INTERNATIONAL SUGAR JOURNAL

VOLUME LXXXIV

ISSUE No. 1002

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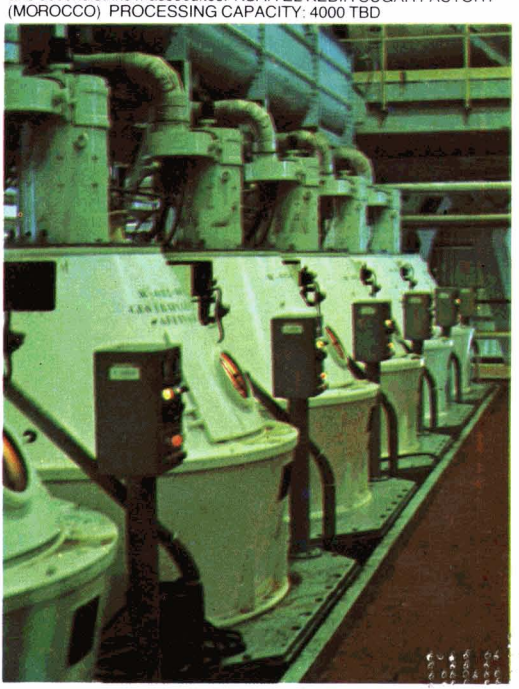

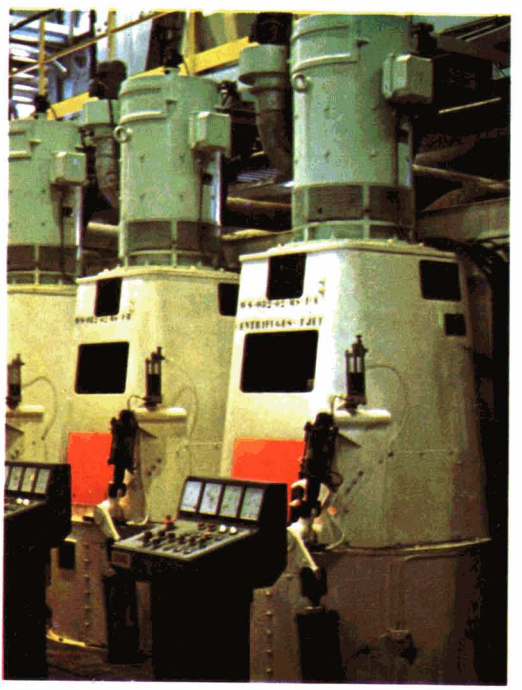

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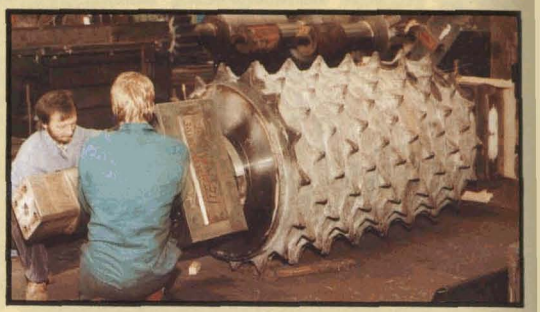

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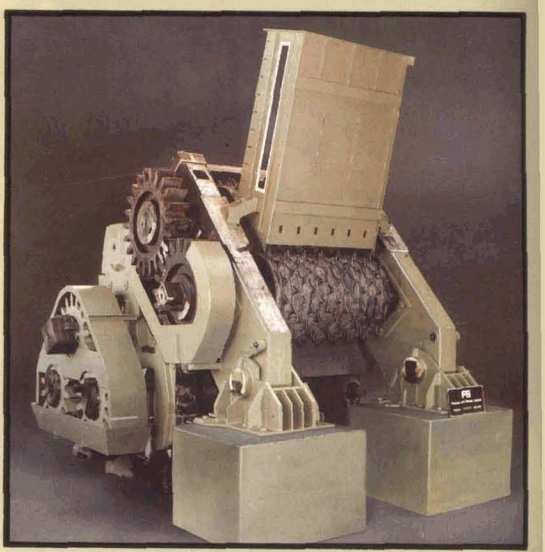

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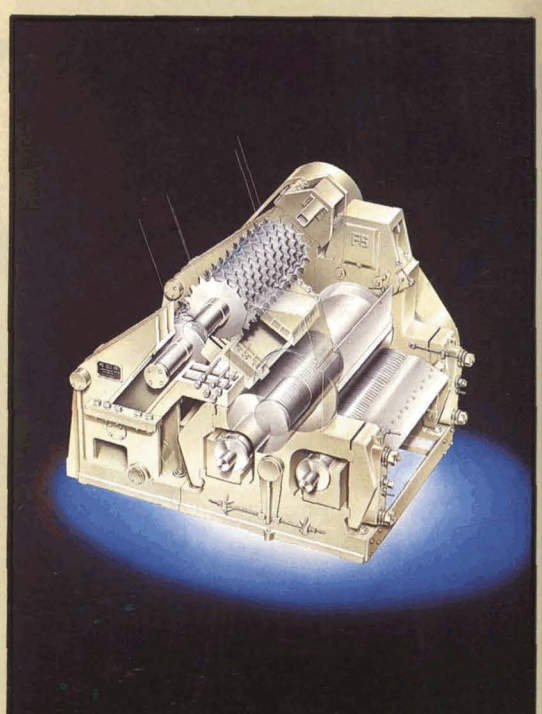

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INTERNATIONAL SUGAR JOURNAL

Volume 84
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UK ISSN 0020-8841

Annual Subscription:
£30.00 post free

Single Copies:
£3.00 post free

Airmail charges quoted on request to

The International Sugar Journal Ltd.,
23A Easton Street, High Wycombe,
Bucks., England HP11 1NX

Printed by the Wrightsons Group of Companies, London; and published by the Proprietors, The International Sugar Journal Ltd., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.
PRINTED IN GREAT BRITAIN.

Published by

The International Sugar Journal Ltd.

23A Easton Street, High Wycombe, Bucks., England HP11 1NX.

Telephone: 0494-29408 *Telex:* 21792 REF 869

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NOTES AND COMMENTS

European beet area, 1982

F. O. Licht GmbH recently published[1] their first estimate of European beet sowings for 1982, as tabulated below with corresponding figures for 1981:

	1982	1981	Decrease/ Increase, %
	hectares		
Western Europe			
Belgium/Luxembourg	130,000	135,000	− 3.7
Denmark	76,000	76,000	0
France	550,000	610,000	− 9.8
Germany, West	430,000	464,000	− 7.3
Greece	43,000	42,000	+ 2.4
Holland	135,000	133,000	+ 1.5
Ireland	36,000	35,000	+ 2.9
Italy	270,000	317,000	−14.8
UK	200,000	207,000	− 3.4
Total EEC	*1,870,000*	*2,019,000*	*− 7.4*
Austria	58,000	59,000	− 1.7
Finland	32,000	32,000	0
Spain	239,000	220,000	+ 8.6
Sweden	53,000	53,000	0
Switzerland	16,000	14,000	+14.3
Turkey	369,000	370,000	− 0.3
Yugoslavia	160,000	145,000	+10.3
Total Western Europe	2,797,000	2,912,000	− 4.0
Eastern Europe			
Albania	11,000	12,000	− 8.3
Bulgaria	72,000	70,000	+ 2.9
Czechoslovakia	220,000	225,000	− 2.2
Germany, East	267,000	265,000	+ 0.8
Hungary	125,000	121,000	+ 3.3
Poland	493,000	490,000	+ 0.6
Rumania	255,000	245,000	+ 4.1
USSR	3,720,000	3,720,000	0
Total Eastern Europe	5,163,000	5,148,000	+ 0.3
Total Europe	7,960,000	8,060,000	− 1.2

In a memorandum released at the beginning of October 1981, the EEC Commission said that its stockpiling of sugar would lead automatically to a "corresponding" reduction in production in 1982. The stockpile amounted to 1,685,000 tonnes and, on a basis of average yields over 1976-80, this corresponds to 268,000 hectares or more than 13%. This reduction has evidently not been forthcoming, according to Licht's figures, and they note that the calculated reduction does not include the area corresponding to the additional 315,000 tonnes which may also be withheld by the Commission. Licht also point out that, following destruction by cold weather of a large area of winter grain, some of this might be planted to beet instead of spring grain.

The decrease in the EEC area is partly offset by increase in Spain, which wants to become self-sufficient again, and Yugoslavia, which has ambitious export plans. While Cuba plans to increase deliveries of cane sugar to Eastern Europe, the Comecon countries evidently feel that such supplies are not so sure that they can reduce their own plantings and the Eastern Europe area is set almost unchanged from 1981. Licht conclude that sugar production in Europe next campaign will be relatively little below that of 1981/82 unless it is badly affected by poor weather.

World sugar prices

The London Daily Price for raw sugar continued to fall throughout April, starting at £148 on April 1 and ending at £126 on April 30, with only two one-day recoveries (on April 22 and 29) when the price rose by £3 and £5, respectively, merely to fall to £126 in both cases on the following day. The decline witnessed during the past few months reflects the considerable surplus of sugar available, but it has also been suggested by E. D. & F. Man[2] that the fall has been assisted by an element of speculative selling. However, their view is that the EEC "looks almost certain to succeed in completing its special stockpile of 2 million tonnes and ISO member countries are committed to stockpile 1 million tonnes by the end of June. These have effectively reduced the availability of sugar for export . . . . With the market currently trading at levels not seen since mid-1979 we anticipate that world consumption will increase in the near future. In addition, some producing countries may take this opportunity to increase their domestic stocks to act as a buffer, should they experience another poor crop in the next few seasons. Declining world interest rates should assist this trend, just as in the past rising rates encouraged destocking". However, another factor affecting the market trends has been the expectation of an announcement from the USA regarding the introduction of quota controls on imported sugar, although to date no announcement has been made. It is stated[3] that rumours in the US indicate a possibility of import quotas for 1982 being set at only some 50% of last year's actual import level. "Such a tough quota would have far-reaching repercussions for the international sugar market, as several million tonnes of sugar will effectively be barred from the US."

The white sugar market has suffered less than the raw sugar market, although, after an initial rise to £172 in the first week of the month, it fell to £157 on April 30, with some surges in between. The market has been dominated by the EEC position, with a proposed minimum 9% increase in the intervention price; however, the latest meeting of Agriculture ministers to discuss the new round of proposed farm price increases has broken up without result. In the meantime, reports from Western European countries indicate a very good start to the beet growing season, with drilling all but completed well before the end of April under very good weather conditions; this, plus rather pessimistic predictions of inadequate rise in consumption, cannot but have a depressing effect on sugar prices.

UK sugar market competition investigation

The British Sugar Corporation has raised officially with the Competition Directorate of the European Commission the position under Article 86 of the Treaty of Rome concerning the acquisition by S & W Berisford Limited of 40% of British Sugar's shares. Article 86 is concerned with abuse of dominance within markets in the European Community.

The European Commission is already probing the complexities of the UK sugar market. In 1980 four of the six merchants in the UK Sugar Merchants Association issued a complaint to the Commission based on British

[1] *International Sugar Rpt.*, 1982, **114**, 129-132.
[2] *The Sugar Situation*, 1982, (350).
[3] *Public Ledger's Commodity Week*, April 24, 1982.

Sugar's dominance in the UK market. In their submission they described possible abuses within Article 86 stemming from the lessening of competition in the UK market as a result of their claimed diminution of the role of sugar merchants. This complaint is still under consideration.

The essence of the case which British Sugar has now put to the Commission is that control of the dominant producer in the UK sugar market by the dominant merchant will distort competition. British Sugar's submission can be traced back to the Monopolies and Mergers Commission's investigation of the proposed takeover by Berisford and its report last year.

The MMC's general conclusion was that the merger might be expected to operate against the public interest and that safeguards were necessary. These were that Berisford should keep the activities and accounts of British Sugar separate, and should not sell Tate & Lyle sugar products. British Sugar did not accept that these conditions would be effective, and was subsequently advised by the Department of Trade that if it wished to raise the issue of distortion of competition under Article 86 it must do so with the European Commission. British Sugar believes that only a detailed investigation of the UK sugar market can be expected to reveal the extent to which competition is threatened.

US beet sugar in 1981/82 and 1982/83[1]

The USDA Crop Reporting Board recently estimated 1981/82 beet sugar production at 3,349,000 short tons, raw value, against 3,149,000 tons in the previous campaign. The sugar beet crop amounted to 27,300,000 tons, harvested from 1.23 million acres at a yield of 22.2 tons per acre, compared with 19.8 in 1980/81. During the campaign most processing areas experienced high beet yields per acre but sugar recovery declined in most regions, partly owing to the extension of the campaign to handle the higher beet tonnage. In the Red River Valley about 40% of the crop was affected by a freeze in the autumn which severely reduced sugar content and recovery and brought the industry average recovery down from 13.4% to 12.3%, raw value.

In February the USDA estimated that 1,170,700 acres would be planted to beet for the 1982/83 crop, a decline of 7% from 1981. A large part of the decline is in California, where closure of the Spreckels factory at Salinas has been announced. Great Western Sugar Co. have also announced that their plants at Ovid, Colorado and Bayard, Nebraska, will not operate in 1982/83 because of the poor current economic conditions, although they could reopen in 1983/84 if an improvement occurred. Based on historical yields, 1982/83 beet sugar production is estimated at 3,000,000 tons, raw value, or 350,000 tons less than 1981/82.

Rumania sugar expansion[2]

The processing capacity of the Rumanian sugar industry is to double during the next five years. In 1985, 10 million tonnes of sugar beets are to be processed in 35 factories to 1.3 million tonnes of white sugar. The area under cultivation is planned at 350,000 hectares in 1985, yielding 12.6 million tonnes of beet. Harvesting is planned to be completely mechanized by 1985. Four new sugar factories with a slicing capacity of 4000 tonnes each are to be put into operation this year; construction will start in 1982 on a further four, each processing 2000 tonnes of beets per day, and 11 factories processing 1000 tonnes of beets per day will be commissioned in 1983.

The plan for 1982 provides for a total beet area of 225,000 hectares, a harvest of nearly 9 million tonnes of beets and production of 850,000 tonnes of sugar; in 1981 sugar production was 610,000 tonnes, white value, against 509,000 tonnes in 1980. Sugar production in Rumania in the past two years was not sufficient to cover domestic requirements and the country was a net importer. The planned increase in white sugar output to 1.3 million tonnes (1.4 million tonnes, raw value) suggests that Rumania will have a substantial surplus by 1985 even taking into account further increases in domestic demand. Assuming that the plans materialize, the country could have an export surplus of more than 500,000 tonnes by 1985.

Brazil and Australian complaint over EEC sugar policy

The Council of the General Agreement on Tariffs and Trade (GATT) decided on March 31 to take no further action regarding complaints by Brazil and Australia concerning the effects of the Common Agricultural Policy of the European Economic Community. The two had claimed that the Community's export rebate program had resulted in losses in their respective market shares as well as monetary returns on sugar exports. The EEC delegate claimed that the co-responsibility measures embodied in the new régime which started in July 1981 removed all elements of subsidy in sugar exports.

The objectors, now including Argentina, have launched a fresh challenge[3] claiming that the system is causing them financial harm by depressing prices.

Western Australia sugar industry plans[4]

The Queensland sugar industry is considering forming a consortium to study the feasibility of Western Australia's plans for a cane sugar industry in the Ord River region[5]. The move was announced in a joint statement by CSR Ltd. and Bundaberg Sugar Co. Ltd.; these two companies hosted a meeting in Brisbane on March 18 which was attended by Australian sugar millers. The Queensland industry has opposed the scheme because of the threat to its own viability posed by it and also because it considers that any required expansion of Australian sugar output cane be adequately met from existing sugar areas. The two companies mentioned above had already completed a preliminary feasibility study which showed that production of ethanol from cane in the Ord River region for use as a fuel extender would be viable, but the statement on March 18 included the provisos that ethanol is not economically viable during the sort of oil glut the world is currently experiencing and that existing Queensland facilities are better placed to produce crystal sugar.

In the meantime, a South Korean group has made a A$200 million bid to develop the proposed Western Australia cane area[6], and a delegation from South Korea has already held discussions with the Western Australia Primary Industry Minister, followed by inspection of cane trial plots and talks with the Western Australian Prime Minister.

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[1] *McKeany-Flavell Sweetener News,* March 24, 1982.
[2] F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 174.
[3] *The Times,* April 7, 1982.
[4] *Westway Newsletter,* 1982, (101), 9.
[5] *I.S.J.,* 1982, **84**, 65.
[6] F. O. Licht, *International Sugar Rpt.,* 1982, **114**, 212.

Rapid determination of lactic acid in factory juices using gas chromatography

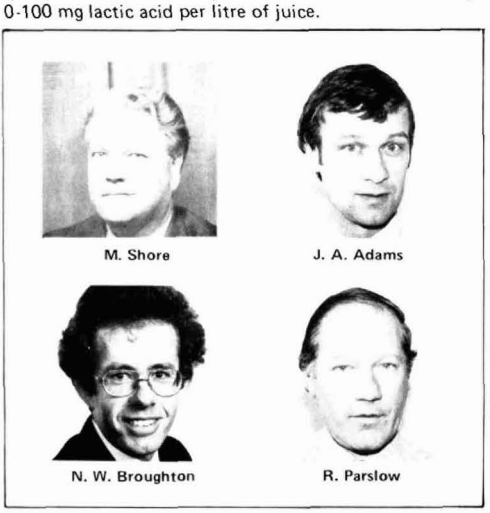
by M. SHORE, J. A. ADAMS, N. W. BROUGHTON
and R. PARSLOW
(British Sugar Corporation Ltd., Research Laboratories,
Colney, Norwich)

Introduction

The concentration of lactic acid in diffusion juice samples can be used to monitor the extent of thermophilic bacterial activity in the extraction process and to indicate the quantity of sugar lost as a result of such activity[1,2]. Several techniques for determining lactic acid are well established, and three of these have found particular application within the British Sugar Corporation, not only for studies of sugar loss in diffusion[3,4] but also for investigations of invert sugar degradation in processing[1,5,6], especially carbonatation and clarification[6].

The UV spectrophotometric method using a micro-diffusion procedure[7] is a high precision research tool, but requires juices to be cleaned-up by ion-exchange resins and so is rather time-consuming. A gas liquid chromatographic (GLC) method[8], also developed at British Sugar Corporation Research Laboratories, is somewhat quicker to carry out for samples having a high ratio of lactic acid to sucrose, e.g. thin juice or molasses, but it is not as convenient as the previous method for direct determinations on raw juices.

As a guide to lactic acid production in diffusion, British Sugar factories have used a thin layer chromatographic (TLC) technique[3] which is simple and provides a fair estimate of the lactic acid concentration in about 90 minutes. However, the lower limit of detection under typical factory conditions is about 100 mg lactic acid per litre juice and, while suitable for circumstances involving considerable bacterial infection, this is too high for efficient operation of modern factories. There is thus a need for a simple, accurate and reasonably specific method of analysis for lactic acid in the range 0-100 mg lactic acid per litre of juice.



The control of bacterial activity in British Sugar diffusers is effected, in general, by maintaining the temperature above 70°C at all times and by shock dosing with formaldehyde at roughly 2-hour intervals [1,3,4,8]. Consequently, the analytical method of choice should be one which can be accomplished in a much shorter time than 2 hours, so that dosing control can be optimized.

