conventional dewatering device.

Continuous hydrolysis of raffinose. J. Shimizu and T. Kaga, of Tokyo, Japan, *assrs.* Hokkaido Sugar Co. Ltd. **3,836,432.** 2nd September 1971; 17th September 1974.—Raffinose present in beet juice or syrup is hydrolysed continuously with α-D-galactosidase produced by the mould *Mortierella vinacea* var. *raffinose utilizer* in pellet form, the pellets containing the enzyme accumulated in the mycelium of the mould being in contact with the juice or syrup at (10–15°Bx,) pH 4·5–7 (and between room temperature and 60°C), in a stirred vessel (for a retention time of $\frac{1}{4}$–$1\frac{1}{2}$ hr) from which the juice or syrup in which the raffinose has been hydrolysed is continuously withdrawn while syrup which has not been treated is fed continuously to the vessel.

Continuous vacuum pan. G. Windal, of Roubaix, France, *assr.* Fives-Lille Cail. **3,837,811.** 28th September 1972; 24th September 1974.

The pan is generally in the form of a cylinder 10 divided into a number of compartments by transverse vertical baffles 18 but with openings 24 to allow passage of massecuite along the length of the cylinder. The compartments are heated by plate elements running the length of the pan and provided with steam from the ends. Vertical longitudinal partitions 22 also divide the pan compartments into four sections *A, B,* C and D, each with its own bank of plate heaters 12, 14, 16. Apertures are left between the bottoms of partitions 22 and the tank 10.



Massecuite or liquor flowing from one side of baffle 18 to the other through opening 24 is heated by elements 16 and circulates in section A before passing to section *B* where it is again heated and circulated before passing to section *C* and then section D. It then passes through the corresponding opening 24 of the next baffle 18 to the next compartment and so along the length of the pan.

Increasing sugar accumulation in the storage organs of plants (sweet corn, cane and beet). J. Amir and J. H. Cherry, *assrs.* Purdue Research Foundation, of Lafayette, IN, USA. **3,837,837.** 5th August 1971; 24th September 1974.—About 1-5 days before harvesting a chelating agent in the form of an aqueous solution of (a monovalent salt of) ethylene diamine tetra-acetic acid is applied to the plant (by spraying or injection).

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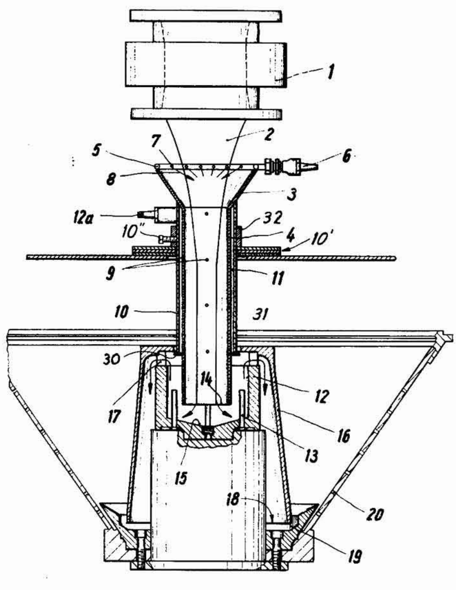
Continuous centrifugal. H. Hillebrand and H. Schaper, of Braunschweig, Germany, *assrs.* Braunschweigische Maschinenbauanstalt. **3,837,913.** 23rd June 1972; 24th September 1974.

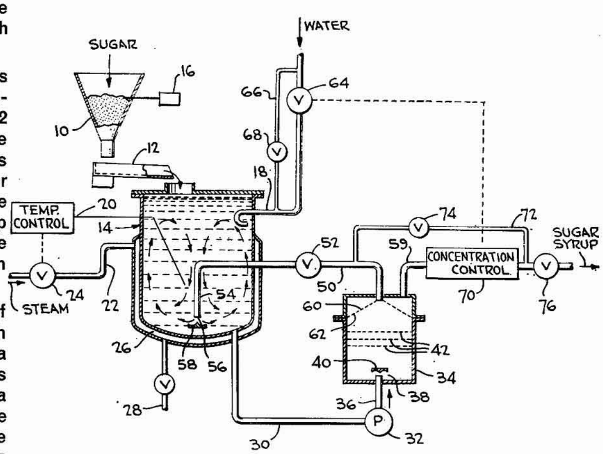
Massecuite 2 falls through a slide valve 1 and enters the upper funnel 3 and vertical inlet tube 4 of the continuous centrifugal. It passes into distribution cup 12 which is provided with several distribution pins 13, the relationship of the bottom 14 of tube 4 and the top of pins 13 being adjustable either by use of spacer rings 10′ or by movement of tube 4 in collar 32 and use of the locking set screw 10″. The massecuite leaves the cup 12 as shown by the arrows, enters the acceleration cone 16 and then passes over the edges 18 onto the bottom of screen 20.

Surrounding the massecuite stream 2 at the top of funnel 3 is a ring 5 with perforations 7 through which water supplied through pipe 6 is sprayed to form a sleeve on the massecuite. Tube 4 also has perforations 9 through which steam from inlet 12a is conducted via the jacket 10 which forms an annular cavity around tube 4. The vapour and water are mixed with the massecuite by pins 13 to form a homogeneous mixture which is conveyed uniformly and smoothly to the screen.



Sugar syrup preparation. A. Cadeo and J. Cavelti, of Rothrist, Switzerland, *assrs.* Frebar AG. **3,837,914.** 23rd May 1972; 24th September 1974.

Sugar from hopper 10 is maintained at a constant level by controller 16 and portions are discharged onto conveyor 12 which feeds into a first dissolving vessel 14. Water is admitted to the vessel through pipe 18 which may be provided anywhere in the vessel, not just at the wall as shown. If a syrup of more than 60°Bx is to be prepared the vessel may be heated by steam jacket 26, the steam valve 24 being controlled by the temperature sensor 20 and condensate removed through pipe 28. The contents of the vessel are transferred by pump 32 through pipes 30 and 36 into the second dissolving vessel 34. A baffle 40 mounted above the pipe 36 im-



parts a uniform radial motion to the material entering and is so shaped as to cause a spiral movement.

The turbulence is reduced by upward passage of the solution through a series of perforated plates 42 and the solution is then separated into two parts. The first enters the pipe 50 and via valve 52 re-enters vessel 14, a deflector plate 58 below the end 56 of pipe 50 imparting uniform circulatory movement which aids solution of the sugar. The second part passes through the screen 60 and is withdrawn through pipe 59. A concentration controller 70 governs the water supply valve 64 but a by-pass 66 with its own valve 68 may be used when starting up. Similarly the valve 76 may be closed and the product stream recycled through pipe 72 and valve 74 to pipe 50 when starting up; the valve 74 is closed and valve 76 opened when the syrup reaches the required Brix.

Molasses—protein food additive. E. F. Glabe, P. W. Anderson and S. Laftsidas, *assrs.* Food Technology Inc., of Chicago, IL, USA. **3,843,821.** 5th April 1973; 22nd October 1974.—A solid, more-easily handled molasses product in the form of a dry-appearing flowable powder is obtained by incorporating 20-40% (35%), on total weight, of a partially de-fatted soya protein flour to form a slurry and heating this in a thin film for sufficient time to dehydrate the slurry.

Sucrose recovery from beet molasses. G. F. M. F. Duchateau and R. G. E. Vandewijer, *assrs.* Raffinerie Tirlemontoise, of Brussels, Belgium. **3,844,835.** 15th November 1972; 29th October 1974.—The calcium saccharate cold precipitation process (in which 90-120 g CaO is added per 100 g of sucrose in beet molasses, diluted to 6% sucrose) is improved by decanting the limed molasses prior to filtration and recirculating at least part of the decantate to additional molasses before adding lime. In this way the dilution does not need to be so low (12%, 15% sucrose).

Cane harvesters. S. R. Makeham, of Bundaberg, Australia, *assr.* Massey-Ferguson (Australia) Ltd. **3,848,399.** 30th April 1973; 19th November 1974.

TRADE NOTICES

Electronic boiling controller. Baduga Aparelhos Electronicos Ind.e Com. Ltda., C.P. 1097, Londrina, Paraná, Brazil 86100.

The "Baduga" is an electronic programmed controller designed for pan boiling control on the basis of massecuite conductivity. It is applicable to *A*-, *B*- or *C*-massecuite boiling, provided the Brix of the syrup is above 50° and molasses dilution is maintained at 60-65°Bx. Being truly electronic, it has no electro-mechanical devices which could cause failures or inaccuracies; it controls process variables to pre-set values and is suitable for use by even an inexperienced pansman. A gatefold brochure sets out the sequence of operations of the controller, and indicates advantages to be obtained from its use.