This paper describes an alternative gas chromatographic (GC) method for the determination of lactic acid in, principally, diffusion juices. In this method, which has been developed from published methods for the determination of lactic acid in clinical samples[9,10] and which takes about 12 minutes per determination, acetaldehyde produced by ceric sulphate oxidation of lactic acid is determined by GC analysis of the head-space gases above the reactants.

An aliquot of the juice, diluted with water as necessary, is mixed with an equal volume of acidified ceric sulphate solution in a glass vial. The vial is then closed with a special rubber seal and immersed in a water bath at 37°C. After 10 minutes, a portion of the head-space gas from the vial is sampled with a syringe and injected into an appropriate packed column of a gas chromatograph fitted with a flame ionization detector. The resultant peak response has been shown to be directly proportional to the lactic acid concentration of the sample and the latter can therefore be readily established by comparison with peaks produced from known standard lactic acid solutions.

The method is applicable over the range 0-100 mg lactic acid per litre juice, and results of several hundred duplicate determinations have shown that duplicates are typically reproducible to ± 5% about their mean value.

Microbial activity in raw juice and other factory juices between sampling and analysis can easily invalidate the results of determinations such as lactic acid. In British Sugar it has been found advantageous to add mercuric chloride to these samples at about 1000 mg/l with the aim of inhibiting such activity prior to analysis. An advantage of the GC method described is that it can

1 Carruthers & Oldfield: *Paper presented to the 8th Tech. Conf. British Sugar Corporation*, 1955.
2 Carruthers, Gallagher & Oldfield: *Paper presented to the 11th Tech. Conf. British Sugar Corporation*, 1958.
3 Oldfield, Dutton & Shore: *I.S.J.*, 1974, **76**, 260-263, 301-305.
4 Oldfield, Shore & Broughton: *Sucr. Belge*, 1977, **96**, 35-50.
5 Carruthers, Oldfield, Shore & Wootton: *Paper presented to the 7th Tech. Conf. British Sugar Corporation*, 1954.
6 Shore: *Comptes Rendus, Xe Assemblée, Commission Internationale Technique de Sucrerie*, 1957, 196-202.
7 Oldfield & Shore: *I.S.J.*, 1970, **72**, 3-4.
8 Oldfield, Parslow & Shore: *ibid.*, 35-40.
9 Savory & Kaplan: *Clinical Chemistry*, 1966, **12**, 559-569.
10 Toseland: *Lab. Equipment Digest*, 1976, (4), 68.
11 Vogel: "A text-book of quantitative inorganic analysis including elementary instrumental analysis", 3rd Edn. (Longman, London), 1961, pp.320-321.

be applied directly to juices preserved in this way without the need for a clean-up procedure; this is not the case with enzymic methods for lactic acid measurement.

Reagents and apparatus

Ceric sulphate reagent: A suitable grade for this method is, for example, BDH General Purpose Reagent ceric sulphate, $Ce(SO_4)_2,4H_2O$, which is low in other rare earths. Dissolve sufficient in 0.5 molar sulphuric acid at 70°C such that the solution, when filtered after standing overnight at room temperature, contains 2.08 g Ce/100 cm^3 solution, equivalent to 6% w/v $Ce(SO_4)_2,4H_2O$. Different samples of this chemical have been found to have markedly different solubilities, and it may be necessary to suspend as much as 20-30 g reagent in 100 cm^3 solution to achieve the required concentration after filtration. A procedure which will give this concentration should be established for each fresh bottle of reagent. The cerium content of an initial filtered solution prepared as described should be established by titration, and the adjustment with 0.5M sulphuric acid calculated which will give 2.08% w/v Ce. A satisfactory method of analysis, based on an established procedure[11], has been found to be direct titration of aliquots of the filtered solution against standard oxalic acid solution at 70-80°C; no indicator is necessary.

Higher concentrations than 6.5% w/v $Ce(SO_4)_2,4H_2O$ may oxidize sucrose to acetaldehyde, giving spurious results for the lactic acid content of juice. The concentration should be in the range 5.5-6.5% w/v $Ce(SO_4)_2,4H_2O$ (1.90-2.25 g Ce/100 cm^3 solution).

Replace the working solution with fresh if a precipitate forms.

Lithium lactate solution I (1000 mg lactic acid/l): Dissolve 1.0668 g lithium lactate in distilled water and dilute to 1 litre. Prepare daily.

Lithium lactate solution – daily calibration standard (100 mg lactic acid/l): Dilute 10 cm^3 solution I to 100 cm^3. Prepare daily.

Lithium lactate solutions – Response linearity test: Prepare freshly when needed by accurate dilution of Solution I. Concentrations ranging from 0 to 200 mg lactic acid/l would be appropriate.

Reaction vials: Soda glass, 18 mm x 85 mm (20 cm^3 capacity) (R. W. Jennings & Co.).

Serum caps: Suba Seal No. 33 (R. W. Jennings & Co.).

Pipettes: 1 cm^3 capacity and as needed for preparing the secondary standards.

Gas chromatograph: Fitted with flame ionization detector (Pye Panchromatograph, Perkin Elmer F33 and Hewlett Packard 5750 instruments have been used).

GC column: Pye: 1.8 m x 4 mm i.d., boro-silicate glass
F33: 2.0 m x 1.8 mm i.d. stainless steel
5750: 2.0 m x 4 mm i.d. boro-silicate glass

Column packing: 80/100-mesh Chromosorb 103 porous polymer or 80/100-mesh Porapak Q polymer.

Syringe: 5 cm^3 capacity Gas Tight Hamilton 1005 LTN 50 mm needle (Phase Separations Ltd., Catalogue No. 1005).

Thermostatic water bath: 37°C ± 1°C.

Timer: Stop-clock.

Gas chromatographic conditions

Carrier gas: Oxygen-free nitrogen, 30 $cm^3\,min^{-1}$.

Hydrogen: 30 $cm^3\,min^{-1}$.

Air: 500 $cm^3\,min^{-1}$ (use the appropriate combustion gas rates for the particular instrument).

Column temperature: 135°C. The column temperature is adjusted to give a retention time for acetaldehyde of 1½ minutes.

Detector temperature: 150°C.

Injector: 135°C.

Sensitivity: As required to give about 65% of full-scale recorder deflection at 100 mg lactic acid/l. A sensitivity of 10^{-10} amp was suitable on all instruments.

Headspace gas aliquot: 3 to 5 cm^3, as required for suitable response according to sensitivity of the system. The same aliquot must be used for all standards and samples in a particular series of determinations but the aliquot required for suitable response may need to be changed from series to series because of changes in the characteristics of the column.

Analytical procedure

Into a 20 cm^3 vial accurately pipette in sequence 0.5 cm^3 distilled water, 0.5 cm^3 raw juice and 1.0 cm^3 ceric sulphate reagent. Immediately cap the vial with a serum cap, swirl thoroughly and immerse *completely* in the water bath at 37°C ± 1°C. After 10 minutes remove the vial and immediately sample the headspace gas as follows. Index the piston of the gas-tight syringe to the required volume and pierce the serum cap with the syringe needle. Mix the headspace gas by pumping the full volume of the syringe four times. Inject the required volume of headspace gas into the chromatograph injection port.

To maintain a tight seal in the gas syringe and to reduce the possibility of condensation on the syringe wall, it is advisable to keep the syringe above room temperature but not above 30°C or expansion of the syringe needle may result in fracture of the syringe barrel.

Determine the peak height for acetaldehyde, which should elute at approx. 1½ minutes. Duplicate determinations should agree within ± 5% of their mean value.

When analysing a series of samples, the following procedure will allow determinations to be started at 5-minute intervals. The 0.5 cm^3 water and 0.5 cm^3 aliquots are placed in the reaction vial at a convenient time and, as the timer approaches a 5-minute interval, the ceric sulphate solution is added and the vial capped. At the 5-minute interval, the vial is swirled and placed in the water bath and simultaneously the vial which had been placed in the bath 10 minutes previously (and which has thus completed its oxidation period) is removed and sampled for analysis.

For samples containing less than 10% w/v sucrose, e.g. diffuser mid-bay samples, take a 1 cm^3 aliquot and omit the 0.5 cm^3 aliquot water. Allow for this doubling of the sample aliquot by halving the apparent lactic acid content to obtain the true figure for the sample.

When a sample is found to contain so much lactic acid that the peak is off-scale, dilute it accurately with water to bring the peak response within the range and repeat the determination (in duplicate) using a 1 cm^3 aliquot, and therefore omitting the 0.5 cm^3 water. The dilution and the doubling of the sample aliquot is then taken into account when calculating the true lactic acid content of the juice. This procedure is to be preferred to any attempt to estimate the concentration by reducing the detector sensitivity until the peak for the undiluted sample fits the chart.

Calibration

A plot of peak height against lactic acid concentration should be linear, passing though the origin. To verify

that linear response is obtained over the full range of expected raw juice lactate concentrations under the experimental conditions used, a series of standards containing lactice and concentrations in the range 0-200 mg/l should be analysed by the procedure detailed above.

Assuming that a linear response is achieved, then daily calibration factors may be determined using a single standard of 100 mg lactic acid per litre.

The linearity of response should be checked periodically, particularly if experimental conditions are altered.

The analyses and calibration runs should be made in a regular sequence. Two calibration runs with the 100 mg/l standard should be made before any unknowns, and two more should be carried out after all the unknowns. Analysis of unknowns should be made in duplicate and an additional calibration standard should be run after every second sample analysis, i.e. every 5th analysis is of the secondary standard lactic acid solution. This procedure allows for an update of the mean response factor if its value is found to drift. Normally, once the instrument has stabilized, response factors are stable throughout the day but, if drift is observed, the mean response factor should be calculated from the values of the standards which bracket the required samples.

Calculation of results

Assuming that a linear response curve is obtained, the response factor f should be determined from the calibration runs using the relationship:

$$\text{Response factor } f = \frac{\text{Standard lactic acid concn.(mg/l) (usually 100 mg/l)}}{\text{Peak height response (mm)}}$$

Calculate the mean $\bar{f}$ from the individual f values for all the calibration runs made in association with a particular series of samples and then estimate the lactic acid concentration in each juice sample of the series from the relationship:

$$\text{Concentration (mg/l)} = \bar{f} \times \text{Peak height response (mm)}$$

Average the results for the duplicates of each unknown.

Recovery of lactic acid added to juices

Recovery determinations were made on several raw juices and on a diluted thick juice, using additions ranging from 10 to 100 mg lactic acid per litre.

The results of a typical series of recoveries made on a raw juice sample are recorded in Table I; 19 recovery determinations were made on this sample, with replications at each of four addition concentrations from 25 to 100 mg/litre. The overall mean recovery was 97%, and the mean recoveries for the individual addition concentrations ranged from 91.5 to 102%.

The overall mean recovery of lactic acid added to raw juice, determined from the results in Table I and a number of similar series of recovery determinations made on other raw juice samples, was 97%. The mean recoveries for individual addition concentrations in the range 10 to 100 mg lactic acid/litre ranged from 74 to 106%, with recoveries below 80% occurring only at addition concentrations of 25 mg lactic acid/litre and less. At these lower addition concentrations, the relatively small differences between the lactate concentrations of the control and spiked juices could have been significantly affected by slight errors in the determined concentrations.

Table I. Recovery of added lactic acid from raw juice

Added lactic acid (mg/l)	No. of replications	Mean lactic acid (mg/l)	Standard Deviation (mg/l)	C.V. (%)	Mean recovery (%)
0	4	50.5	3.1	6.1	–
25	4	76	0.8	1.1	102.0
50	4	99	1.2	1.2	97.0
75	6	123	3.1	2.5	96.7
100	5	142	2.2	1.5	91.5

Table II records the results of 12 recovery determinations made on a diluted (about 5°Brix) thick juice containing 127 mg lactic acid/litre. The overall mean recovery for this series was 87%, with mean recoveries for individual addition concentrations ranging from 72 to 97.3%.

Table II. Recovery of added lactic acid from thick juice

Added lactic acid (mg/l)	No. of replications	Mean lactic acid (mg/l)	Mean recovery (%)
0		127	
25	3	145	72.0
50	3	170	86.0
75	3	200	97.3
100	3	220	93.0

Interferences

The method relies upon a given amount of lactic acid in the vial producing the same acetaldehyde peak height for both standard solutions and unknowns. The presence of dissolved solids other than lactate in the unknowns may disturb this simple correspondence in three ways:

(1) acetaldehyde may be formed from these other solutes;

(2) these solutes may be oxidized by ceric sulphate and thus would be in competition with lactic acid for the reagent;

(3) these solutes may cause variations in the activity coefficient of headspace gas. This could give rise to measured differences between an unknown and a standard solution of the same lactic acid content. The possibility of this effect occurring is considered below in the section of this paper comparing GC and semicarbazide methods.

Effect of sucrose concentration

The effect of sucrose, which is typically present at a concentration of up to 15% w/v in raw juice, was examined because some oxidation by ceric sulphate may take place under the analytical conditions. Solutions containing 70, 80 and 100 mg lactic acid and 0, 10, 13 and 16% w/v sucrose were analysed by the method described but taking 1 cm^3 aliquots of the solution and omitting 0.5 cm^3 water. A number of replicates at each level of lactic acid and sucrose was analysed and the data are recorded in Table III.

Table III. Influence of sucrose on acetaldehyde peak height

Lactic acid (mg/l)	Sucrose (% w/v)	Mean peak height (mm)	Standard deviation (mm)	C.V. (%)	Replications	Significant difference from 0% sucrose (one tailed test, 5% level)
100	0	14.23	0.50	3.5	5	–
100	10	13.66	0.60	4.4	5	No
100	13	13.46	0.92	6.8	5	No
100	16	12.81	0.74	5.8	5	Yes
80	0	17.02	0.60	3.5	5	–
80	13	17.03	0.39	2.3	4	No
80	16	15.46	0.81	5.2	5	Yes
70	0	16.93	0.73	4.3	5	–
70	13	16.11	0.80	5.0	5	No
70	16	16.93	0.36	2.1	5	No

The mean peak heights recorded for each of the 70, 80 and 100 mg/l series of analyses are not in proportion as they were not analysed at the same time and consequently the detector responses were different.

For each concentration of lactic acid, the mean peak height value obtained with each different sucrose concentration was compared by t-test with that obtained for the corresponding zero sucrose concentrations. The peak height response was found to be significantly different from the control only when the sucrose concentration was greater than 13% w/v and the lactic acid content was concomitantly greater than 70 mg/l.

These results suggest that the sucrose normally present in the majority of raw juices would not significantly affect the measured lactic acid content. However, to avoid any possibility of erroneous results for high lactic acid contents in high sucrose content juices, juices should be diluted with water to less than 10% w/v sugar. For example, as specified in the section above on analytical procedure, raw juice samples and diffusion juices containing more than 10% w/v sugar are diluted with an equal volume of water prior to addition of ceric sulphate but diffusion juices with 10% w/v or less sugar are analysed without dilution.

Effect of selected juice components

Solutions containing 1000 mg/l of the following important beet juice components were subjected to the standard lactic acid procedure: fructose, glucose, sodium glycollate, malic acid, citric acid, pyrrolidone carboxylic acid, oxalic acid, betaine hydrochloride, asparagine, glutamine, glutamic acid, aspartic acid, alanine, glycine.

None of these solutions gave significant acetaldehyde peaks, and furthermore, no other peaks were recorded up to a GC retention time of 20 minutes under the standard analytical conditions. No interference was detected from the addition of 30% w/w formaldehyde to a diluted thick juice at concentrations ranging from 125 to 500 mg/l.

Comparison of GC and semicarbazide methods

In the semicarbazide method[7] lactic acid is determined in juices after separation from neutral and basic constituents by an ion exchange procedure. It is therefore less subject to possible interference than the direct GC method described here; it is also known to be capable of higher precision than the new method. A comparison of results from the two methods was therefore made by analysing 10 samples of raw juice and 5 of molasses by both GC and semicarbazide methods.

In addition to direct determinations on the samples, GC determinations were also made using some of the ion exchange eluates prepared for the semicarbazide method. For these latter determinations, the instrument was calibrated using standards which had also been processed by the ion exchange method. It was found that response factors so determined were not significantly different from those for the aqueous standard solutions.

The results from these comparisons of GC and semicarbazide methods are detailed in Tables IV and V as means of duplicate determinations.

The new GC method gave results in good general agreement with those from this high precision technique, suggesting that there are no significant unchecked interferences with the GC method. Where GC determinations were made both directly on the juice and on the ion exchange eluate prepared from the juice, agreement was acceptable, suggesting that possible variations in the activity coefficient of acetaldehyde because of changes in the concentration of dissolved solids other than lactic acid do not significantly affect the concentration in the headspace gas.

Table IV. Lactic acid content of raw juice by two methods

Sample number	Lactic acid (mg/l juice)		
	Semicarbazide method	GC method	
		Direct on juice	on IE eluate
J1	62	59	
J2	212	218	
J3	254	276	
J4	293	329	
J5	159	172	
J6	101	99	
J7	39	38	
J8	51	46	46
J9	296	308	313
J10	252	249	255

Table V. Lactic acid content of molasses by two methods

Sample number	Lactic acid (mg/kg molasses)		
	Semicarbazide method	Direct on 1% solution	on IE eluate
M1	7926	7904	7699
M2	6139	6074	5968
M3	9028	9042	8779
M4	10671	10665	10582
M5	15988	15908	16141

Practical aspects

An insufficiently conditioned GC column will give two large positive peaks and one negative peak within 1 minute of an injection, owing to the effects of air and water vapour on the column. As the condition of the column improves with use, these peaks will reduce to give a peak limit of 1×10^{-11} amp full-scale. An electrometer sensitivity of 10^{-10} amp per full-scale recorder response is required to determine lactic acid in the range 0-100 mg/l and a well-conditioned column is therefore required.

Once the column has been conditioned, the air and water peaks do not affect the determination of the acetaldehyde peak height but, if electronic integration is used instead of peak height, it may be necessary to ensure that the negative peak does not influence the baseline. Typical traces for three samples of raw juice are shown in Figure 1.

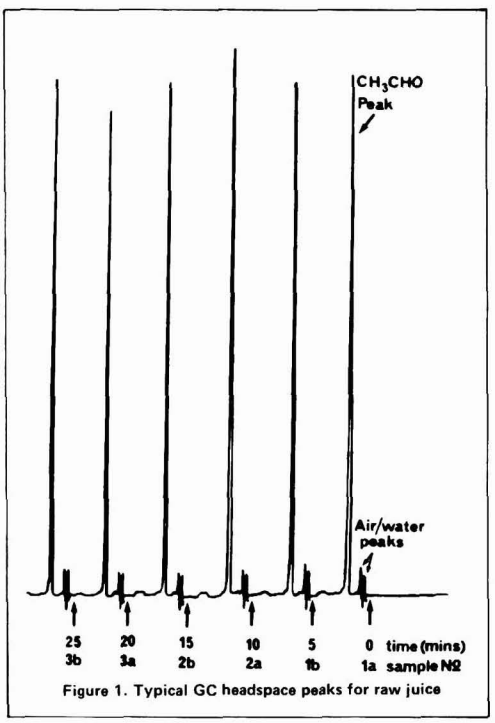


Figure 1. Typical GC headspace peaks for raw juice

Periodic reductions in sensitivity have been observed using the method, but the original sensitivity has been recovered by heating the column overnight in a stream of nitrogen at 190°C. Loss of sensitivity does not show an obvious correlation with the number of injections so it is not possible to state how frequently such treatment may be required.

The seals for the vials should be replaced whenever they show signs of having perforations; such perforations can usually be seen without difficulty when the seal is being fitted on the vial.