PUBLICATIONS RECEIVED

Sugar factory machinery. Eng. M. Farahmand Group, 19 10th Street, Pakestan Avenue, Abbasabad, Teheran, Iran.

Eng. M. Farahmand Group have been active since 1966 in the manufacture of equipment for various industries, including the sugar industry. They have supplied cube making plants to five beet sugar factories in Iran as well as cube and sugar loaf plants to four refineries. In addition, they have supplied other equipment to fifteen Iranian sugar factories. Evaporators, vacuum pans, mixers, conveyors and filters are among the equipment obtainable from the group; a catalogue gives details.

"Bagasse is not for burning . . .". W. R. Grace & Co., Peadco Division, 2925 Lyndon B. Johnson Freeway, Dallas, TX, USA 75234.

A booklet available from W. R. Grace & Co. gives details of the Peadco process for manufacture of pulp and paper products from bagasse; colour illustrations demonstrate the equipment and stages in process from bagasse storage to rolls of finished paper.

Agricultural systems. Alexander & Baldwin Agribusiness, P.O. Box 3440, Honolulu, Hawaii, USA 96801.

Brochures illustrate the activities of Alexander & Baldwin Agribusiness who offer a complete package of services from feasibility studies to complete management control of agricultural projects, including financing, transport, marketing, etc. A special brochure is devoted to water management and irrigation.

Sugar projects. Edward L. Bateman Ltd., P.O. Box 565, Boksburg, South Africa.

A gatefold card explains, in English, Spanish and Portuguese, the services which Edward L. Bateman Ltd. offer as engineers, contractors, designers and constructors of sugar factory equipment and turn-key projects. It is emphasized that no equipment supplied is proprietary, so that every project and piece of equipment is designed and made to customer specification in order to provide the optimum.

Sprayers for the sugar industry. D. B. Smith & Co., 414 Main St., Utica, NY, USA 13501.

Literature from D. B. Smith & Co. describes their high-density polyethylene sprayers for agricultural chemicals, and particularly the EZ knapsack sprayer which applies the chemical to the very last drop by means of an over-sized double-acting pump which provides a constant high pressure at fewer strokes.

Juice pre-flocculating tower.—A patented pre-flocculating tower (US Patent 3,963,513) developed by Unice Machine Co., of 1275 Columbus Avenue, San Francisco, CA, USA 94133, has given outstanding results in preliminary trials at Ingenio Jiboa in El Salvador, where it has increased the capacity of the existing conventional clarifier by more than 50%, reduced mud losses by increasing the density of the mud, and has greatly improved sugar quality. The factory has received a contract for the supply of 350,000 quintals of sugar to Coco-Cola at a premium of $1.20 per quintal because of the high quality of the sugar.

New US sugar consultancy.—Cane Tech, a management/engineering consulting firm to the international sugar industry, has been formed, with headquarters at Houma, Louisiana, it was announced by Dr. James C. P. Chen. Robert M. Gerstenkorn, Mario P. Caballero and John A. Wood, with Dr. Chen, are the four principals in the firm, with over 100 years of world-wide collective experience in sugar operations and consulting services. "It was from this experience base and observations that led us to the conclusion that there is an acute and continuing need for a professional management/engineering consulting firm with the capability of offering expertise in all phases of sugar production, from preplanting, through raw mill processing, refining and marketing of products", Dr. Chen stated. "We believe Cane Tech can fill this need". The four principals of Cane Tech have been associated with Southdown Sugars, Inc.—Chen as technical director, Gerstenkorn as refinery/mill manager, Caballero as engineering director, and Wood as vice president-operations—for several years. Chen is internationally known as the author of the recently published "Meade-Chen Cane Sugar Handbook" 10th Edition. He holds a degree from the National Central University, China, and an honorary degree of Doctor of Science conferred by The China Academy. He is author of more than 80 technical papers in international sugar journals and was a co-developer of the middle juice carbonatation process. Before joining Southdown, Robert M. Gerstenkorn was associated with Amstar Corporation where he held technical and operating positions with increasing responsibilities. Mario P. Caballero holds a Bachelor of Science degree in Mechanical Engineering from Louisiana State University and is a Registered Professional Engineer in the State of Louisiana. He served as assistant chief engineer at Central Moron, one of Cuba's largest sugar mills, until 1953 and as chief engineer of the Progreso Sugar Company, Cuba, until 1960. John A. Wood is a graduate of Louisiana State University with Bachelor of Science degree in Agricultural Engineering and is a Registered Professional Engineer in the State of Louisiana. Cane Tech have the capability to provide design, operations, training and internal organization services as well as to introduce technological applications to sugar production. The address of the new organization is P.O. Box 9037, Houma, LA, USA 70361.