Acknowledgment

The authors wish to acknowledge the work carried out by their colleague Mr. I. J. Rose in the later stages of method evaluation.

Summary

A rapid method for the routine determination of lactic acid directly in raw and process juices from beet sugar factories is described. Lactate is oxidized by ceric sulphate to acetaldehyde in a closed vial and the acetaldehyde concentration in the headspace gas is estimated by gas chromatography. The time required for a single analysis is about 12 minutes and, for a series of samples, the analyses may be initiated at 5-minute intervals. Duplicate determinations are typically reproducible to within 5% of their mean value, and typically about 95% recovery is obtained for lactic acid added to raw juice. Only sucrose at relatively high concentrations appears to interfere, probably by competition for the oxidizing agent, but this effect is easily overcome by sample dilution.

Détermination rapide de l'acide lactique dans les jus d'usine par chromatographie en phase gazeuse

Une méthode rapide pour la détermination de routine de l'acide lactique dans le jus brut et de fabrication de sucreries de betterave est décrite. Le lactate est oxydé en aldéhyde acétique par du sulfate cérique en vase fermé et la concentration en aldéhyde acétique dans le gaz enfermé dans la partie supérieure est mesurée par chromatographie en phase gazeuse. Le temps nécessaire pour une seule analyse est d'environ 12 minutes et pour une série d'échantillons les analyses peuvent être mises en route à des intervalles de 5 minutes. Les déterminations en double sont typiquement reproductibles endéans 5% de leur valeur moyenne et on retrouve typiquement environ 95% de l'acide lactique ajouté au jus brut. Seul le saccharose à des concentrations relativement élevées paraît interférer, probablement par compétition pour l'agent oxydant, mais on obvie aisément à cet effet par dilution de l'échantillon.

Schnelle Bestimmung von Milchsäure in Fabrikationssäften durch Gaschromatographie

Eine Schnellmethode zur Routinebestimmung von Milchsäure direkt in Roh- und Prozeßsäften von Rübenzuckerfabriken wird beschrieben. Das Lactat wird mit Cersulfat zu Acetaldehyd in einem geschlossenem Glasfläschchen oxidiert und die Acetaldehyd-Konzentration in der Gasphase durch Gaschromatographie bestimmt. Für eine Analyse braucht man etwa 12 Minuten und bei Serienanalysen kann in 5-Minuten-Intervallen mit einer Analyse begonnen werden. Doppelproben sind normalerweise innerhalb von 5 % des Mittelwertes reproduzierbar, und die Ausbeute beträgt normalerweise etwa 95 % für dem Rohsaft zugesetzte Milchsäure. Nur Saccharose in relativ hohen Konzentrationen scheint wahrscheinlich durch eine Wettbewerbsreaktion mit dem Oxidationsmittel zu stören. Dieser Effekt kann leicht durch Verdünnung der Proben vermieden werden.

Determinación rápida de ácido láctico en jugos del proceso por cromatografía de gases

Se describe un método rápido para la determinación rutinaria de ácido láctico en jugos crudo y del proceso en azucareras de remolacha. El anión lactato se oxida por sulfato cerico al acetaldehido en un pequeño frasco cerrado y la concentración del acetaldehido en el espacio sobre el líquido se estima por cromatografía de la fase gaseosa. El tiempo que necesita un sólo análisis es unos 12 minutos y, para un serie de muestras, es posible iniciar los análisises en intervalos de 5 minutos. Deter-

minaciones por duplicado estan tipicamente reproducible dentro de 5% de su valor medio, y la recuperación obtenido de ácido láctico añadido a jugo crudo es tipicamente 95%. La sola causa de entremetimiento parece estar la presencia de sacarosa en concentraciones relativamente altas, probablemente por competición para el agente oxidante, pero este efecto se supera facilmente por dilución de la muestra.

Juice screening*

By G. A. BROTHERTON, A. G. NOBLE and R. J. SWINDELLS
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Introduction

Improvements in cane preparation, while allowing increased extraction efficiency, have led to processing difficulties at several mills in recent years. The increased quantity of fibre passing through the juice screens has to be removed during clarification and this can lead to problems at the filter stage. In extreme circumstances, interruptions to crushing have occurred when the filters were unable to handle the abnormally high fibre content of clarifier underflow.

Little technical data have been available regarding the performance of juice screens. To obtain further information on this subject, BSES carried out a series of tests during the past season to evaluate the efficiency of the various juice screening systems in use in Queensland mills. This work, which was carried out at nine factories throughout the State, has covered both DSM screens (as single units and in series) and rotary trommels of various screen apertures. The performance of a pilot-scale Contra-Shear unit supplied by Hawker Siddeley was also evaluated at Victoria mill.

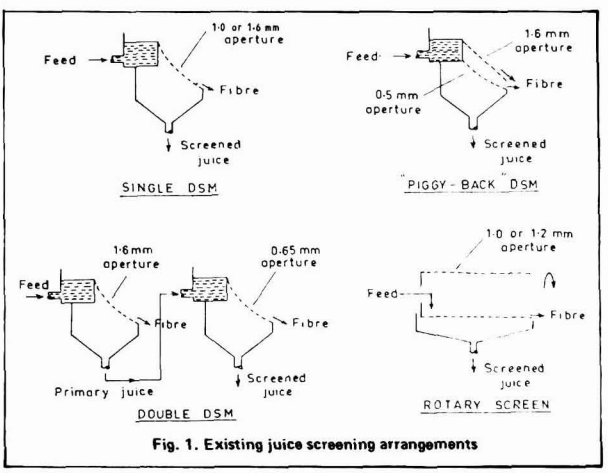

Fig. 1. Existing juice screening arrangements

Another aspect of concern at some mills has been the increased amount of bagacillo "floater" present in clarified juice following improvements in cane preparation. Trials were therefore carried out at several factories to assess the extent of this problem and its relationship to the increased fibre loading on the clarifiers.

This paper reviews the results of BSES work on the above aspects and makes a number of recommendations to guide mills in the selection of juice screening equipment.

Evaluation of existing equipment

Equipment and operating procedure:

The various juice screening arrangements studied in the survey of existing equipment are illustrated in Figure 1 and included:

(i) Single DSM screens (1.0 and 1.6 mm aperture);
(ii) A "piggy-back" DSM system – a screen of 1.6 mm aperture mounted above one of 0.5 mm aperture;
(iii) A double DSM system – a screen of 1.6 mm aperture followed by one of 0.65 mm aperture;
(iv) Rotary screens of 1.0 and 1.2 mm aperture.

The normal procedure in carrying out a trial on any of the above systems was simply to obtain composite samples of the juice before and after screening over a period of approximately 10 minutes. The fibre content of these samples was then determined by screening, washing and drying a known weight of juice (approximately 500 g for unscreened juice and 1000 g for screened juice) in an 8 cm diameter cylindrical can fitted with a 200 mesh (72 μm aperture) gauze base. The fibre content of the material removed from the juice during screening was determined using a sample weight of approximately 100 g.

As the screens formed part of the operating plant, there was little opportunity to vary the juice flow rate except in the case of the 0.65 mm screen in the double DSM system. An estimate of the flow was obtained either from a knowledge of the crushing rate or from measurement of the depth of juice flowing over the weir supplying the DSM screen.

Discussion of results

The results of trials carried out on DSM and rotary screens in this survey are summarized in Table I.

* *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 117-124.

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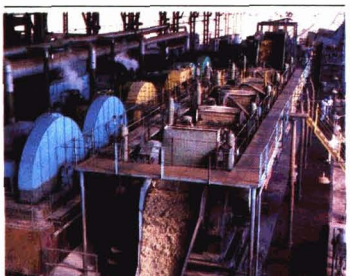

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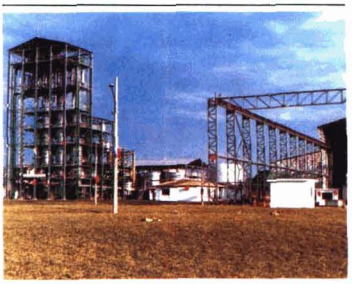

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Table I. Performance of juice screening equipment in various mills

Screen type	Screen aperture (mm)	Juice loading ($t.hr^{-1}.m^{-2}$)	Fibre content of feed (%)	Fibre content of screened juice (%)	Fibre removal efficiency (%)
DSM	1.60	38-66	0.47-1.52	0.16-0.62	**42-77**
DSM	1.00	38	0.80-0.84	0.11	86-87
DSM	0.65*	29-62	0.30-0.42	0.15-0.23	44-53
DSM	0.50*	38-45	0.36-0.62	0.07-0.14	71-82
Rotary	1.20	24	0.85-0.99	0.28-0.30	65-72
Rotary	1.00	24-27	1.06-1.26	0.21-0.44	60-83

*Juice previously screened with a 1.6 mm DSM.

The average fibre removal achieved by DSM screens varied from 65% at an aperture of 1.6 mm to 87% at an aperture of 1.0 mm. There were wide variations in performance between mills equipped with similar juice screening facilities. Reasons for these variations in perf-ormance were not identified in this survey, but the following observations were made:

(i) Hydraulic loading:

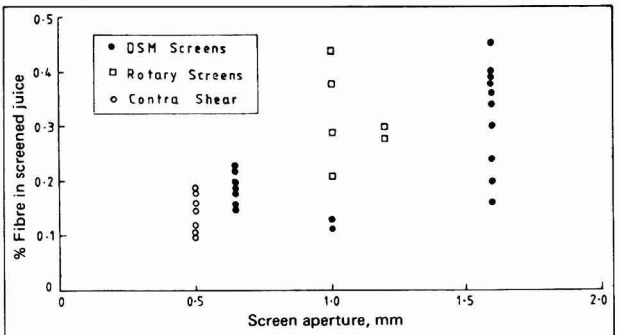

Fig. 2. The influence of screen aperture on the fibre content of screened juice

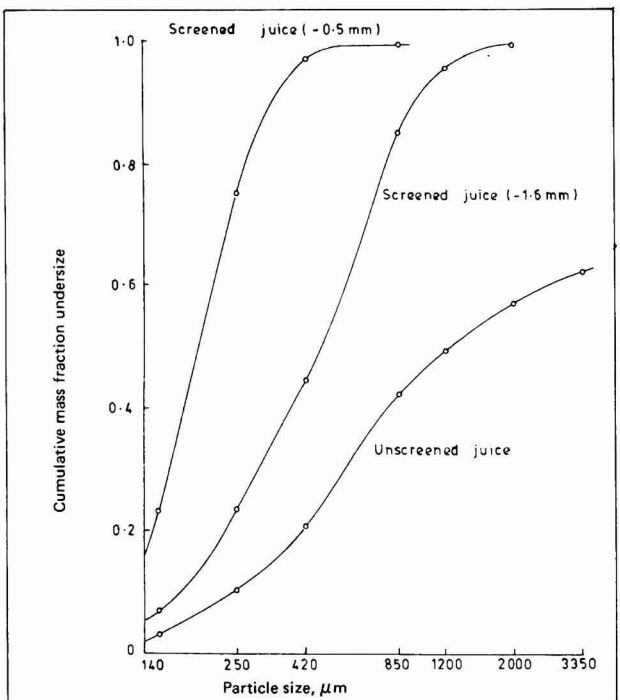

Fig. 3. Particle size distribution of fibre in juice before and after screening

The hydraulic loading did not appear to have any major effect on screen efficiency.

(ii) Screen aperture:

The effect of screen aperture on the fibre content of screened juice is shown in Figure 2. This clearly illustrates the wide variation in results obtained in this survey and the improvement in fibre removal efficiency achieved as screen aperture was reduced.

(iii) Screen condition:

Wear of the edges of the screen bars is difficult to quantify. In one installation two screens which were obviously worn to different extents were operating in parallel. The screened juice from the more worn contained 30% less fibre than that from the other screen. However, drainage was poorer on the more worn screen, resulting in a wetter oversize fraction.

(iv) Particle size distribution:

The fibre content of juice supplied to the screens varied from 0.47 to 1.52%, presumably owing to varietal influences and/or differences in the level of preparation achieved by the various mills.

The particle size distribution of fibre present in juice samples was determined by a wet sieving technique. The results of a typical series of measurements on the "piggyback" DSM system at Victoria mill are illustrated in Figure 3.

Virtually all the fibre which passed through the 1.6 mm screen was smaller than this aperture and 80% was less than 780 μm. A material balance showed that the screened juice from the 1.6 mm screens contained practically all the original fibre less than 1000 μm. All the fibre present in the juice discharged from the 0.5 mm screen was less than 500 μm, with 80% smaller than 260 μm.

This analysis demonstrated that the fibre content of screened juice is a function of the quantity of fine material in the feed and thus is dependent on both the total fibre content and the fibre size distribution. The degree of cane preparation would be a major factor influencing these parameters. This is illustrated in Figure 4 which shows that, for a given screen aperture, the fibre content of screened juice was higher at mills such as Victoria and Plane Creek, where the cane preparation was considerably better than at mills such as Tully.

(v) Screen blinding:

One mill which has been double-screening second crushing juice with 1.6 and 0.5 mm DSM screens installed in a "piggy-back" arrangement has reported problems in keeping the lower screen clean owing to a build up of sand between the wedge wire bars. This was probably due to the fact that the 0.5 mm screen was mounted immediately below the 1.6 mm screen and was therefore operated more as a sieve than as a true DSM system. A second mill also practised

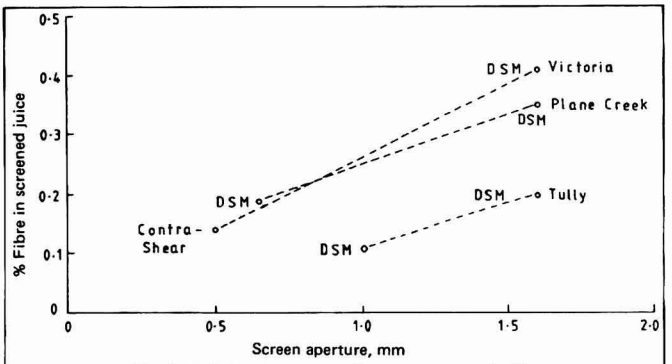

Fig. 4. Variation in screen performance at several mills

double screening by passing the juice from the 1.6 mm DSM screens through a second set of DSM screens of 0.65 mm aperture located in a different part of the factory. It was claimed that the 0.65 mm screens became partially blocked owing to the build up of bacterial material between the wedge wire bars, but there was no evidence of this problem over a trial of 30 hours duration carried out during this survey.

(vi) Rotary screens:

The rotary screens inspected in this survey were equipped with punched screen of 1.0 and 1.2 mm aperture. They appeared to be operating quite satisfactorily apart from a slightly lower fibre removal efficiency (68 to 72%) and more pronounced stapling of fibre than with the DSM screens. It is considered that both of these problems could be overcome by the use of a wedge wire screen of finer aperture and by introducing the feed in a manner that does not direct it radially at the surface of the screen.

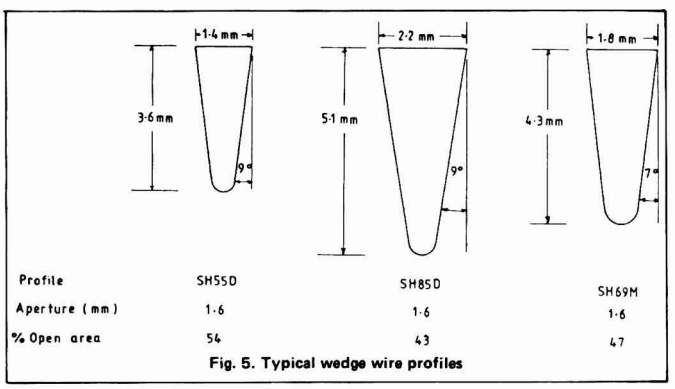

Fig. 5. Typical wedge wire profiles

Design requirements

Several mills equipped with 1.6 mm DSM screens have experienced processing difficulties due to excessive fibre levels in screened juice, and it is apparent that, as preparation improves, it will be necessary for mills to install screens of smaller aperture. Mills with a fibre content of screened juice less than 0.2% by weight experienced no processing problems at the filter station. To ensure that the fibre content is maintained in this safe operating region, mills with a high degree of preparation should use screens with an aperture no larger than 0.8 mm.

The configuration of wedge wire used in DSM screens is determined by the manufacturer's profile number. Several typical profiles for screen used in the sugar industry, and supplied by Surescreen Pty. Ltd., are illustrated in Figure 5.

SH85D is clearly a heavier and stronger wire than SH55D or SH69M but, for the same aperture, the screen has a lower percentage open area. In selecting an appropriate wedge wire profile for use in juice screening, one therefore not only has to specify the aperture, but also has to make some compromise between screen strength and drainage area.

While it is difficult to give a precise figure for screen area requirements at this stage, observations indicate that SH85D profile screens of 1.6 mm aperture and 43% open area can handle loadings of up to 60 tonnes.hr^{-1}.m^{-2} quite effectively. This figure compares favourably with the capacity ratings given by Elsken & Ehinger[1] and Adkins & Jensen[2]. For smaller apertures, one can expect a lower hydraulic capacity, and the use of open area would be the best design basis for estimating screen capacity. Overseas studies[3] indicate that 0.5 mm screens can handle juice loadings of about 10 tonnes.hr^{-1}.m^{-2}. More information on this aspect will be obtained by carrying out trials with pilot scale trommel and DSM systems during the 1981 season.

EVALUATION OF CONTRA-SHEAR SYSTEM

Equipment and operating procedure

The performance of a pilot scale rotary screen, supplied by Contra-Shear Developments Ltd. in conjunction with Hawker Siddeley Engineering, was evaluated at Victoria mill. The screen was 1524 mm in diameter and 914 mm in length (4.4 m^2 screen area) and rotated at a speed of 6.8 rpm. It was also equipped with water and steam spray washing facilities. The basic operating features of the unit are illustrated in Figure 6.

The Contra-Shear system was similar to that of conventional rotary juice screens in use in the Queensland sugar industry except for the following design features:

(i) method of feed introductions;

(ii) the use of wedge wire of 0.5 mm aperture and 33% open area as the screening element; and

(iii) the provision of flow diverter bars to assist solids discharge.

As the juice entered the unit it passed through a surge chamber designed to reduce turbulence. It then flowed through an arc of 90 degrees before being discharged over a weir which covered two-thirds of the screen length. The juice struck the screen almost tangentially

[1] *Chem. Eng. Prog.*, 1963, **59**, (1), 76-80.
[2] *Proc. 32nd Conf. Queensland Soc. Sugar Cane Tech.*, 1965, 241-249.
[3] *SMRI Annual Report*, 1979-80, 8.

but in the reverse direction to that of screen movement, thus ensuring a high initial shearing and screening rate. After dewatering, the solids were moved towards the discharge end of the unit by the action of the screen diverters.

Two different feed arrangements were studied. The system originally supplied with the screen utilized a relatively deep feed trough which frequently became blocked with sand and fibre. This arrangement was therefore later replaced with a shallower "pan feed" system similar to that shown in Figure 6.