Swaziland sugar project.—The Government of the Kingdom of Swaziland, the Swazi nation, Tate & Lyle and a number of international leading agencies and investors have signed a series of agreements for the financing and establishment of a new sugar project at Ngomane in the Umbuluzi Basin of Swaziland. Total funds being raised for the project are of the order of E122 million (US$140 million) and the equity capital of the new Royal Swaziland Sugar Corporation Ltd., is some E40 million (E = Emalangeni, the Swaziland unit of currency, at par with the South African Rand.) The agreement marks the successful completion of multi-national negotiations involving Tate & Lyle as managers of the project in its early years of operation, and as minority investors. Other partners with Swaziland include the government of Nigeria; DEG (the German development company); Coca-Cola of the USA; Mitsui of Japan; the Commonwealth Development Corporation and the International Finance Corporation (World Bank). Additional finance is being made available by the European Investment Bank, the African Development Bank and through various supplier credits. The project includes the construction of a 6000 t.c.d. sugar factory, designed to produce in excess of 100,000 tons raw sugar per annum from a 100% irrigated estate in the Lowveld of Swaziland. This estate, of 9000 hectares (gross 20,000 ha), will be developed during a four-year programme. In parallel, Tate & Lyle have agreed with the Swaziland Sugar Association to purchase and market the new factory's output for the first five years.

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

World sugar production estimates 1977/78[1]

BEET SUGAR	1977/78	1976/77	1975/76
Europe	(tonnes, raw value)		
Belgium	777,000	732,000	716,000
Denmark	554,000	416,000	423,000
France	4,217,000	2,974,000	3,239,000
Germany, West	2,940,000	2,734,000	2,540,000
Holland	924,000	945,000	915,000
Ireland	196,000	189,000	203,000
Italy	1,348,000	1,747,000	1,467,000
United Kingdom	1,030,000	756,000	697,000
Total EEC	*11,986,000*	*10,493,000*	*10,200,000*
Austria	478,000	416,000	512,000
Finland	71,000	77,000	88,000
Greece	293,000	386,000	313,000
Spain	1,179,000	1,387,000	917,000
Sweden	336,000	302,000	277,000
Switzerland	86,000	83,000	65,000
Turkey	1,239,000	1,284,000	986,000
Total West Europe	*16,433,000*	*15,078,000*	*13,841,000*
Albania	20,000	20,000	18,000
Bulgaria	260,000	240,000	157,000
Czechoslovakia	910,000	620,000	780,000
Germany, East	680,000	560,000	665,000
Hungary	445,000	400,000	331,000
Poland	1,900,000	1,801,000	1,840,000
Rumania	700,000	670,000	561,000
USSR	9,100,000	7,350,000	7,702,000
Total East Europe	*14,015,000*	*11,661,000*	*12,054,000*
Total Europe	30,448,000	26,739,000	25,895,000
Other Continents			
Afghanistan	14,000	12,000	14,000
Algeria	10,000	10,000	8,000
Azores	7,000	7,000	7,000
Canada	132,000	163,000	133,000
Chile	223,000	315,000	319,000
China	1,000,000	1,100,000	960,000
Iran	635,000	717,000	625,000
Iraq	13,000	11,000	10,000
Israel	37,000	39,000	39,000
Japan	328,000	327,000	244,000
Lebanon	20,000	15,000	4,000
Morocco	340,000	310,000	255,000
Pakistan	33,000	37,000	27,000
Syria	30,000	24,000	25,000
Tunisia	11,000	9,000	9,000
United States	2,994,000	3,522,000	3,646,000
Uruguay	70,000	66,000	100,000
Total Other Continents	5,897,000	6,684,000	6,425,000
Total Beet Sugar	36,345,000	33,423,000	32,320,000
CANE SUGAR			
Europe			
Spain	22,000	20,000	19,000
North and Central America			
Barbados	140,000	124,000	106,000
Belize	120,000	94,000	63,000
Costa Rica	213,000	194,000	174,000
Cuba	6,500,000	6,485,000	5,700,000
Dominican Republic	1,300,000	1,361,000	1,267,000
Guadeloupe	92,000	97,000	96,000
Guatemala	520,000	540,000	549,000
Haiti	55,000	54,000	60,000
Honduras	159,000	107,000	88,000
Jamaica	325,000	290,000	369,000
Martinique	15,000	15,000	14,000
Mexico	2,800,000	2,697,000	2,725,000
Nicaragua	250,000	224,000	246,000
Panama	190,000	182,000	143,000
Puerto Rico	250,000	248,000	279,000
St. Kitts	36,000	43,000	36,000
El Salvador	305,000	296,000	271,000
Trinidad	198,000	178,000	205,000
USA—Mainland	1,414,000	1,515,000	1,657,000
Hawaii	950,000	937,000	953,000
Total N. & C. America	15,832,000	15,681,000	15,001,000