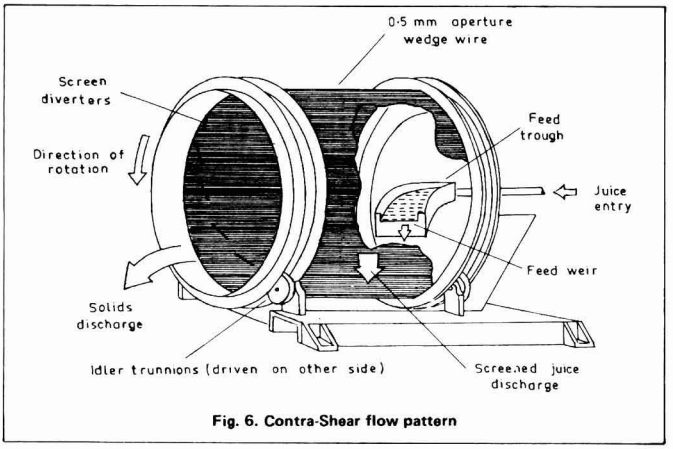

Fig. 6. Contra-Shear flow pattern

In evaluating the Contra-Shear system, composite samples of juice before and after screening and of the solids discharged from the unit were obtained in each trial. The fibre content of these samples was determined as described in a previous section of the paper. The flow rate of juice leaving the screen was determined by diverting the flow into a calibrated mobile tanker, while the solids discharge rate was obtained by collecting the material in a tared tray over a known interval of time. These measurements enabled a complete materials balance to be carried out over the system in each trial.

Discussion of results

Screening performance was evaluated at feed rates ranging from 43 to 109 $t.hr^{-1}$ (10 to 25 $t.hr^{-1}.m^{-2}$), but a slightly higher flow could have been handled satisfactorily. The fibre content of juice supplied to the screen ranged from 0.52 to 1.5%.

Under these operating conditions, the fibre content of screened juice varied from 0.10 to 0.19% (average 0.14%) and the percentage fibre removal from 78 to 87% (average 84%). This is extremely satisfactory performance for a single stage screening operation.

The influence of fibre loading on screen performance is illustrated in Figure 7 where it can be seen that the fibre in screened juice increased linearly with the feed fibre rate.

The fibre removal efficiency was independent of juice feed rate over the range 40 to 110 $t.h^{-1}$. There was no evidence of any difference in screening performance with the two feed systems.

No problems with screen blinding or stapling of fibre were experienced even during prolonged operation, and this was presumably due to the high velocity of the juice relative to the screen surface and to the fact that the juice entry was in a direction almost tangential to the screen surface and to the fact that the juice entry was in a direction almost tangential to the screen movement. A similar principle is utilized in the DSM system, the only difference being that the screen is stationary. Some difficulties were experienced with the two feed systems tested owing to the settling out of sand and fibre in the feed chamber, but a more satisfactory self-flushing system could readily be devised.

Bagacillo carryover during clarification

Trials to assess the extent of bagacillo carryover during clarification were carried out at Mossman, Mourilyan, Victoria and Plane Creek mills. The procedure was simply to filter a known weight (a minimum of 16 kg) of the juice through a 200-mesh fibre can, and then wash and dry the contents at 100°C overnight. In one trial, fibre determinations were also carried out on clarifier feed, and in this case the sample weight taken for analysis was 1000 g.

The results of these measurements are summarized in Table II.

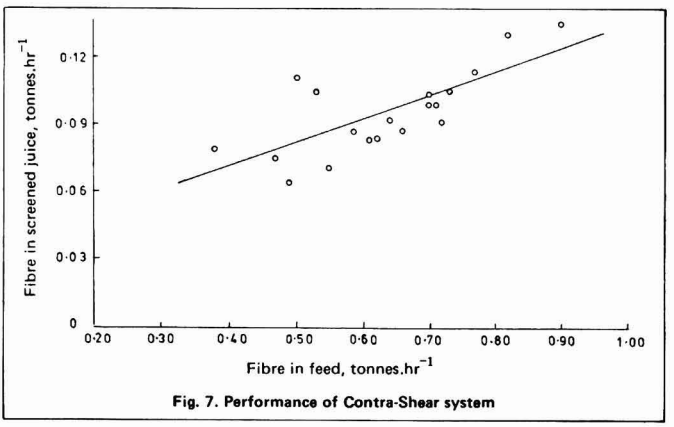

Fig. 7. Performance of Contra-Shear system

The extent of the variation in fibre content of clarified juice is illustrated in Figure 8, which shows the results of measurements carried out at Victoria mill. This fluctuation in bagacillo carryover persisted throughout all trials even though clarifier operating conditions remained stable. It would appear from this brief survey that the fibre content of clarified juice is influenced by the fibre content of clarifier feed and by the residence time available in the clarifiers.

Conclusions

The processing difficulties associated with excessive fibre loadings on the clarification stage have highlighted the importance of

achieving adequate fibre removal from the juice leaving the milling train. To ensure that the fibre content of screened juice is maintained in the safe operating region of less than 0.2% by weight, it is recommended that mills with a high level of cane preparation use a screen aperture no larger than 0.8 mm.

Table II. Fibre levels in clarified juice

Mill	Duration of trial (hr)	Sampling frequency (min)	Fibre content of clarified juice (ppm)		
			Max.	Min.	Avge
Mossman	7.7	20	12.9	1.1	3.0
Mourilyan	5.6	30	25.2	1.0	11.2
Victoria	6.7	30	11.6	0.3	5.4
Victoria	6.0	30	34.2	0.8	15.5
Victoria	4.5	30	50.0	2.6	20.2
Plane Creek —ATV —SRI	 5.0 5.0	 30 30	 3.0 14.0	 0.1 4.1	 1.0 7.8

Note: In the trial carried out at Mossman mill, the fibre level in clarifier feed varied from 1370 to 1840 ppm and averaged 1630 ppm.

The choice between rotary and static screening arrangements is governed largely by economic considerations, the head room available above the milling train and floor area limitations. Future work directed at establishing the fibre removal efficiency and hydraulic capacity of various wedge wire screen configurations will be carried out using both factory and pilot scale trommel and DSM systems.

Acknowledgements

The authors wish to acknowledge the ready assistance of staff at the various mills involved in this project. Thanks are also due to Contra-Shear Developments Ltd. and Hawker Siddeley Engineering for their interest in this work and the provision of a pilot scale screen for evaluation at Victoria mill.

Summary

A series of trials were made at a number of Australian sugar factories using various types of juice screens, and the influence of a number of factors on their efficiency, measured in terms of fibre removal, is discussed. A new type of rotary screen was tested and, after modification of the feed arrangements, found to have a very satisfactory performance. Initial tests were made to investigate the carryover of bagacillo during clarification.

Tamisage du jus

Une série d'essais ont été effectués dans un certain nombre de sucreries australiennes utilisant différents types de tamis à jus et l'influence d'un certain nombre de facteurs sur leur efficacité, mesurée en termes d'élimination de fibres, est discutée. Un nouveau type de tamis rotatif a été essayé et après modification du dispositif d'alimentation on lui a trouvé des performances très satisfaisantes. Des tests préliminaires ont été effectués pour déterminer l'entraînement de bagacillo au cours de la clarification.

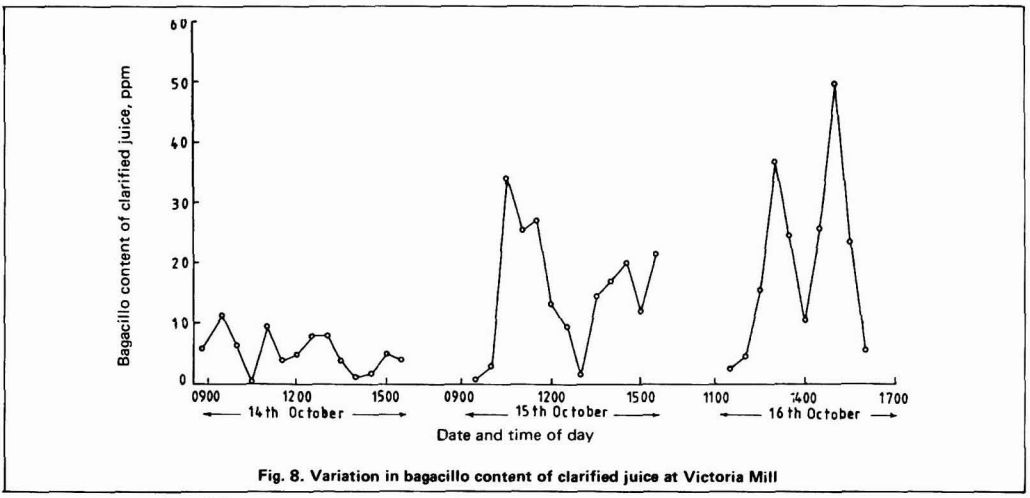

Fig. 8. Variation in bagacillo content of clarified juice at Victoria Mill

Filtersieben von Rohsaft

Eine Reihe von Versuchen wurden bei einer Anzahl von australischen Zuckerfabriken gemacht, die verschiedene Arten von Filtersieben verwenden, und der Einfluß einer Reihe von Faktoren auf deren Effektivität, die in Bezug auf die Entfernung von Fiber gemessen wurde, wird diskutiert. Eine neue Art Trommelsieb wurde getestet, und nach Veränderung des Zuflußes fand man sehr zufriedenstellende Ergebnisse. Vorläufige Versuche wurden gemacht, um das durchgegangene Bagacillo während der Saftreinigung zu untersuchen.

Cribado de jugo

Un serie de ensayos se han hecho en algunos azucareras de Australia usando varios tipos de cribas para jugo, y la influencia de algunos factores sobre su eficiencia, medida en términos de eliminación de fibra, se discute. Un nuevo tipo de criba rotaria se ha ensayado y, después de modificación del dispositivo de alimentación, manifestó un cumplimiento muy satisfactorio. Ensayos iniciales se han hecho para investigar el contenido de bagacillo en jugo clarificado respecto de su contenido en el jugo mixto.

SUGAR CANE AGRONOMY

Maximization of sugar yield through scientific harvest planning – a review. A. P. Gupta. *Sharkara,* 1977, **16,** 9-16. – A review is presented of work carried out on assessment of cane maturity for harvest scheduling.

Phosphate fertilizer recommendation for sugar cane from chemical analysis of soil. E. Zambello, J. Orlando and A. A. Rodella. *Brasil Açuc.,* 1981, **97,** 178-183 *(Portuguese).* – Similar experiments to those of Manhães *et al.*[1] were carried out for soils in the states of Paraná, São Paulo, Mato Grosso, Goias and the south of Minas Gerais, corresponding yield/soil phosphorus relationships obtained and fertilizer recommendations made for the soils classified as very low, medium, high and very high in P.

Losses of sugar and water from cane in fires. D. H. Foster and P. C. Ivin. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 13-20. – Investigations of the effect of burning on cane are discussed. Fire causes major physiological changes to a degree which depends on its severity. Temperatures measured within the stalk and visual observations in laboratory and field tests have shown that there are significant losses of fluid through physical ejection and exudation from the stalk, while substantial thermal degradation of the outer tissue is very probable. Theoretical considerations suggest that water flow within the stalk may be accelerated toward the leaf at the peak of the fire, but immediately afterwards juice may flow toward the root system, provided the water deficiency is sufficient to give the pressure potential. Immediate weight losses varying from 0.3 to 2.6% represent the sum of the physical losses and the changes caused by rapid liquid movements within the burnt cane; about 6% weight loss was recorded only one day after a severe fire, whereas smaller immediate weight losses caused by moderate fires were masked during subsequent days by the water supplied through the roots. Besides microbial losses occurring between burning and crushing, other factors contributing to a reduced c.c.s. in burnt cane may be: thermal destruction of sucrose, dilution by water flowing into the vascular bundles from the roots, a possible loss of sugar solution flowing into the root system immediately after the fire, a physical loss of sugar in juice bursting from the cane tissue, and loss of sugar by exudation onto the cane surface (much of which would be lost in separated trash).

The influence of stubble shaving and cultivation on ratoon performance of sugar cane in the Ord River irrigation area of Western Australia. T. O. Albertsen and G. Kingston. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 305-308. – Because of rapid decline in yields of ratoon cane in the title area, the effects of ratooning methods on performance were investigated in the case of Trojan cane. Results showed that yields were significantly affected by stubble shaving and deep ripping; with tine cultivation only, cane yields were 138.2% and 104.8% for 1st and 2nd ratoons, respectively, and sugar yields were 18.60% and 11.97%, respectively; these compared with cane yields of 100.5% and 70.3% for 1st and 2nd ratoons where deep stubble shaving was combined with deep ripping and tine cultivation, and sugar yields of 13.71% and 7.79%, respectively.

An assessment of c.c.s. profiles and ash in juice for sugar cane grown in the Ord River irrigation area of Western Australia. T. O. Albertsen, D. M. Hogarth, G. Kingston and A. J. Benson. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 309-317. – The sugar contents of four promising varieties and a standard variety grown in the title area in 1977-80 are discussed. While conditions in the area vary less from year to year than in Queensland, where large climatic differences result in considerable variation in c.c.s. levels in different years, the figures for Western Australia showed significant annual differences. However, for a harvest extending from May to November, a weighted seasonal average c.c.s. of 14% is indicated for Q 87, Q 96, Q 99 and N:Co 310 harvested in equal proportions over a plant and three ratoon crops. However, the ash contents in first expressed juice from 2nd ratoons grown in a replicated varietal trial give cause for concern, although the high ash levels may be related to high soil potassium levels which could be expected to fall after some years of cane growing. Ash % juice for 18 varieties ranged from 0.50 to 0.85, while ash % impurity ranged from 29.7 to 42.4.

Some aspects of land utilization or rotation in relation to farm production and productivity. B. T. Roach, D. J. Quinan and D. H. Parsons. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 319-324. – Whereas, before 1965, growing of cane on individual farms in Queensland in any given year was restricted to 75% of the gross assigned area, in 1965 the proportion was raised to 85% and in 1974 all restrictions were removed. This has led to a general increase in the proportion of assigned land cropped annually. However, investigations of data for a number of years have failed to show that increased land utilization and the consequent reduction in fallowing have any generally adverse effects on production, although in some mill areas there are indications that, as rotation increases beyond a certain level, productivity per unit area may decline; nevertheless, in the period under investigation such decline was generally more than balanced by production from the additional area cropped. On the other hand, the results of the study cannot be used to forecast the long-term effects of reduced fallowing or of increased rotation above present levels. Moreover, differences in soil type and drainage pattern may contribute to considerable differences in the sustainable level of rotation between districts.

Checking the fertility of Queensland's sugar land. L. S. Chapman, M. B. C. Haysom and C. W. Chardon. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 325-332. Some aspects of the soil fertility monitoring program implemented by the Bureau of Sugar Experiment Stations in 1975 are discussed. In each of the 30 mill areas in Queensland, eight 0.1-ha sites were surveyed within assigned cane blocks, having been selected to represent proportionally the soils of the Queensland sugar industry. A system of recording all farm operations on the sites was developed, and included data from laboratory analysis of samples collected from each site. Chemical and physical analyses of soil samples from each site are to be carried out every five years. When each site

[1] *I.S.J.,* 1982, **84,** 76.

was established, soil samples were collected to a depth of 750 mm at 250-mm intervals. For the present paper, mean soil analyses and mean crop nutrient removal data were calculated for seven regions; mean regional values of soil analyses for N, P, K, Ca, Mg and S are given for the three soil depths, while fourteen additional assays were carried out on the 0-250 mm samples. The percentage of sites in each region on which yields are likely to respond to fertilizer treatment is also given. The results are discussed in some detail.

An examination of BSES personal contact extension to sugar cane growers in the Bingera and Fairymead mill areas. L. G. W. Tilley and P. A. Jones. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 339-345. – Personal contact, principally on the farm, was the main extension method employed by the Bureau of Sugar Experiment Stations (BSES) in the two areas during 1977-80. More than 50% of holdings were visited annually, 60% of these by request. The proportion of farmers requesting visits and contacts increased over the 3-year period.

Water penetration problems in the Lower Burdekin – a review. G. J. Ham. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 357-365. – The area in question has a low average annual rainfall (1000 mm), most of which is received only in the summer months. However, for more than 25 years problems have arisen in the form of both excessive and impeded penetration, and trials on the use of various soil amendment treatments are reported. Positive cane growth responses have been obtained to 10 tonnes.ha^{-1} gypsum at a number of sites, while burnt lime has also had beneficial effect; deep ripping and watering down the row failed to improve on normal cultivation practices as regards cane yield and sugar content, while surface application of bagasse reduced c.c.s.

Role of minor elements with special reference to manganese in formation and accumulation of sugar in sugar cane. A. P. Gupta and G. S. C. Rao. *Indian Sugar Crops J.,* 1980, **7,** 72-76. – The role of trace elements Fe, B, Cu, Zn and Mo is briefly explained, and the importance of Mn as an enzyme activator and in its effect on N, sugars, nucleic acid and mineral metabolism of the cane is discussed. Pot trials are reported in which increase in Mn application caused a general increase in leaf chlorophyll content (the effect falling with age of cane) and increase in the fructose, glucose and sucrose contents.

Agronomic practices to increase fertilizer use efficiency in sugar cane. R. L. Yadav. *Indian Sugar Crops J.,* 1980, **7,** 77-78. – The effects of time and method of application of N, P and K, of seed cane quality and planting technique and date, of irrigation, of weed control, of intercropping and of plant protection against insect pests and diseases on fertilizer utilization efficiency are briefly indicated.

Weed control. *Rpt. Centre d'Essai de Recherche et de Formation* (Réunion), 1980, 27-30 *(French).* – Tests conducted on various herbicides complementary to Diuron are reported. Of these, Sencoral is effective against a number of broad-leaved weeds and grasses, but is too expensive for widespread use, so that its use is recommended only in plant cane infested with *Paspalum* spp. Velpar, also highly effective against grasses, has a phytotoxicity which prevents its use in young cane; it acts better under wet than under dry conditions and is highly persistent. Dual is effective as a pre-emergence treatment only against grasses. Erbotan has a wide range of activity, but is not very effective against *Mimosa pudica* and is less effective against grasses than broad-leaved weeds. Goal (a Rohm & Haas product containing Oxyfluorfen) is as good as but no better than Karmex, which has been used in Réunion for several years. Tandex has only slight action against broad-leaved weeds. Post-emergence application of Igrane at 5 kg.ha^{-1} with Actril DS as wetting compound had a spectacular effect when used against *Rottboellia exaltata,* but it is highly phytotoxic to cane; Gesapax + MSMA (1 + 1.8 kg.ha^{-1}) gave identical results. While post-emergence treatment is therefore not recommended, no effective pre-emergence treatment is known, so that the weed must be eliminated at the germination stage, for which a number of herbicides are suitable while not being toxic to cane. Three herbicides have proved effective in control of *Vigna sinensis* when applied as a post-planting pre-emergence treatment, but the trials were considered inadequate for recommendations to be given.

Use of vinasse, supplemented with nitrogen and phosphorus, in sugar cane ratoons *(Saccharum* **spp.).** H. Monteiro, C. A. Pexe and J. P. Stupiello. *Brasil Açuc.,* 1981, **97,** 226-231 *(Portuguese).* – Sugar cane plots were treated in triplicated experiments with 75-45-90 kg.ha^{-1} of N-P_2O_5-K_2O as standard and 35 m^3.ha^{-1} of vinasse (equivalent to 24.5-3.5-238 kg.ha^{-1} of N-P_2O_5-K_2O alone or with 20 or 46 kg.ha^{-1} of N and/or 20 kg.ha^{-1} of P_2O_5). Stalks were sampled at monthly intervals in the five months before harvest, and yields and juice characteristics submitted to statistical analysis. It was concluded that the application of vinasse influenced stalk production, while supplemental N provided further gain. The technological quality of the cane as raw material for sugar manufacture was not affected by application of vinasse, with or without supplemental N and P.

Comparative study of forms and doses of nitrogen in the cultivation of sugar cane (18-months cane). O. Brinholi, J. R. Machado and T. H. Liem. *Brasil Açuc.,* 1981, **97,** 232-238 *(Portuguese).* – Nitrogen, as ammonium nitrate and anhydrous ammonia, was injected in a structured Terra Roxa soil in São Paulo state, using 30, 60 and 120 kg of N per ha. Statistical analysis of the results obtained showed no statistical differences between the forms and rates of application in terms of cane and sugar yields.

Soil preparation for sugar cane planting and its effects on the ratoons. J. Fernandes, V. L. F. Neto and R. Stolf. *Brasil Açuc.,* 1981, **97,** 241-244 *(Portuguese).* – The total cane yields obtained from plant cane and two ratoon crops were compared in two separate experiments at different locations, using different methods of soil preparation. Ploughing to 45 cm depth gave the highest yields in both cases and the differences indicate that the effects on the ratoon crops should be borne in mind when deciding which method to use.

Association between systems of soil preparation and phosphating of sugar cane *(Saccharum* **spp.). I. Effects on the soil.** A. A. Casagrande, M. E. Ferreira, P. C. Corsini and R. Rodrigues. *Brasil Açuc.,* 1981, **97,** 252-266 *(Portuguese).* – Application of 0, 500, 1000, 1500, 2000 and 2500 kg.ha^{-1} of rock phosphate to a red latosol soil was combined with preparation by ploughing plus harrowing and the same preceded by subsoiling because of a compacted layer at a depth between 20 and 53 cm. Soil samples were then taken from eight layers

down to 72 cm and the characteristics examined; it was observed that the subsoiling did not promote the transference of mineral components to the deeper levels, nor change the texture components (sand, loam and clay). The added phosphate increased P down to 27 cm.

Studies on land disposal of Hsingying by-product factory waste water. I. Effects of consecutive furrow irrigation of waste water on sugar cane growth, chemical properties of soil and quality of ground water. J. M. Chen and H. T. Li. *Rpt. Taiwan Sugar Research Inst.*, 1981, (91), 1-26 *(Chinese)*. – Waste water, diluted 1:5 and containing 543-1138 ppm BOD_5, 1524-3230 COD and given quantities of mineral salts, was applied to cane land; at a rate of 500 mm per year it increased cane and sugar yields by 26% and 20%, respectively, in 1978/79 and by 18% and 7%, respectively, in 1979/80, by comparison with a control plot irrigated with fresh water. A lower dilution (1:3) of higher BOD_5 and conductivity depressed yields, however. Tile drainage gave better yields than surface drainage. The 1:5 dilution had little effect on soil pH, organic matter content, sodium adsorption ratio, exchangeable sodium and extractable phosphorus contents over three crops, but significantly increased conductivity, soluble salts and non-exchangeable potassium.

The comparative reproductive capacity of several broadleaf weeds and grasses from seed in Louisiana. E. R. Stamper. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 16-18. – The reproduction of seed from ten plants in the cane area of Louisiana was determined. Tabulated results are given for *Amaranthus retroflexus* (pigweed), *A. spinosa* (spiny pigweed), *Panicum* sp., *Digitaria sanguinalis* (crab grass), *Lactuca* spp. (wild lettuce), *Eleusine indica* (goose grass), *Aster* spp., *Sorghum halepense* (Johnson grass), *Brachiaria platyphylla* (signal grass) and *Rottboellia exaltata* (itch or Raoul grass). The numbers of seeds produced per plant are given for five locations, and the order of reproduction shown to be as given above; the two species of *Amaranthus* were by far the largest seed producers.

Experiences with standover cane during the 1977-78 season of the Rio Grande Valley Sugar Growers. N. Rozeff. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 19-23. – Heavy rains followed by periods of frost necessitated the standing-over of cane on some 5600 acres. The practices used in association with the standover cane are described, and the condition of the cane at harvest (after a growth period of 18-27 months) and difficulties with mechanical harvesting are noted. Guidelines are given for standover cane handling on the basis of the experience.

Sugar cane juice quality as related to nitrogen fertilization. J. R. Thomas and J. A. Schmidt. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 24-30. – Investigations were carried out on the effect of soil fertility and N fertilization on cane and sugar yields and juice mineral content, on the relationship between juice quality and mineral composition and the relative importance of specific cations and anions in regard to juice quality. Soil fertility affected juice Cl, N and P contents, while application of N increased juice cation, Cl and N contents. Low juice pol and purity were associated with high cane yields, high juice cation levels or electrical conductivity, high N and Cl contents and low quantities of P. Brix and pol fell only slightly at juice N concentrations greater than 20 meq/100 g, whereas increase in juice Cl caused a progressive fall in pol.

Computer analysis of sugar cane data in Louisiana. G. Dill, F. A. Martin and K. L. Koonce. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 31-33. – A computer program, developed to facilitate calculation of cane yield variables from observed data obtained by various sampling methods, is described. Yield can be calculated from observed variables such as normal juice sugar content and sugar per ton of cane. Sugar per ton and associated variables may also be calculated from mill or laboratory press data. The program is also applicable to handling of other types of data, but its prime role is as a means of statistical analysis.

Increasing populations from mechanically harvested sugar cane seedpieces. B. R. Eiland and J. L. Dean. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 49-52. – Stalk populations and crop yields were determined for two varieties, two seedpiece lengths (25 and 45 cm) and two fungicides (Captafol and Benomyl) with and without heat treatment of the setts. Differences were found in the populations of both varieties, but the best results were given by heat treatment coupled with planting of the longer setts. The effects of the fungicides decreased over the growing season. Yields of one variety were increased to a greater extent by planting the longer setts than in the case of the other variety.

Effects of planting rates on yields of sugar cane in Florida. E. R. Rice. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 53-55. – Cane is planted in 5-ft rows in Florida, but the planting rates vary considerably between 1 and 4 lines of setts in the furrow. Three-year comparisons were made of the yields from 1, 2 and 3 lines per furrow for three and six varieties. In the first study, average plant cane yield for all three varieties increased with the number of lines, while in the 1st and 2nd ratoon crops the trend was reversed. The maximum average for all three crops resulted from 1 line. On the other hand, in the second study the average yield for plant cane and 1st ratoon cane was maximum with 2 lines and minimum with 1 line, whereas in 2nd ratoons it was maximum with 1 line and minimum with 2 lines; the average for all crops was maximum with 2 lines and minimum with 1 line. The results suggest that additional seed cane beyond that required for an adequate stand is unnecessary.

Methods for disposing of unharvested sugar cane and their influence on subsequent production. G. Kidder and B. R. Eiland. *Proc. Amer. Soc. Sugar Cane Tech.*, 1978, 66-68. – Cane killed by frost frequently deteriorates to the extent that it is not economical to harvest it, so that the problem of disposal arises. Effects of the disposal method on cane and sugar production in the subsequent crop were investigated. One set of plots was burnt before treatment, which consisted of leaving the stalks standing, running a tractor wheel over the row of standing cane, running a rolling chopper-drum over the cane, or mowing with a rotary machine. For both burnt and unburnt cane, subsequent cane and sugar yields were lowest where the cane was left standing and highest where it was run over with the tractor wheel. No significant differences were found in the sugar content of the cane in the subsequent crop as a result of the different disposal methods, although burning gave somewhat higher sugar and cane yields than absence of burning. The unharvested cane presented no serious problem to mechanical harvesting of the following crop, but dead stalks were found in all harvested samples.

CANE PESTS AND DISEASES

Observations and considerations on sugar cane rust incidence, varietal reaction and possible occurrence of physiological races. L. J. Liu. *Sugarcane Pathologists' Newsletter,* 1980, (25), 5-10. – From observations on the outbreaks of rust reported from Western Hemisphere countries, it is concluded that the most economical means of control is replacement of susceptible with resistant varieties; details are given of the reactions to the disease of cane varieties in Dominican Republic, Puerto Rico, Jamaica and Venezuela. Canes aged 1-3 months were most susceptible to the disease, while those older than 6 months gradually gained some degree of resistance; incidence of rust was greater in the cooler months (November-March) than in the summer months. Spraying with fungicide alone does not seem to give economical control, although when coupled with specific agronomic practices would offer probably the most effective and practical means of control. The possibility of different races of the pathogen is suggested on the basis of findings regarding cereal rusts, and advice is given on inoculation and identification procedures to follow for the sake of uniformity.

Maturity resistance, a useful phenomenon for integrated control of sugar cane rust. L. J. Liu. *Sugarcane Pathologists' Newsletter,* 1980, (25), 11-13. – With the aim of developing an integrated rust control system based on agronomic practices, cane of ten susceptible varieties was planted in 50-gal drums in May and August, and the rust intensity on the leaves estimated monthly. In general, rust infection decreased with age of the cane, that planted in May having its highest incidence when two months old, whereas there was a dramatic fall in infection in October, when the cane was five months old. In some varieties, the resistance to rust was gained slowly, while in others it developed rapidly. The percentage rust infection on leaves of the same varieties was much higher in the August- than in the May-planted cane, so that the earlier planting date is suggested as one means of rust control.

Smut reaches southern Haiti. A. L. Fors. *Sugarcane Pathologists' Newsletter,* 1980, (25), 14. – The discovery of smut in an area of southern Haiti in October 1980 is reported. The worst affected variety was B 47258 (19% infection), while the least affected was Co 421 which, however, occupies 75% of the total area under cane.

Smut at the Juba Sugar Project in Somalia. D. Eastwood. *Sugarcane Pathologists' Newsletter,* 1980, (25), 15. Smut, caused by *Ustilago scitaminea,* has been present for many years on cane grown on an estate on the Shebelle river in Somalia. However, the disease was not observed at the other estate, on the Juba river, until August 1980; whips were observed in a field of N 53/216 first ratoon cane. No other variety exhibited symptoms, and intensity of the disease was low, so that control measures were being restricted to field inspection, systematic roguing and curtailing of further extension of N 53/216 cane.

Further report on leaf scald disease of sugar cane in Andhra Pradesh (India). Y. Satyanarayana and M. A. Rao. *Sugarcane Pathologists' Newsletter,* 1980, (25), 16-17. Leaf scald, caused by *Xanthomonas albilineans,* has been reported on ratoon cane of a number of varieties at the Sugarcane Research Station, Anakapalle, where the disease was first observed in 1972. The number of diseased stools per ha is reported for each of eleven varieties. Two varieties, CoA 71-1 and CoC 671, were unaffected, but this apparent resistance needed confirmation. Other varieties in the Co series and two Queensland varieties, Q 49 and Q 70, were infected to a slight extent.

Gumming disease and chlorotic streak in Argentina. B. T. Egan. *Sugarcane Pathologists' Newsletter,* 1980, (25), 17. – Chlorotic streak was found in one cane plantation in north Argentina; it was endemic in some heavily irrigated fields and caused losses in one particular variety. Gumming disease caused considerable damage in original seedlings and early selection stages at the Tucumán experiment station, but few symptoms were seen on commercial varieties. Both diseases were found to be well established and had obviously been present for several years, although not previously recorded.

Symptoms of sugar cane streak disease – similarities with mosaic. C. Ricaud. *Sugarcane Pathologists' Newsletter,* 1980, (25), 18-21. – Symptoms of streak, no longer considered of economic importance in countries where it exists, are described. While the typical symptoms are distinguishable from those of mosaic, variations in symptom expression caused by differences in virus strain, cane variety and growth conditions may lead to confusion between the two diseases. Such variations in streak symptoms are described, and areas of similarity between streak and mosaic symptoms are indicated.

Methods for the storage of the pineapple disease fungus. C. C. Ryan, L. J. Lopez and J. A. Wilson. *Sugarcane Pathologists' Newsletter,* 1980, (25), 22-23. – Field trials of fungicides to evaluate their action against pineapple disease fungus, *Ceratocystis paradoxa,* are undertaken each year by the Bureau of Sugar Experiment Stations in Queensland. After fungicidal treatment, setts are inoculated with isolates of the fungus collected from diseased but untreated setts. However, suitable specimens are not always available when required, so that investigations were carried out on two techniques for storage of isolates for up to one year without impairing their pathogenicity. Details are given of the techniques, the more suitable of which was storage in the freezer compartment of a refrigerator. In the other method, storage in an incubator at 28°C, some of the cultures became infested with mites. Both methods maintained the cultures in a viable and pathogenic state after 12 months.

Cane movement and quarantine in some countries of the Caribbean. A. M. Whittle. *Sugarcane Pathologists' Newsletter,* 1980, (25), 24-25. – Work towards implementation of quarantine procedures for importation of cane varieties into Guyana, Trinidad and Jamaica is described, and research on leaf scald identification and bud germination in Jamaica is briefly reported.

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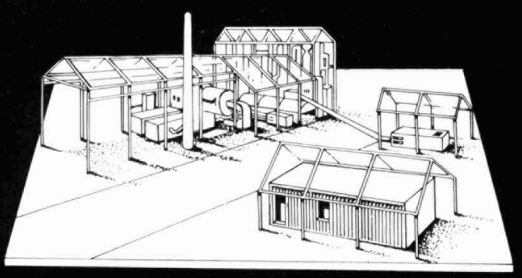

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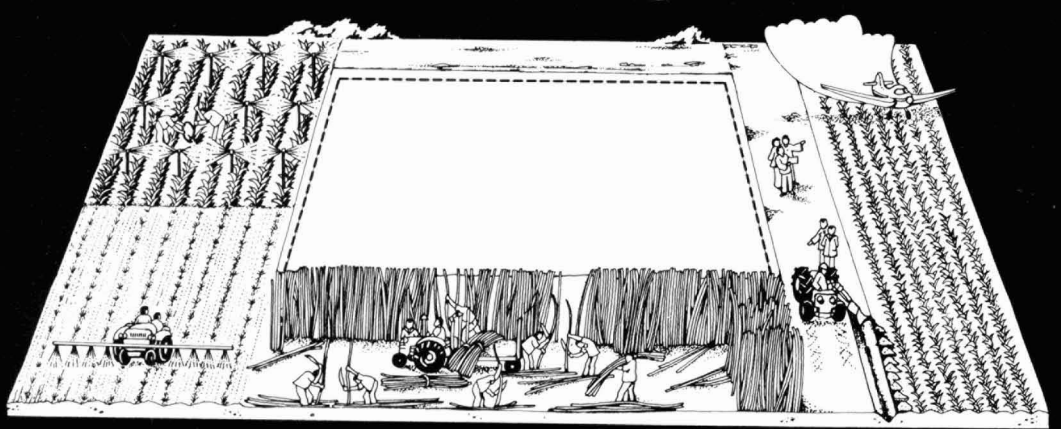

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New record of *Maliarpha separatella* Raganot on sugar cane. A. S. Patil, D. G. Hapase, B. P. Gajare and P. R. Moholkar. *Maharashtra Sugar,* 1981, **6,** (6), 41. – The title pest is a serious rice borer, but larvae have been found feeding on the lower portion of cane stalks in September-October at the Sugarcane Research Station, Padegaon.

***Scirpophaga excerptalis* Wlk. on sugar cane in Maharashtra.** A. S. Patil, D. G. Hapase, B. P. Gajare and P. R. Moholkar. *Maharashtra Sugar,* 1981, **6,** (6), 41. – Mention is made of the discovery of the title top borer on cane at Padegaon.

Seed piece transmissible diseases of sugar cane and the three seed program. K. Singh. *Indian Sugar,* 1981, **30,** 589-590, 593-596, 599-601. – Descriptions are given of symptoms of major cane diseases found in India: ret rot, wilt, smut, grassy shoot and ratoon stunting disease. The question of possible control through changes in cane varieties grown commercially is discussed, and details are given of a three-tier seed cane program which aims to provide disease-free material.

Mosaic: an extraordinary disease problem. H. Koike. *Sugar J.,* 1981, **43,** (10), 19. – The reasons why cane mosaic is a much greater problem in Louisiana cane fields than in most other parts of the cane-growing world are discussed. The mechanism of transmission of this viral disease is explained, and the interaction of differing strains of the virus and changing cane varieties in Louisiana discussed. Because of the occurrence of new strains of the virus, cane varieties that are inherently resistant may not remain so indefinitely. The climate in Louisiana is such that the cane remains small for long periods after planting in August-September and again in February-June, and is highly vulnerable to attack by aphids, seven of which have been identified as mosaic vectors in Louisiana. Details are given of the history of mosaic strain occurrence in Louisiana and of the cane varieties grown.

Towards a solution to the problem of sugar cane smut. H. L. Lloyd. *S. African Sugar J.,* 1981, **65,** 153, 156. Because of the length of time (1-3 years) needed for accurate determination of smut resistance in cane varieties, screening may only be carried out at a relatively late stage in the selection program. Research was therefore carried out with the object of developing a rapid, efficient technique for evaluating smut resistance which would be applicable to large numbers of progeny at an early stage in the breeding program. Observations showed that there appears to be an inhibitory factor inside or on the surface of the buds of some smut-resistant cane varieties that reduces the chances of smut spores gaining access to the buds, which are known to be the primary site of infection; the disease then spreads to the developing region of the cane stalk and ultimately manifests itself as a black whip at the top of the stalk. The chemical components in the scale covering the bud were fractionated and each tested for inhibitory properties. The inhibition of smut spore germination was found to be associated with a group of closely related constituents, and the sums of the concentrations of these components were directly related to the resistance of four varieties under field conditions. A fairly close correlation between field resistance assessed by the traditional method and resistance assessed by a chemical test was established for 22 varieties. However, further tests are needed to confirm the efficacy and practicability of a chemical assay for the assessment of smut resistance; it is also considered that a chemical inhibitor is unlikely to be the only mechanism of smut resistance.

Symphyla control in young plant cane. H. L. Boyle. *Cane Growers' Quarterly Bull.,* 1981, **44,** 115-116. Symphyla are small, white, centipede-like creatures 5-10 mm long, which have been recognized as a cane pest for a number of years although occurring only sporadically and not causing any significant crop loss. However, in 1980, the pest caused significant damage to young plant cane in the Ingham area of Queensland; more than 200 ha on 37 farms was affected. The pest eats small, cylindrical pits along the root and into the root tip; heavy infestations cause root growth to cease, giving the cane the appearance of being drought-affected. Injection of EDG 193 soil fumigant at 15 litres.ha^{-1} (diluted with up to 500 litres of water) into the soil just below the depth of the sett in a band on each side of the stool, with the injector tines no further than 45 cm apart, was effective in eliminating the pest in a number of trials.

RSD – is it costing you money? L. G. W. Tilley. *Cane Growers' Quarterly Bull.,* 1981, **44,** 120. – It is pointed out that it is difficult for cane growers to know how extensive ratoon stunting disease infection is because of the lack of external symptoms and hence difficulty in identifying the disease. Guidance is given on identification of the internal symptoms and on means of controlling the disease (basically through the growing of uninfected cane from a "clean" plant source). Many trials have shown that RSD can cause at least 10% reduction in yield under good growing conditions, and possibly 25-50% in susceptible varieties grown under unfavourable conditions.

RSD – don't stop treating and sterilizing. L. K. Izatt. *Cane Growers' Quarterly Bull.,* 1981, **44,** 120-121. Control of ratoon stunting disease is best achieved by growing only hot water-treated cane or cane obtained from a disease-free source, having all the planting material officially inspected, and sterilizing all cutting equipment.

Introduction and establishment of an ectoparasite, *Epipyrops melanoleuca* Fletcher (Epipyropidae: Lepidoptera) in Bundi district (Rajasthan) for the biocontrol of sugar cane Pyrilla, *Pyrilla perpusilla* (Walker). A. D. Pawar, J. Prasad, R. Singh, K. P. Yadav and R. Asre. *Indian Sugar,* 1981, **30,** 745-749. – Eggs and cocoons of the title parasite collected from regions of Uttar Pradesh and Haryana were released in cane fields. Complete control of the leaf hopper was thus achieved in a 2000-ha block. Recovery of the parasite has indicated that it has established itself well in the district.