	1977/78	1976/77	1975/76
South America			
Argentina	1,645,000	1,559,000	1,353,000
Bolivia	280,000	282,000	213,000
Brazil	8,900,000	7,598,000	6,180,000
Colombia	934,000	850,000	935,000
Ecuador	375,000	314,000	287,000
Guyana	290,000	210,000	343,000
Paraguay	77,000	57,000	52,000
Peru	940,000	928,000	956,000
Surinam	9,000	5,000	11,000
Uruguay	67,000	21,000	30,000
Venezuela	549,000	460,000	483,000
Total South America	14,066,000	12,284,000	10,843,000
Africa			
Angola	60,000	50,000	40,000
Cameroun	54,000	33,000	30,000
Chad	15,000	15,000	13,000
Congo (Brazzaville)	35,000	33,000	31,000
Egypt	690,000	649,000	626,000
Ethiopia	152,000	135,000	134,000
Ghana	13,000	13,000	13,000
Ivory Coast	54,000	35,000	23,000
Kenya	195,000	175,000	173,000
Madeira	2,000	2,000	2,000
Malagasy Republic	110,000	107,000	121,000
Malawi	100,000	97,000	69,000
Mali	15,000	15,000	14,000
Mauritius	715,000	731,000	496,000
Morocco	15,000	8,000	4,000
Mozambique	250,000	260,000	240,000
Nigeria	40,000	38,000	35,000
Réunion	255,000	250,000	226,000
Rhodesia	290,000	270,000	260,000
Senegal	40,000	40,000	30,000
Somalia	38,000	39,000	29,000
South Africa	2,340,000	2,204,000	1,934,000
Sudan	229,000	151,000	125,000
Swaziland	239,000	220,000	224,000
Tanzania	120,000	114,000	106,000
Uganda	25,000	23,000	21,000
Upper Volta	30,000	22,000	15,000
Zaire	70,000	50,000	69,000
Zambia	85,000	84,000	85,000
Total Africa	6,276,000	5,863,000	5,188,000
Asia			
Bangladesh	176,000	152,000	95,000
Burma	90,000	70,000	80,000
China	2,700,000	2,750,000	2,650,000
India	5,600,000	5,250,000	4,630,000
Indonesia	1,200,000	1,139,000	1,126,000
Iran	100,000	98,000	89,000
Iraq	20,000	15,000	10,000
Japan	231,000	220,000	223,000
Malaysia	105,000	50,000	47,000
Nepal	25,000	20,000	12,000
Pakistan	750,000	746,000	641,000
Philippines	2,524,000	2,768,000	2,875,000
Sri Lanka	29,000	25,000	25,000
Taiwan	770,000	1,123,000	817,000
Thailand	1,921,000	2,294,000	1,757,000
Vietnam	33,000	25,000	15,000
Total Asia	16,274,000	16,745,000	15,092,000
Oceania			
Australia	3,450,000	3,390,000	2,933,000
Fiji	335,000	307,000	283,000
Total Oceania	3,785,000	3,697,000	3,216,000
Total cane sugar	56,255,000	54,290,000	49,359,000
Total beet sugar	36,345,000	33,423,000	32,320,000
Total sugar production	92,600,000	87,713,000	81,679,000

[1] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (35), 1–5.