The fight against Eldana: pheromones. Anon. *S. African Sugar J.,* 1981, **65,** 197-198. – Work is to be carried out to identify the components of pheromones emitted by the *Eldana sacchari* moth and determine their functions. In an examination of the mating behaviour of the moth, it is pointed out that it is the male that releases the pheromones and the female that searches for the male, in contrast to normal moth behaviour. At the South African Sugar Association Experiment Station, a wind tunnel has been built to test the effects of pheromones.

SUGAR BEET AGRONOMY

Improving the quality of beet. M. Loilier. *Sucr. Franç.*, 1981, **122**, 131-140 *(French).* – After a period of sharp frosts in November 1980, which affected the entire French beet area, investigations were conducted on stored beets. These showed that beets harvested mechanically and piled during the frosty period lost (over a 54-day storage period) almost three times the sugar lost by the control (samples taken from the interior of the pile and first stored before the frosts); beets piled at the start of the period and beets lifted by hand during the period suffered little more loss than the control. The difference between pol measurements and actual sucrose content, typically 0.15 units for healthy beet, increased to as much as 0.40 in the case of the badly frosted beet as a result of the formation of optically active substances from sugar. Beet varietal trials carried out at 10 sites showed much lower differences between fields for the same variety in terms of extractable sugar % beet than in terms of the grower's return. The results for 25 varieties are indicated by a diagram. Nitrogen trials showed that the mean net revenue and the extractable sugar (tonnes.ha^{-1}) obtained by following official recommendations on N dosage were the same as the values obtained by the grower applying 50 units more N than the recommended amount. Fungicidal treatment of some 100 tonnes of stored beet restricted mould formation to 60% of the beets, compared with 84% of the beets in the control pile.

The effect of sugar beet spacing on yield and sugar content. Z. Izsaki. *Cukoripar*, 1981, **34**, 1-3 *(Hungarian).* For a given optimum plant population, root yield and sugar content can be increased slightly by ensuring uniform spacing between plants. Tests conducted in 1978 showed that highest sugar content was obtained at a spacing of 20.5-30.0 cm.

Post-emergence treatments, or completion of weed control in sugar beet. J. M. Belien and J. F. Salembier. *Le Betteravier*, 1981, **15**, (152), 12-14 *(French).* – Recommendations are given on post-emergence herbicide application as the final stage in weed eradication for a given beet crop.

Beet transplanting. Anon. *Le Betteravier*, 1981, **15**, (152), 14 *(French).* – Transplanted beet seedlings are stated to give some 20% greater yield than drilled seed. The strip technique used for growing seedlings is briefly described with the aid of photographs.

Beet bolters. J. Pichenez. *Sucr. Franç.*, 1981, **122**, 193-203 *(French).* – Descriptions are given of the two basic types of weed beet to be found in French sugar beet fields, viz. the groundkeepers left in the field after harvesting, and wild annual diploids (primarily found in the south-west of France where most of the mother beet for seed production is grown). Typical incidences of beet bolters in French regions are indicated and the problems associated with them are discussed. In a survey of control means, it is stated that, despite the risk of injury to industrial beet and difficulties created by storage of the injured beets together with unharmed roots, chemical treatment with Gramoxone and/or Roundup is still considered the best method, and every effort is being made to introduce more suitable systemic herbicides.

Residual effects of Atrazine applied in a maize crop on subsequent sugar beet treated with different weed control programs. W. Haquenne, J. F. Salembier and J. M. Belien. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1980, **48**, 179-197 *(French, Dutch).* – Two-year investigations on the possible phytotoxic effects of Atrazine, used for weed control in maize, on the following beet crop are reported. In 1977, Atrazine applied at 0.625, 1.375 and 2.125 kg.ha^{-1} a.i. did not adversely affect beet population, root yield or beet sugar content, although growth retardation caused by some of the weed control programs used in the beet crop was aggravated by Atrazine at the highest rate. Higher rates of Atrazine application were used in 1979, viz. 1.0, 1.75 and 2.5 kg.ha^{-1} a.i. The subsequent beet population was slightly reduced under the effect of 1.75 kg.ha^{-1} Atrazine, but considerably so with the highest application rate, the reduction then averaging 37% for all the weed control programs. The effects on the other beet crop parameters were not known at the time of writing.

The importance of sugar beet fertilization method. A. Kovarik. *Listy Cukr.*, 1981, **97**, 74-75 *(Czech).* – A decline in Czechoslovakian beet agronomy in recent years is attributed to the growing of unsuitable varieties, to the poor state of the soils, to faulty agronomic practices and to inadequate attention to beet fertilization. This last factor is discussed and its dominant role in agronomy stressed.

Soil sampling. J. Jaros. *Listy Cukr.*, 1981, **97**, 77-78 *(Czech).* – Advice is given on soil sampling as a means of determining beet nitrogen requirements.

Soil analysis. M. Friml. *Listy Cukr.*, 1981, **97**, 79-81 *(Czech).* – Soil analysis for nitrate and ammonia N is described.

Predicting sugar beet nitrogen fertilizer requirements on the basis of soil analyses. J. Chochola. *Listy Cukr.*, 1981, **97**, 81-85 *(Czech).* – The importance of determining beet N requirements so as to provide for maximum sugar yield is discussed and the wide range of values found for this optimum in different area of Czechoslovakia is indicated. A suitable means of determining the optimum is analysis for nitrate N down to 80 cm and calculation of the N requirement as 210 – 1.25 nitrate N (kg.ha^{-1}).

Problems of sugar beet fertilization. A. Cumakov. *Listy Cukr.*, 1981, **97**, 85-87 *(Czech).* – For optimum N fertilization in Czechoslovakia in 1981, soil samples were to be taken from an area of 160,000 ha and analysed for nitrate N. The use of electro-ultrafiltration for this is described.

Influence of liquid manure on nitrogen supply and the growth of sugar beet. F. X. Maidl and G. Fischbeck. *Die Zuckerrübe*, 1981, **30**, 112-113 *(German).* – The problems associated with liquid manure application, viz. risk of over-supply of nitrogen and imprecision in

N fertilization rate, are discussed, and the effects of liquid manure on soil nitrate content, on leaf and root yield, on pol and on monetary return are indicated.

Factors affecting sugar beet quality. Anon. *Die Zuckerrübe,* 1981, **30,** 114, 116 *(German).* — Factors considered are the relationship between quality and yield loss and the effects of N, P and K on beet quality and financial returns.

Nmin, supplementary supply of soil N and N fertilization. K. Bürcky. *Die Zuckerrübe,* 1981, **30,** 124, 126 *(German).* — It is pointed out that more than 95% of the N in the soil is not available to the beet plant at the start of the growing season, but that some will become available through mineralization and nitrification during the season. However, it is difficult to assess the effective soil N by analysis, although an approximate value can be obtained; on the other hand, climatic conditions will determine how close this value is to the actual figure. The result may be imprecision in the determination of the optimum N fertilization rate, while application of organic manure will also add to the difficulties of accurate assessment.

In which periods of time during growth must sugar beet be weed-free? H. Hack. *Die Zuckerrübe,* 1981, **30,** 127-130 *(German).* — It has been found by various authors that it is unnecessary to maintain the beet field weed-free throughout the entire growing season in order to achieve high crop yields, although there is a critical period during which the growth of weeds will have an adverse effect on yield. Investigations carried out to determine this period are reported, and it is shown that it is possibly the entire 8-week period after emergence, although it may be shorter, but should not start later than emergence. Chemical control of weeds and development of both beets and weeds are discussed.

The population dynamics of weed beet. G. Cussans and C. Bastian. *British Sugar Beet Rev.,* 1981, **49,** (2), 17, 20-21. — Preliminary results of investigations showed that weed beet plants, spaced apart and free of competition, have produced over 19,000 seeds each, and even in the presence of a sugar beet crop have yielded more than 2 tonnes of seed per ha. Viable seed production per unit area increases with increasing plant population up to about 20 plants per m^2, after which it remains constant until very much higher populations are reached. Failure of seedlings to emerge after new seed had been ploughed under during the previous season was due less to the inability of the seedlings to reach the surface than to dormancy of the seed. When ploughing brought the seeds to the surface in a spring barley crop, there were three times as many seedlings on twice-ploughed land as when tine cultivation was used. The possible effect of seed depth on seedling emergence is to be further studied; it has already been suggested that seeds buried at depths down to 14 cm tend to become dormant, so that seed survival (in a viable but non-germinated state) thereby increases. Emergence was very much reduced in the presence of a crop canopy by comparison with bare ground, although seed survival was much greater.

Weed beet survey 1980. G. Maughan. *British Sugar Beet Rev.,* 1981, **49,** (2), 21-23. — A survey of weed beet infestation of sugar beet fields in the UK in 1980 showed that the national average was 21.8% of fields infested, ranging from 10.9% to 18.7%. Where the sugar beet is grown in a 3- or 4-crop rotation (some two-thirds of the UK crop), incidence of mis-placed beet seeds is greatest and falls with extension of the rotation. Most attempts to control the bolters succeeded to some extent, the most common method being light manual work; however, there was no attempt to control the bolters in 42% of the fields, and more than half of these fields produced seeds considered viable.

A new machine for tackling weed beet. W. Hollowell. *British Sugar Beet Rev.,* 1981, **49,** (2), 23. — The machine described is mounted on the front of a tractor and comprises a series of hydraulically operated clamps placed above the beet rows. Centrally positioned sensors activate the clamps when they come into contact with bolters; the forward movement of the tractor is sufficient to allow the closed clamp to pull the entire weed beet plant from the ground. The clamp stays shut for a pre-set time, then re-opens.

When and how to control bolters to prevent weed beet developing. P. Longden and M. Johnson. *British Sugar Beet Rev.,* 1981, **49,** (2), 24-26. — Three methods of weed beet control are: hand hoeing to allow the weeds to be pulled out of the ground, topping (the quickest and possibly the only suitable method for very heavy infestations), and application of herbicide such as Roundup. Pulling should be done from mid-July to mid-September whenever any of the weeds are seen to flower. Topping is best carried out at peak or late flowering stages, possibly twice at a 2-week interval; topping before peak flowering allowed viable seed to be produced on re-growth, while topping after the end of flowering was too late, since live seeds were already present. Chemical control is best carried out at the immediate pre-flowering stage and then repeated at 10-14 day intervals up to, but not after, mid-August.

Seedbed preparation for sugar beet on medium and heavy soils. P. McClean and R. Clare. *British Sugar Beet Rev.,* 1981, **49,** (2), 48-50. — Advice is given on beet seedbed preparation so as to allow a high level of seedling emergence, especially when a mild winter (with little frost-weathering of the soil) is followed by dry weather continuing to well after drilling.

Planting sugar beets to stand in Wyoming. K. J. Fornstrom. *J. Amer. Soc. Sugar Beet Tech.,* 1980, **20,** 535-543. Studies conducted on seed spacing and emergence in beet crops planted to stand are reported, in which it was found that an initial stand count in the range 24-40,000 plants per acre would give final yields comparable to those with over-planting followed by thinning. Good chemical weed control is a requirement for planting to stand, while the emergence rate required is governed by soil moisture.

Yield, quality and tissue N and Mn levels as affected by interactions between applied N and Mn. R. D. Voth and D. R. Christenson. *J. Amer. Soc. Sugar Beet Tech.,* 1980, **20,** 544-552. — In greenhouse and field experiments, increase in N application to beets reduced the foliar accumulation of Mn applied as $MnSO_4$, whereas Mn had no effect on N accumulation nor on root and sugar yield, although Mn uptake rose with increase in the amount applied. Increase in N application, whether to the previous crop (navy bean or corn) or to the beet crop, was accompanied by increase in root and sugar yield, while sugar content was unaffected.

CANE SUGAR MANUFACTURE

A procedure for introducing stored bagasse and sugar beet pulp into process. G. Dumbaugh. *Sugar y Azúcar,* 1981, **76,** (5), 47, 50-51, 54-55. – Problems associated with the withdrawal of materials from storage bins are discussed and the value of the bin activator powered by a vibratory excitor is indicated. Factors to be considered in the application of bin activators are examined, and the types of material for which they are suitable are listed.

Wear-resistant materials for sugar cane shredder hammers. V. Mason, C. M. Perrott and I. R. Sare. *Wear of Materials* (Int. Conf. Wear of Materials), 1979, **2,** 343-350; through *S.I.A.,* 1981, **43,** Abs. 81-693. – A series of tests on sugar cane shredder hammer tip materials was undertaken to determine the wear rates and shatter behaviour of sintered tungsten carbide-cobalt inserts and various grades of alloy white iron. Silica grains brought in with the cane were found to be the prime cause of hammer tip wear. If the tip hardness can be raised above the hardness of silica, then wear rates decrease markedly. Tungsten carbide-cobalt tips were observed to wear at about a quarter the rate of white irons, used either as weld-deposited hardfacing or as hardened castings. The shatter failure of hammer tips was caused by the presence of tramp iron and not stones or rocks. Simple design modifications were effective in decreasing the incidence of shatter failures.

The multiple-effect evaporator – optimum number of effects. S. K. Ghosh. *Sharkara,* 1977, **16,** 5-8. – It is indicated, by a mathematical examination of multiple-effect evaporation, that increasing the number of effects in order to save steam reaches a limit where the increase in capital and maintenance costs outweighs the fuel saving benefit. The optimum number of effects, with a quadruple-effect evaporator as basis, is discussed. (See also Ghosh: *I.S.J.,* 1980, **82,** 83-85.)

Administration of a safety program. R. K. Gard and K. J. Kenny. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 1-5. – Aspects of a safety program operated at Victoria factory of CSR Ltd. since 1957 are described, including the reasons for the program and the legal responsibilities of management for worker safety, organization of the program and results achieved up to 1980. Causes and types of injury in the period 1967-80 are indicated.

Technology change in the Australian sugar milling industry. C. N. Anderson and R. J. Stalker. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 7-12. – A study of the rate at which the Australian sugar industry has adopted new types of equipment and techniques is reported, covering chopper-harvesters, bin cane trucks, diesel locomotives, Searby shredders, heavy-duty shredders, pressure feeders, hydraulic loading of cane rollers, calandria vacuum pans and fly-ash collection. The main benefit of each is given, and the economic worth of the average investment, as determined by capital cost and pay-back period after tax, related to the speed of adoption. It is shown that the sugar industry has an "index of innovation" which is far higher than those of comparable food industries in Australia.

Self-sufficiency in boiler fuel at Pleystowe. B. J. Doolan and G. D. Jacklin. *Proc. Australian Sugar Cane Tech.,* 1981, 21-22. – Whereas annual fuel oil consumption at Pleystowe during the period 1974-78 varied from 186 to 246 tonnes in the pre-crush season and from 829 to 1627 tonnes during the actual crushing season, the figures were reduced to 138 and 86 in the 1979 and 1980 pre-crush seasons, respectively, and to 78 and 17 in the crushing seasons, respectively, after a new boiler and 1000-tonne bagasse bin and stacker-reclaimer had been installed. Other factors contributing to the reduction are described.

Design ideas for a continuous low-grade pan. R. Broadfoot and P. G. Wright. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 23-29. – A 60 m^3 continuous pan was installed at Mossman factory in 1976, and observations on its operation are described as a possible contribution to future pan design. The pan is based on the multiple mixed cell concept (as is the Fives-Cail Babcock continuous pan) in contrast to the "long path" or plug-flow concept of the Langreney pan[1] and one installed at Racecourse factory. (The former design is preferred by the Sugar Research Institute, collaborators with Evans Deakin Industries Ltd., mainly because of the simplicity of operation, although it is considered that no significant difference in yield or crystal size C.V. should occur between the two types of pan where batch-produced crystal is used as seed.) A number of design recommendations based on the observations are given, and a design layout incorporating the various features is proposed. Its salient points are described.

Techniques for the graining of *C*-seed. K. F. Miller and P. G. Wright. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 31-37. – Recent literature on low-grade graining methods is reviewed, and an investigation of slurry seeding at Pleystowe factory is reported. In the 15 trials carried out, the best supersaturation for seeding was found to be in the range 1.15-1.18, as found earlier by Diago[2]. A temperature of about 70°C at the graining point was preferable to a lower temperature. On the basis of the results, recommended steps in an acceptable graining procedure are described.

***C*-massecuite cooling trials – Macknade mill 1979 season.** P. C. Atkins and A. W. Strong. *Proc. Australian Soc. Sugar Cane Tech.,* 1981, 39-43. – Because of inadequate drive power for the batch crystallizer station and hence inability to cool the massecuite to the desired temperature, the station was converted to a series of five continuous crystallizers. Trials in 1979 (before the conversion) aimed to establish the effect of cooling rate and final temperature on *C*-molasses purity. Results confirmed the validity of the CSR formula for prediction of final molasses change (log purity = $1.0400 - 0.1181 \log \frac{\text{reducing sugars}}{\text{ash}} - 0.5980 \log \frac{\text{impurities}}{\text{water}} + 0.5068$ log saturation temperature) and indicated a 2-2.2 units lower purity than with the batch

[1] *I.S.J.,* 1977, **79,** 310-314.
[2] *ibid.,* 1967, **69,** 20.

system as a result of a 6°C reduction in the final temperature from 55° to 49°C. It was found that cooling rates did not greatly affect the decrease in purity, which was mainly governed by the final temperature. This permitted a faster cooling rate as a result of operation at lower crystallizer levels, at the same time increasing station capacity.

The continuous crystallizer station at Macknade mill. Anon. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 45-48. — Details are given of the crystallizer station conversion referred to in the previous abstract. The massecuite reheaters were removed and a 120-tonne massecuite receiver installed under the first crystallizer; the receiver has paddle-type stirrers designed to break the surface of the massecuite and enhance air cooling, so that massecuite leaving a full receiver is typically 2°C cooler than when dropped from the pan. The first crystallizer was raised 600 mm and the 3rd, 4th and 5th crystallizers lowered by 700, 1400 and 2100 mm, respectively, relative to the 2nd crystallizer. Cooling takes place in crystallizers 1-3, while hot water flows through crystallizers 5 and then 4, thus limiting the temperature difference between massecuite and water to 15°C (i.e. between actual and saturation temperatures). Massecuite flow in the system depends on use of a control valve to recirculate massecuite to the receivers in the event of too high a level in crystallizer 1 or crystallizer 5, or too low a level in the receiver; the level controller used for crystallizer 5 also controls the pumping rate to the centrifugals under the effect of the level in the batch centrifugal distribution trough and in the continuous centrifugal header tank. During 1980, average temperature drop was from 69°C (at dropping from the pan) to 49°C in crystallizer 3, after which the massecuite temperature was raised to 54°C in crystallizer 4 and to 60°C in crystallizer 5; a 2.3 unit reduction in molasses purity over the 5-year average for 1975-79 was achieved.

Continuous high-grade massecuite separation. R. J. Swindells and L. K. Kirby. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 49-54. — The development of the batch and continuous centrifugal is briefly described, and factors which become of increasing importance at the currently attainable charge level in batch machines or as this level increases are listed. Because of these, it is considered that further developments in batch centrifugals are unlikely. However, though the continuous machine has a number of advantages over the batch centrifugal, its main disadvantage of crystal breakage restricts its application to low-grade massecuites. The authors feel that there is now need for a continuous machine capable of handling high-grade massecuites; either considerable efforts should be made to solve the crystal breakage problem, or the significance of crystal breakage should be re-evaluated, although an easier solution would be the incorporation of a crystal breakage reduction device in conventional conical basket machines. The continuous vacuum filter designed by Thirel[1] as an alternative to centrifugal separation is briefly described.

Massecuite heating with finned tube heat exchangers. J. N. Ness. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 55-60. — Results of tests on five finned-tube massecuite heaters at four sugar factories are summarized. While good performance was generally indicated, losses being minimal provided the heating water temperature control was adequate, problems have arisen with regard to inadequate available pressure head between the crystallizer station and the centrifugals, while blockages have apparently been caused by scale and massecuite accumulation on the fins and tubes. It is suggested that an access cover be provided above the top row of tubes for inspection of fins and removal of foreign matter, while suitable treatment of the hot water feed would prevent scaling and corrosion. The heater requires less supervision and maintenance than electrical resistance heaters and is subject to fewer operational problems.

A quantitative determination of the flow and frictional properties of raw sugar. II. D. F. Bagster. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 61-65. — As part of an investigation on the flowability of raw sugar as a function of the length of time of storage under load[2], a study was undertaken in order to quantify the caking of freshly dried raw sugar in terms of its strength and storage period. The moisture content of a sample of sugar was increased and the sugar then dried; samples were then consolidated by shear under an arbitrarily chosen pressure of 7.74 kPa and subsequently stored at 14.8 kPa (the major consolidating pressure found for fresh unaltered sugar) for three days before shearing under 2.77 kPa. (A sample that was sheared without the 3-day loading period immediately after drying and 25 days later demonstrated that the instantaneous shear properties did not alter with time.) Results showed that during the 3-day storage period the strength of the sugar almost trebled, after which it gradually fell to the instantaneous value during a period of several weeks. Hence, freshly dried raw sugar can be expected to cause storage difficulties for that length of time after manufacture. The phenomena are apparently consistent with a crystallization process, and contact between some crystals in a sample has been established; a photomicrograph clearly shows such a crystalline bridge.

Recent advances in thermal spray applications. J. W. Hoffman. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 107-115. — Thermal spraying processes capable of applying an abrasion-, erosion- and corrosion-resistant coating of metals or alloys, glasses, ceramics, etc. between 0.1 and 25 mm thick are briefly described, and examples of application indicated with the aid of photographs.

Primary juice heating by direct vapour contact. R. C. Young and A. H. Westmoreland. *Proc. Australian Soc. Sugar Cane Tech.*, 1981, 125-134. — After conversion of a quintuple- to a quadruple-effect evaporator of greater total heating surface area, a modified condenser was installed between the 3rd and 4th effects to act as a direct vapour contact heater (DCH) for juice in order to improve the steam economy and reduce the heat load on the spray cooling system. Initially, the DCH was used for partial primary heating, which was completed by a tubular heater operating on 1st effect vapour. Later in the season, full primary heating with 3rd effect vapour was carried out by the DCH. Both arrangements were evaluated in trials which confirmed the applicability of the DCH as an alternative to conventional tubular heaters. Excellent juice temperature control was provided by a butterfly valve in the incondensable line from the DCH. The combination of evaporator arrangement and DCH gave acceptable evaporator steam and vapour loadings.

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[1] *I.S.J.*, 1979, **81**, 293-296.
[2] *Bagster: ibid.*, 1981, **83**, 373.

BEET SUGAR MANUFACTURE

Operation of Pereleshino sugar factory with thick juice production. N. A. Zherebtsov, R. L. Kashchenko, S. V. Vorontsova, M. V. Petrov, A. N. Torokhov and N. G. Mamotenko. *Sakhar. Prom.*, 1981, (4), 24-26 *(Russian)*. – Observations on thick juice production and storage for post-campaign processing at Pereleshino are reported. During 40 days' storage in 1977/78 there were slight falls in Brix to 66.3° and sugar content and a slight rise in colour (which was initially 71.8°St), but the purity remained unchanged at 88.1. The numbers of mesophiles, thermophiles and slime-forming bacteria fell gradually during storage. In 1979/80 the thick juice was stored for 95 days. There was little change in Brix and sugar content as a result of storage, and purity fell by only 0.3 units to 89.5, while colour rose from 47.6° to 58.4°St. However, there was marked increase in the numbers of all three groups of bacteria; this was attributed to the condensation of water on the walls of the storage tank as a result of a higher sugar temperature (40-45° compared with 35-40°C in 1977/78).

Test on a combined dryer/cooler at "V. V. Kuibyshev" sugar factory. V. I. Kruglovenko, L. S. Pokutnev, E. M. Belen'kaya, V. A. Pronina and Yu. I. Epikhin. *Sakhar. Prom.*, 1981, (4), 26-29 *(Russian)*. – A modified SPS-20 fluidized bed dryer/cooler is described which was tested throughout a period of 72 hours on white sugar of 99.65 purity. Average moisture reduction was from 1.032% to 0.064% at a temperature drop from 46.3° to 30.1°C; temperature of the drying air varied between 95.9° and 120°C, while the air used for cooling averaged 17.4° (13.5-25°C). Power consumption was 150.5 kWh, throughput averaged 6.19 $kg.sec^{-1}$, and dust entrainment was 0.34% on dried sugar. Comparison is made with the original SPS-20 dryer.

A suitable beet elevator design. G. N. Stepanov. *Sakhar. Prom.*, 1981, (4), 31-33 *(Russian)*. – The types of beet elevator available for use in Soviet sugar factories are surveyed and recommendations given on the most suitable type and operation for a given factory throughput.

Processing frozen and deteriorated beet. R. S. Palmer and S. C. H. McCarey. *Sucr. Belge*, 1981, **100**, 167-184. See *I.S.J.*, 1981, **83**, 343.

The 1980 campaign. E. Reinefeld. *Zuckerind.*, 1981, **106**, 397-407 *(German)*. – After a survey of the 1980 beet growing season and results obtained in West Germany, the author discusses various aspects of processing, including operations at the beet end of the factory. Mention is made of trials on disinfectants as alternatives to formalin; varying results were obtained with a preparation based on dithiocarbamate and Antiformin, a Stockhausen product. There is a tendency to expand pulp pressing stations, and results from 20 factories showed that between 1976 and 1980 the average pulp dry solids content rose from 19.60% to 23.22% as a consequence of reduction in the rotary speed of the presses and possibly addition of chemicals. Tests with $CaCl_2$ addition to press water showed that the dry solids content rose by 1% when 9.22 kg of chloride was added per tonne of beet. However, for a distinct improvement in pressing, the minimum $CaCl_2$ dosage should be 130 g/tonne of beet. On the other hand, addition of chloride has an adverse effect in increasing thick juice K^+, Na^+ and Cl^- contents and hence increasing molasses formation. A higher thick juice purity has been obtained by using calcium sulphate. It is considered, however, that the higher molasses formation becomes of lesser importance as the oil price rises. Tests on the benefits of a second pulp pressing are reported; results showed that the dry solids was increased from 23.3% to 29.2% by this means when 1 kg of $CaCl_2$ per tonne of beet was added between pressings. Identical results were obtained when the rotary speed was increased from 4.4 to 6.1 rpm so as to increase the throughput from 1140 to 1600 tonnes per day. A vertical liming vessel produced by BMA is described which has given good results at one factory; an automatic sand trap below the conical bottom of the vessel easily discharges sand of up to 70% dry solids content. Adverse weather conditions in November and December led to processing difficulties, which are described. Investigations of massecuite seeding and conglomerate formation in boiling are reported. The problem was associated with the use of fine crystals for slurry preparation; the dissolution of these was studied and the time required found to depend on supersaturation and crystal size. Despite a reduction in supersaturation when shock seeding is used, there is still risk of conglomeration, and therefore the use of coarse grain is considered preferable. Crystal damage in continuous centrifugals was investigated; a "mashing" device, comprising an annular system above the basket rim with nozzles facing downwards into the basket contents, was found to reduce crystal damage by spraying the crystals with condensate (or higher-purity run-off), but further experiments are needed in view of the complexity of the physical relationships. However, at Düren sugar factory crystal damage in continuous machines was sufficiently reduced by decreasing the speed, which also improved mother liquor separation, that no difficulties arose in subsequent spinning of the crystals in a batch centrifugal. Descriptions are given of treatment systems for low-load waste water (particularly excess condensate), for dust separation from pulp dryer vapours and for pulp separation from beet flume water.

Attempt to analyse the primary energy supply in the coming 25 to 30 years with particular reference to the interests of the German sugar industry. B. Pauli. *Zuckerind.*, 1981, **106**, 407-412 *(German)*. – The fuel utilization prospects in the West German sugar industry up to the year 2010 are discussed, and the conclusion drawn that oil and coal will remain the primary sources of energy in view of the need for factories to have a fuel that can be stored and made readily available. Where the factory location is such that there is ready access to coal supplies (in close proximity to mines, to ports handling imported coal or to waterways and/or roads on which the coal can be transported), this fuel will displace oil. Both oil and natural gas are expected to become disproportionately expensive relative to living costs. Of other sources of energy, geothermal and tidal energy would be restricted geographically, while solar and wind energy would require considerable capital investment. Alternative forms of fuel are thought to be too limited in their application. The importance of waste heat re-

cycling and of improvement in energy utilization efficiency in the sugar factory is mentioned.

Investigations on material transfer in slurry particles in an industrial vacuum pan. K. E. Austmeyer and D. Schliephake. *Zuckerind.,* 1981, **106,** 421-431 *(German).* — Investigations are reported in which changes in the number and size distribution of particles in seed slurry occurring in the period immediately after injection into the pan were determined. Material transfer in the slurry was simulated by exposing it, in a model boiling tube, to temperatures and circulation velocities typical for normal pan boiling. Conditions suitable for particle growth and dissolution were established by dissolving a mass of fine grains in a stirred vessel. Results of the tests showed that, immediately after introduction into the pan, a considerable proportion of the seed material does not survive the undersaturation conditions in the vicinity of the tube walls and is dissolved.

Raw juice purification at Pal'mir sugar factory. G. K. Gorskii, A. G. Babak and B. P. Kuz'menko. *Sakhar. Prom.,* 1981, (5), 25-28 *(Russian).* — With reconstruction of the title factory, a second juice purification line was installed parallel with the existing one, but with a horizontal progressive preliming vessel instead of a vertical prelimer, and with provision for progressive cold followed by hot main liming (as opposed to two-stage hot liming in the existing line). Full details are given of the processes used and the results obtained. The progressive prelimer in the second line permitted better juice filtration and settling and gave improved thin juice and thick juice quality by comparison with the first line.

Tests on an experimental model of a thin-film clarifier for 1st carbonatation juice at Kobelyakskii sugar factory. I. A. Oleinik, I. G. Bazhal, R. M. Polishchuk and V. S. Bondarenko. *Sakhar. Prom.,* 1981, (5), 28-31 *(Russian).* — After initial tests on the thin-film clarifier[1] had shown that at an hourly throughput of 25-30 m^3 some suspension was entrained with the clear juice, further tests were carried out to determine the effect of bottom cone diameter on juice flow rate at a given central tube diameter. Results showed that at an increase in throughput from 30 to 60 $m^3.hr^{-1}$ the juice flow rate at the bottom conical plate increased from 3.5 to 7.2 mm sec^{-1}, while that at the top plate increased from 5.8 to 11.0 $mm.sec^{-1}$, which was far greater than it should have been. To overcome this, the juice feed line diameter was increased, as were the diameters of the lower rims of the plates, resulting in more stable hydrodynamic conditions. An optimum depth to which the central tube was taken relative to the conical bottom of the clarifier was also established, at which maximum mud density was achieved. Results with the modified clarifier, using a flocculant, are tabulated.

Cleaning the horizontal perforated collar in tower diffusers. A. P. Parkhod'ko. *Sakhar. Prom.,* 1981, (5), 33-35 *(Russian).* — A system for cleaning the juice screens in a tower diffuser is described which comprises pipes connected to the juice line and attached to the rear of the conventional scraper blades parallel with the rims of the shoes. After the blades cut through the mass of accumulated cossettes, juice under pressure is played onto the screens.

Sugar losses in storage. Respirometric study. P. L. Devillers. *Sucr. Franç.,* 1981, **122,** 205-212, 237-263 *(French).* — A survey is presented of methods of determining the respiration rate of stored beet, and the correlation between sugar losses and respiration rate is discussed. Factors affecting respiration and sugar losses are examined, including duration of storage; temperature and temperature fluctuation; nitrogen fertilization; beet size; beet injury; topping, leaf removal and regrowth; and mould growth. No significant effect of variety, harvesting date, hormones and growth factors has been found. Means of reducing storage losses are discussed.

Pressure loss during forced ventilation of stored beet. O. Mikus, J. Rejsek and L. Budicek. *Listy Cukr.,* 1981, **97,** 104-108 *(Czech).* — A theoretical appraisal of pressure loss in air feed lines used for beet pile ventilation has shown that the loss increases considerably with the quantity of extraneous matter in the pile, falls slightly with increase in the mean root size and is practically independent of pile height. A large proportion of the pressure is lost directly through the air slot, so that of primary importance is an air injection velocity which is as low as practical.

Experiments on measurement of the oxygen concentration in combustion products using solid ceramic electrolytes. J. Zaruba. *Listy Cukr.,* 1981, **97,** 108-115 *(Czech).* — The use of ceramic probes to determine the oxygen content in flue gases is described, and details are given of various schemes for continuous measurement as a means of automatic regulation of fuel combustion in boilers.

Processing frozen and deteriorated beet. R. S. Palmer and S. C. H. McCarey. *Zuckerind.,* 1981, **106,** 517-520 *(German).* — See *I.S.J.,* 1981, **83,** 343.

Tests on control of emmission from a pulp dryer using a BHS dust separation filter. E. Lang. *Zuckerind.,* 1981, **106,** 529-531 *(German).* — Tests are reported in which the exhaust gas from a beet pulp drum dryer was treated by means of a cyclone to remove the solids and then passed through a BHS model bag filter. Results of the tests are given, and a scaled-up system described in which lime is added to the gas after the cyclone so as to allow SO_2 removal (by adsorption) as well as dust separation in the bag filter. The filtered gas is then passed through a tubular heat exchanger where it is used to pre-heat air to be fed to the pulp dryer.

New waste gas washing plant for the sugar industry. B. Johannson. *Umwelt,* 1979, (1), 35-37; through *S.I.A.,* 1981, **43,** Abs. 81-841. — Tests were carried out on a method of desulphurizing flue gas from oil-fired boilers at beet sugar factories. A pilot plant was constructed, in which diluted 2nd carbonatation mud was sprayed into a tower through which were passed the flue gas and pulp dryer waste gas. The process removed 72% and 99% of the SO_2, respectively, and also removed 73% of the residual dust in the pulp dryer gas. The mud, in which part of the $CaCO_3$ had been converted to $CaSO_3$, was discharged with the remainder of the carbonatation mud. In a factory installation, boiler flue gas at 200°C was sent to the pulp dryer, so that the mixture of gases was below 800°C on entry; the discharged gas was sent to a tower into which undiluted carbonatation mud was sprayed. The plant operated very successfully, although the spray nozzles require modification.

Type TL 1000 pulp press. J. Dyntar. *Czechoslovak Heavy Ind.,* 1981, (7), 2-6. — Details are given of a triple-scroll beet pulp press which is designed to handle pulp from 600-1200 tonnes of beet per day.

[1] Bondarenko *et al.: I.S.J.,* 1982, **84,** 56.

NEW BOOKS

By-products of the cane sugar industry. An introduction to their industrial utilization. J. M. Paturau. 366 pp; 16 x 25 cm. (Elsevier Scientific Publishing Co., P.O. Box 211, 1014 AE Amsterdam, Holland.) 1982. Price: $74.50.

The first edition of this book, the only one available in English which is devoted exclusively to the subject of cane by-products, was published in 1969. Significant technological developments have made a new, revised edition desirable, although the resultant volume has lent strongly on the first edition as regards arrangement of the contents. In fact, the only basic changes to the chapters are inclusion of a very small section on methanol production from bagasse via synthesis gas, a section on xylitol manufacture from bagasse, and of sections on lysine and xanthan gum production from molasses, and omission of an appendix giving details of by-product imports into the UK.

The book is divided into five sections, all brought up to date: General (giving, amongst other things, details of the by-products emanating from a typical raw sugar factory and their utilization, as well as a specific chapter on sucrose derivatives); Bagasse; Filter mud and wax; Molasses; and Miscellaneous by-products, including bagasse furnace ash and protein recoverable from cane juice. The format has been reduced from the original large-size pages of the first edition (to bring it into line with the other publications in the Sugar Series, of which this is No. 3), but the printing is not quite as legible, being finer and therefore tending to be overshadowed by the print on the reverse side of the sheet. Moreover, the ragged look of the print on the right-hand side of the page (where it is not justified) detracts somewhat from the value of the contents. However, the book will undoubtedly occupy the same significant place on the bookshelf as did its predecessor, particularly in view of the importance the subject has acquired.

The industrial utilization of sugar and mill by-products. A literature survey. M. J. Kort. 274 pp; 20.9 x 29.4 cm. (Sugar Milling Research Institute, University of Natal, King George V Avenue, Durban 4001, South Africa.) 1981.

The latest edition of this survey of the world literature on sugar and by-product utilization is 22 pages longer than the previous one, continuing the expansion which has taken place each year since its start (this is the nineteenth edition). From the 3202 references collected, 3051 have been noted in the report, an 18.4% increase over the 1980 number. The considerable interest in by-product utilization is shown by the total of 1207 references in the first two chapters ("By-products from sugar manufacture" and "Livestock feeding"), although there have been no startling new developments in this field. Fuel alcohol production continues to receive considerable attention. The next largest collection of references (941) concerns literature on other sweeteners (natural and synthetic), mostly glucose. Then the number of references falls to 365 for "Industrial uses of refined sugar" (no new major discovery has been made or is expected here), followed by 285 for "Recent developments in sucrochemistry" and 253 for "Nutrition and toxicology".

Dr. Kort is again to be congratulated on his excellent contribution to the sugar literature.

Manufacture and refining of raw cane sugar. V. E. Baikow. 588 pp; 16 x 25 cm. (Elsevier Scientific Publishing Co., P.O. Box 211, 1014 AG Amsterdam, Holland.) 1982. Price: $159.50.

Since the first edition of this book[1] was published fifteen years ago, there have been many innovations in the cane sugar industry, including new cane harvesting equipment, new continuous diffusers, new methods of cane preparation, new approaches to boiling and many other changes, so that the need was felt to update the book, which has now become No. 2 in the Sugar Series published by Elsevier.

Obvious changes in the layout of Part I of the book (devoted to manufacture of raw sugar) is the allocation of a complete chapter to diffusion (by contrast with a smaller section of a chapter on juice extraction by both milling and diffusion), and a complete chapter on vacuum pans. Part II (Refining) now includes a chapter, written by M. C. Bennett, on the Talofloc/Taloflote process for simultaneous decolorization and clarification of refinery liquors, a chapter on biological treatment of refinery waste water (by D. E. Tippens) and one on the use of computers in the sugar industry (by W. L. Reed). A third appendix has been introduced – it is a 9-page glossary of technical terms used in the industry.