BREVITIES

International Symposium on Sugar, Science & Technology.—An international symposium on this theme is to be held during the 4th–7th April 1978 at the National College of Food Technology (University of Reading) in England. The programme will commence on the evening of the 4th with an address on the "History of the sugar industry" by J. A. C. Hugill, followed by a reception. The following day will see presentation of papers on "Economics" by F. Sturrock, "Sugar refining: present technology and future developments" by Dr. J. C. Abram, "Colour in the sugar industry" by Dr. M. J. Kort, "Beet technology" by Dr. E. Reinefeld, and "The potential for industrial uses of sucrose" by Dr. J. L. Hickson. Visits will be made in the afternoon to the Tate & Lyle Research Laboratory in Reading and to the Food Science Dept. of the University. On 6th April, papers will be presented on "Advances in sucro-chemistry" by Dr. R. A. Khan, "Sucrose and food technology" by Dr. W. M. Nichol, "Control and standardization of sugar" by D. Hibbert, "Problems of quality and storage of sucrose, molasses and other carbohydrate components of foods" by G. Sobkowicz and G. Lisinska, "The general science and technology of glucose syrups" by D. Howling, "Novel hydrogenated glucose syrups" by M. W. Kearsley and G. G. Birch, "Fructose and fructose syrups" by E. Vanninen and "Xylitol" by F. Voirol. On 7th April the papers will include "Analysis of food carbohydrate" by D. T. A. Southgate, "Perspectives of sweeteners in soft drinks" by D. Hicks, "Sensory discrimination, perceived intensity and hedonic responses to sweetness in beverages" by R. M. Pangborn, "Basic sweetness research in the food industry" by M. G. Lindley, "Sugars in medicine" by I. Macdonald, "Sucrose and coronary thrombosis" by J. Yudkin, "The effect of dietary sucrose on enzyme and metabolite levels in male and female rats" by J. B. Pridham and D. R. Davies, and "Sugar and dental caries" by W. Visser. Residential facilities will be available for participants in the Symposium who are advised to apply promptly to the Secretary, National College of Food Technology, St. George's Avenue, Weybridge, Surrey, England, for an application form.

UK beet area, 1978.—In 1978 British Sugar Corporation Ltd. will accept contracts from farmers for up to 220,000 hectares of beet, as against 204,000 hectares in 1977, with all beet up to nine million tonnes paid at the full price. If exceptional yields should produce more than nine million "adjusted" tonnes (i.e. brought to a sugar content of 16%), the surplus will be paid for at a price reduced by the difference between the *A*- and *B*-quota prices agreed by the EEC.

US sugar stocks.—End-year statistics of sugar stocks[1] show clearly the build-up of stocks by US refiners during the last few weeks of 1977 in order to beat extra sugar duties and to take advantage of low prices before the new International Sugar Agreement might raise them. Stocks in the hands of beet processors amounted to 1,602,445 short tons, raw value, as against 1,777,222 tons in 1976 and 1,595,783 tons at the end of 1975. Refined sugar stocks held by refiners were 265,099 short tons, raw value, on 31st December 1977 as against 278,897 a year earlier and 236,682 tons at end-1975. Raw sugar stocks, however, totalled 1,607,882 tons, more than twice the 775,701 stock at the end of 1976 and almost four times the 414,808 tons of 31st December 1975.

SuCrest Sugar Division sale.—According to reports from New York, the sugar division of SuCrest Corporation was sold to the Philippine sugar broker Antonio Floirendo and the name changed to Sugar Refining Corporation of America with effect from 30th November 1977[2]. The company has refineries in Brooklyn, Charlestown and Chicago. Subsequently it was announced that Revere Sugar Corporation, of 120 Wall Street, New York, NY, USA 10005, had acquired the company.

Thailand sugar exports[3]

	1977	1976
	———tonnes, tel quel———	
China	674,338	55,114
Egypt	0	7,400
Holland	0	1,971
Iran	97,827	22,687
Iraq	26,400	0
Japan	626,108	672,939
Korea, North	1,995	0
Korea, South	8,450	34,785
Malaysia	172,770	109,701
Morocco	0	37,786
Singapore	699	8,400
Sri Lanka	19,500	34,070
Syria	0	20,510
UK	0	13,586
USA	0	62,678
Total	1,637,587	1,081,627

Chile sugar situation[4].—Chile's state-owned Industria Azucarera Nacional S.A. (IANSA) has contracted to purchase 80,000 tonnes of cane sugar from abroad and will have to buy an overall 150,000 tonnes to meet domestic consumption in 1978 in view of a sizeable shortfall in domestic output this year. Owing to low world prices, to which the prices paid to Chilean beet growers are linked, the area sown to beet under contracts with IANSA's five factories fell to 21,400 hectares from 55,000 ha in 1976. IANSA's sugar output from 1977 crop just harvested will be 120,000 tonnes compared with 290,000 tons the previous year and normal domestic output of 330,000 tonnes.

Antigua sugar production resumption[5].—Antigua's Minister of Agriculture has announced that sugar production is to be resumed and that it is planned to reach self-sufficiency within two years. An area of 40 acres of cane has already been planted and this is expected to rise to between 600 and 800 acres by mid-1978. Capital for a sugar factory will come from Canadian aid funds. Restoration of the sugar industry was one of the promises of the Antigua Labour Party during the 1976 election campaign. The island's last sugar crop was harvested in 1971 and amounted to 11,000 tons but the Progressive Labour Movement Government of 1971/76 decided that sugar was not worth maintaining as a cash crop.

Canadian high fructose corn syrup plant[6].—According to press reports from Toronto, Redpath Industries Ltd. and John Labatt Ltd. will jointly construct a $60 million plant in south-western Ontario to produce high fructose corn syrup.

East Germany sugar production increase[7].—According to East German sources, sugar beet production is to be increased substantially by 1980. The increase is to come mainly from higher yields per hectare as the area devoted to beet is not to increase by more than 4·48% compared with 1975. The East German Ministry of Agriculture published plan figures showing 280,000 hectares for beet in 1980 against 268,000 ha in 1975 of which 70,000 ha will be irrigated, as against 9800 ha in 1975, and the yield is set at 35–38 tonnes per hectare compared with the 24·15 tonnes obtained in 1975. Beet yields in 1976 did not exceed 19·1 $tons.ha^{-1}$ and the total quantity produced was not more than 5 million tons. It was said that the 1977 harvest was much higher so that sugar output in 1977/78 should be substantially up on the previous season.

PERSONAL NOTES

We regret to announce the death, at the age of 88, of Emeritus Professor **F. Hardy,** who was Head of the Department of Soil Science and Chemistry of the Imperial College of Tropical Agriculture (now the Faculty of Agriculture of the University of the West Indies) in Trinidad from 1922 until his retirement in 1956. During that period he published over 300 papers on soil science, agricultural chemistry and sugar technology (particularly clarification), many of which have appeared in the pages of this journal.

1 F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (2), v.
2 F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (34), 10.
3 C. Czarnikow Ltd., *Sugar Review*, 1978, (1371), 12.
4 *Public Ledger*, 23rd December 1977.
5 F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (34), 11.
6 *Lamborn*, 1977, **55**, 216.
7 F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (35), 13.

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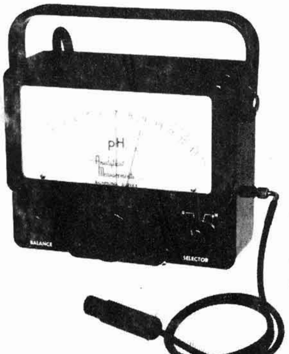

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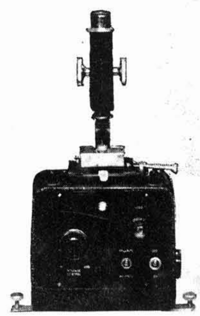

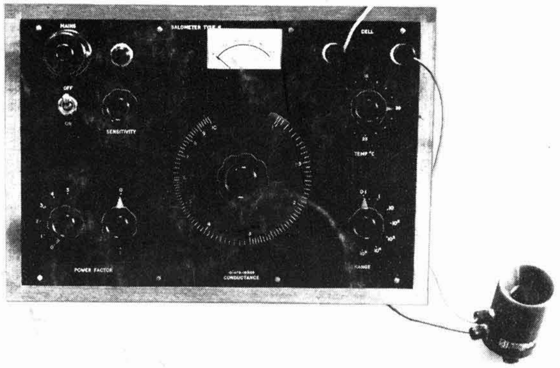

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