The aim of the book is obviously to cover both cane raw sugar and refining as comprehensively as possible without going into too much detail on any one aspect, and in this respect it will undoubtedly serve a very useful purpose. Perhaps the only criticism concerns the selection of illustrations – some of these are the same as used in the first edition and look somewhat dated, while in some cases perhaps the size of illustrations is far greater than is justified for the subject in question. It is rather puzzling to find "Notes on the sugar cane stalk borer" inserted in Chapter 1 ("Sugar cane"); while borers are certainly a major pest of sugar cane, they are not the only ones, and it would perhaps have been better either to omit the notes or mention other pests as well. Merely an introductory section on cane agronomy, outlining the basic features of cane growing, would possibly have sufficed in what is, after all, a book on processing.

Generally, the contents are well laid out with an adequate subject index, and the printing is very legible on a coated paper. For the reader wishing to acquire a suitable book on the subject, this edition has a number of very good points, but the price is on the high side.

Annual report of the "Bishop Colombres" Agro-Industrial Experiment Station, 1979. Ed. V. Hemsy. 180 pp; 16.5 x 21.5 cm. (Estación Experimental Agro-Industrial "Obispo Colombres", Casilla de Correo 71, San Miguel de Tucumán, Argentina 4000.) 1980.

This report, issued as Miscellaneous Publication No. 70 of the Tucumán Experiment Station, provides a record of its work in the many areas and crops with which it is now concerned in addition to sugar cane. Four aspects of cane and sugar were under study: genetic improve-

[1] *I.S.J.*, 1967, **69**, 377.

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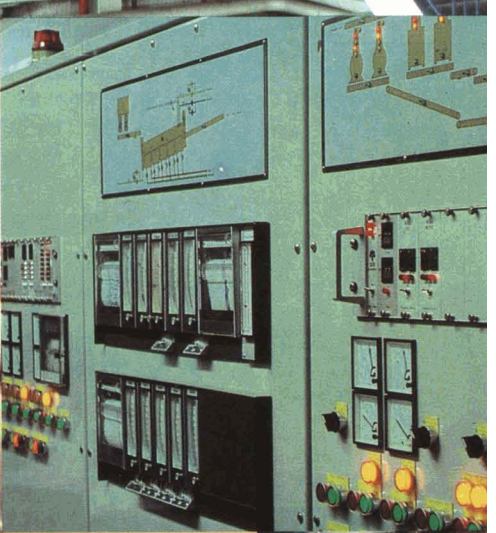

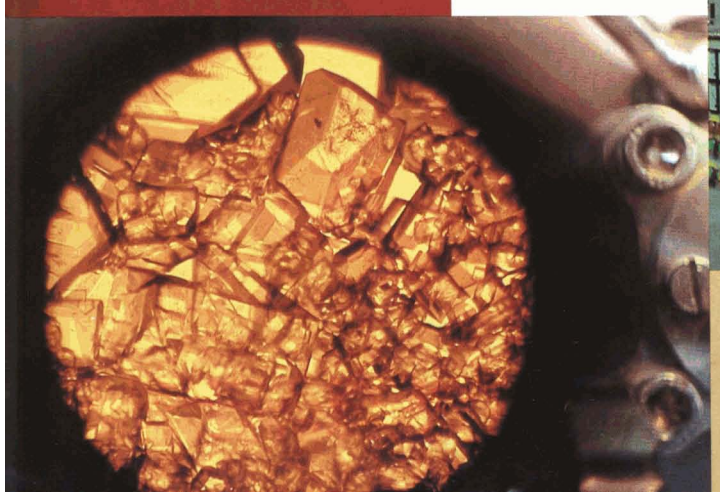

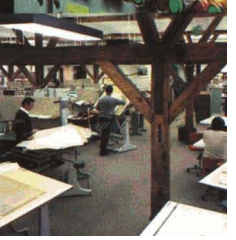

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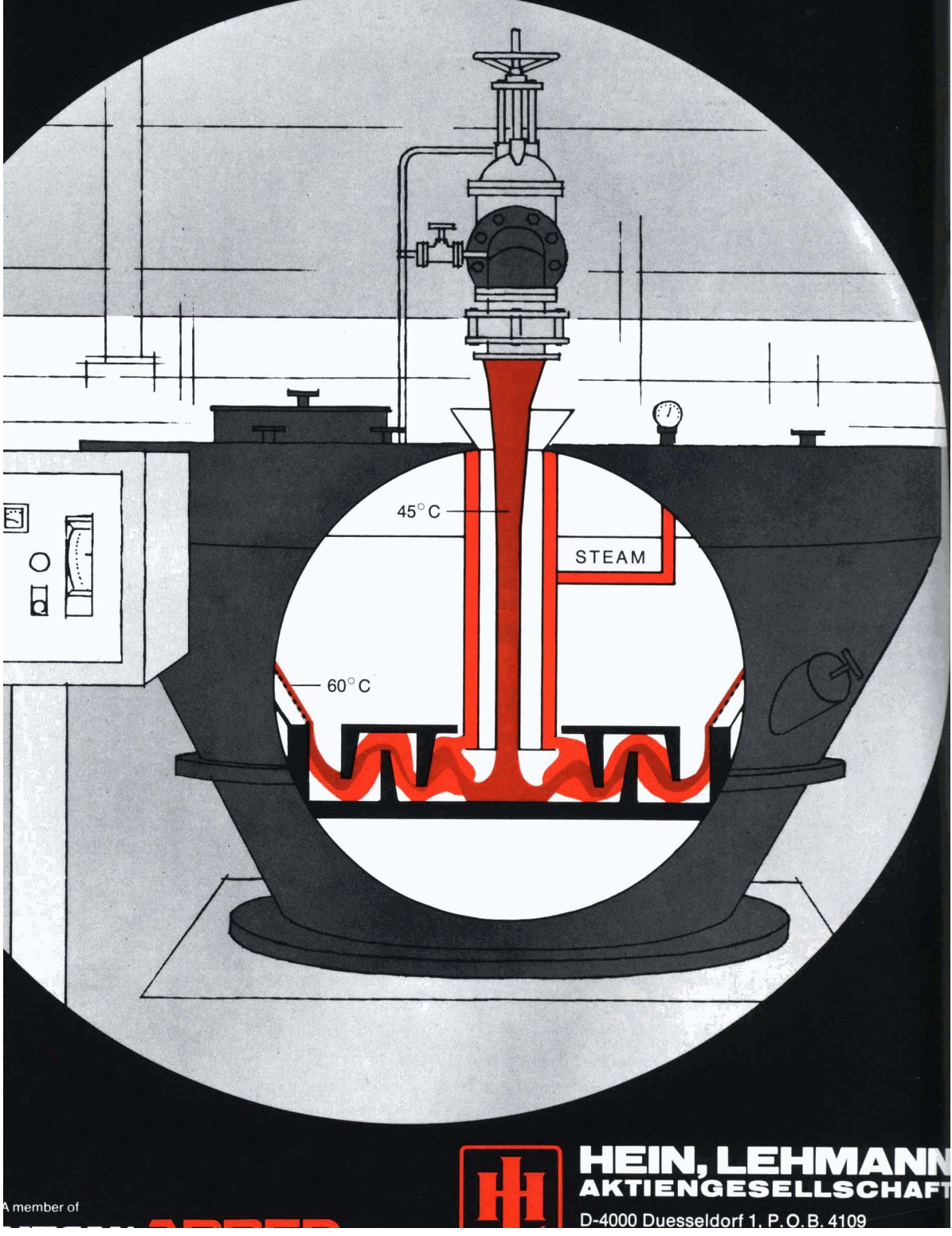


ment of cane; cane pests and diseases (the work was concerned with the borer *Diatraea saccharalis,* cane rats, smut, mosaic and ratoon stunting disease); cultural management and herbicides in cane; and sugar chemistry and technology (in which work on polarimetry, juice analysis, clarification and the effect of burning and storage on cane is reported).

Sugar beet — a grower's guide. 1982 Edition. 74 pp; 14.8 x 21 cm. (Sugar Beet Research and Education Committee, c/o The Library, Broom's Barn Experimental Station, Higham, Bury St. Edmunds, Suffolk IP28 6NP, England.) 1982. Price: £1.75.

After the first edition of this compact book[1] had been well received it was decided to produce a second edition. The result is an enlarged, extensively re-written version incorporating changes based on constructive suggestions put forward regarding the first edition. It covers the whole gamut of beet agronomy, starting from an explanation of the basic process governing crop yield (particularly the role played by sunlight) and ending with clamping and delivery; included are sections devoted to the use of tops and pulp, a glossary of plant protection chemicals, a beet crop calendar and a diagram acting as guide to soil textures. Perhaps a subject index would have been a desirable adjunct. Layout of the contents and clear printing make for an easily readable book, with colour illustrations used to reinforce the points made in the text. For the beet grower this is a very worthwhile acquisition.

Nutritive sweeteners. Ed. G. G. Birch and K. J. Parker. 316 pp; 14.8 x 22.8 cm. (Applied Science Publishers Ltd., 22 Rippleside Commercial Estate, Ripple Road, Barking, Essex IG11 0SA, England.) 1982. Price: £29.00.

This volume represents the proccdings of a symposium held under the auspices of the National College of Food Technology, University of Reading, during March 30-April 1, 1981, and includes sixteen papers, most of them contributed by university and medical reasearch workers. The titles are: "Keynote:intrinsic chemistry of the nutritive sweeteners", "Sucrose, the optimum sweetener", "The use of sugars in confectionery", "Malt and maltose syrups", "Nutritive sweeteners from starch", "Lactose and lactitol", "Fructose in food systems", "Hydrogenated glucose syrups, sorbitol, mannitol and xylitol", "Nutritional significance of sweetness", "Chemical and technological modification of physiological effects in food carbohydrates", "Sugars and dental caries", "The body weight response to nutritional sweeteners", "Obesity, thermogenesis and carbohydrate metabolism", "Sweet taste receptor mechanisms", "Synergism and the sweet response", and "Multidimensional concepts in sweetness evaluation". A subject index is appended. It will be evident from the above list that the bulk of the work concerns the dietary role of sweeteners, and for those of our readers interested in the latest developments and knowledge in this field, the book will have something to offer.

The South African Sugar year book, 1980-1981 edition. 204 pp; 20.7 x 29.5 cm. (The South African Sugar Journal, P.O. Box 1209, Durban, South Africa.) 1981. Price: R 8.00.

The 51st edition of this well-known sugar year book contains a mixture of material, all of it well presented. Particularly important is the work of the SASA Experiment Station, as described with illustrations, and in this connexion there are two articles on major threats to the sugar cane industry, namely the borer, *Eldana saccharina,* and mosaic. Other articles describe taining in cane agriculture and at the Sugar Milling Research Institute. The control of air and water pollution in the sugar industry is another subject discussed. This section of material is followed by industrial reviews and reports from the various sugar industry organizations as well as a review of the 1980-81 milling season in South Africa. The final part of the book gives details of the structure of the South Africa sugar industry, various sugar enterprises and South African sugar manufacturing companies. Information is also given on sugar milling companies in Angola, Kenya, Malawi, Mauritius, Mozambique, Réunion, Somalia, Swaziland, Tanzania, Uganda, Zaire, Zambia and Zimbabwe. The yearbook concludes with tables of South African sugar data and sugar industry addresses and telephone numbers. For the type of information described above, the cost of this publication is very low.

Guide to sugar cane breeding in the temperate zone. P. H. Dunckelman and B. L. Legendre. 26 pp; 20.2 x 26.1 cm. (Agricultural Research Service (Southern Region), U.S. Department of Agriculture, P.O. Box 53326, New Orleans, LA 70153, USA.) 1982.

This booklet describes the program and practices of the U.S. Sugarcane Field Laboratory at Houma, Louisiana, in cane breeding. It discusses sources of germplasm for breeding; evaluation of germplasm for disease resistance, sugar cane borer resistance, cold tolerance and agronomic value; maintenance of parental material; breeding facilities and techniques; and production and storage of true seed. Naming systems for cane varieties bred in different countries are listed, and a bibliography is included. The work sheds light on breeding practices at one of the world's leading sugar cane stations.

Economies of scale in cane sugar manufacturing in less developed countries. M. A. Tribe and R. L. W. Alpine. 47 pp; 20.7 x 29.6 cm. (David Livingstone Institute of Overseas Development Studies, University of Strathclyde, McCane Building, 16 Richmond St., Glasgow G1 1XQ, Scotland.) 1981.

This is Discussion Paper No. 2 of the DLI, and uses research data collected for a research project focused on the economic aspects of choice of technology in developing countries. Using these data, obtained from factory observations in five less developed countries and from a European equipment manufacturer, the authors show that there is a fall in the unit cost of production across five scales of crushing capacity within the range 1250-10,000 tonnes of cane per day, the major source of scale economies being a decline in the initial investment cost per unit. Beyond 5000 tcd capacity, costs do not fall substantially in the economic and technical conditions existing in the countries studied; the scale economies are broadly independent of the length of season, cane sugar content and relative prices, cane costs comprising a high proportion of the total costs and increasing (in absolute terms) proportionately with the scale of crushing capacity, whereas labour costs are not a very high proportion of total costs even where wages are relatively high. In one country, unit production costs did rise after the 5000 tcd point as a result of increased cane transport costs.

[1] *I.S.J.,* 1980, **82,** 286.

LABORATORY STUDIES

Dextran problems. M. Matic. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 121-122. — Crystal elongation caused by a dextran is discussed and means of determining the dextran responsible (having about 90% 1,6-linkages) are examined. The haze method records, besides dextran, other polysaccharides that are insoluble in 50% alcohol and which do not cause crystal elongation. Moreover, addition of dextran to pure sucrose solution produces only a limited degree of crystal elongation, so that other substances or a change in physical conditions must be involved to bring about the marked elongation found in factory products.

Dextran analysis: methods and problems. E. J. Roberts. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 128-133. — Brief descriptions are given of methods for the determination of dextran. Two methods, those of Richards & Stokie[1] and Geronimos & Greenfield[2], are not recommended for factory control analysis (for reasons stated), while a third method, that of CSR Ltd., is criticized because the 50% alcohol used probably does not precipitate all of the lower molecular weight polymers, and some of the high molecular weight insoluble dextran, which is the major cause of abnormal turbidity in refined sugar produced from raw sugar of high dextran content, is lost. Mention is also made of a thin-layer chromatographic method for determination of total polysaccharides which is also not recommended for factory control. Full details are given of the CSRRPI method for determining soluble polysaccharides, in which the polysaccharides are precipitated from the sugar solution by adding alcohol, filtered off and the filter washed with 80% alcohol v/v until free of sugar. The Celite filter aid used and filter paper are boiled in 1% v/v sulphuric acid to dissolve the residue of polysaccharides; the resultant solution is adjusted to a definite volume, filtered and the polysaccharide content (mg/ml) measured colorimetrically. The method is described as simple and rapid and is considered suitable for factory control work.

Analysis of carbohydrates by high-pressure liquid chromatography. M. A. Clarke and M. A. Brannan. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 138-149. — A survey is presented of HPLC methods for analysis of sugars, sugar degradation products, microbiologically derived products such as colorants and organic acids, and polysaccharides. The advantages of HPLC for process control work are indicated.

A model vacuum pan: crystallization studies of occlusions. J. A. Devereux. *Proc. 1980 Tech. Session Cane Sugar Refining Research,* 191-198. — The stages in boiling are explained, and a laboratory vacuum pan is described which was used in studies on crystal occlusions. Reproducibility was achieved within ± 1% for white sugar yield, within ± 0.1°C for temperature conditions and within ± 0.1 mm Hg for pressure conditions. Addition of 0.05% and 0.1% (on solids) of ferulic acid, a known colorant precursor originating in the sugar cane, showed a distribution between crystal and syrup of 1:10. Other compounds, including vanillin, are being investigated to see which, if any, enter the sugar crystal in a ratio greater than this.

A definitive method for the true purity of molasses. J. F. T. Oldfield, M. Shore, R. Parslow and E. L. Williams. *Zuckerind.,* 1981, **106,** 220-229 *(German, English).* See *I.S.J.,* 1981, **83,** 378.

Determination of saccharides in digestion liquids from frozen and thawed beets. H. Gruszecka. *Gaz. Cukr.,* 1980, **88,** 251-252 *(Polish).* — Brei from beets stored in a refrigerator at −20°C for 7 days was subjected to hot digestion with lead subacetate and trimethyl silylation before gas-liquid chromatography. Because of limits placed on the retention time, only sucrose was identified. In the case of brei from fresh beet held for 10 days at +20°C, a number of sugars were identified by GLC, whereas brei from frozen beet held for 3 days at −20°C and then for 7 days at +20°C gave a digestion solution which was very turbid and viscous and proved difficult to filter (because of the presence of dextran); it had a pH of 2.4. The chromatograms did not show any peaks.

Cation and anion balances in juice purification and evaporation. P. W. van der Poel, J. Blok, N. H. M. de Visser, M. A. M. de Schutter, J. Konings and W. A. Fenstra. *Sucr. Belge,* 1981, **100,** 83-94 *(French).* See *I.S.J.,* 1980, **82,** 348.

Analyses. R. Detavernier and J. Roger. *Sucr. Franç.,* 1981, **122,** 149-152 *(French).* — Investigations on evaporator corrosion and on evaporator scale formation at 18 and 20 French sugar factories, respectively, are summarized, as are more than 1000 analyses of raw juice and molasses sucrose (determined enzymatically) and the differences between the values and pol measurements. Analyses of fuel oils used by sugar factories have revealed that a number are outside the normally permitted limits for calorific value and impurities content.

Investigation of changes occurring in sugar beet during storage. VI. Study of changes in nitrogenous substances during storage. K. Hangyal, E. Ungar and R. Lasztity. *Cukoripar,* 1981, **34,** 10-17 *(Hungarian).* — The total N, α-amino-N, glutamine and glutamic acid contents were determined in beets stored for 90 days. While no significant change was observed in the total N content, that of α-amino-N rose initially by 5-20%, but later fell to below the initial level. Differences in the absolute values between beet varieties were relatively insignificant where the same agronomic practices were used. Unirrigated beets generally contained more N than irrigated beets, the level hardly increasing despite a 1-2% increase in N fertilization rate, whereas this caused an average 10% increase in the N content of irrigated beets.

Some problems of quality. H. Gruszecka and E. Walerianczyk. *Gaz. Cukr.,* 1980, **88,** 254-258 *(Polish).* After a brief discussion on the concept of quality of a product and on the type of factor affecting it, the authors examine analyses of sugar factory intermediate

[1] *I.S.J.,* 1974, **76,** 103-107.
[2] *ibid.,* 1978, **80,** 227-232.

products from the 1978/79 campaign (including colour content, mono- and oligosaccharide contents, ash, total nitrogen, invert sugar and Fe, Ca, K and Na contents) and of white and industrial sugar.

The nitrite content in white sugar as a criterion of the efficiency of infection control in the manufacturing process. K. Wagnerowski and J. Kunz. *Gaz. Cukr.*, 1980, **88,** 258-261 *(Polish).* — Details are given of a method of determining nitrite in white sugar solution (using the Griess-Romij reagent, i.e. a mixture of tartaric acid, sulphanilic acid and α-napthylamine, and spectrophotometry at 520 nm) as a means of establishing the effectiveness of control of bacterial infection in the sugar factory. Application of the experimental results to campaign results for seven sugar factories in 1978/79 is described, and the range of values found for 63 samples indicated, showing a maximum of 0.15 ppm NO_2^-.

Simultaneous determination of fructose, glucose and sucrose by the anthrone reaction. I. Abidin and H. G. Maier. *Chem. Mikrobiol. Tech. Lebensm.*, 1980, **6,** (4), 121-123; through *Anal. Abs.*, 1981, **40,** Abs. 4F13. The sum of fructose, glucose and sucrose was determined by a special modification of the reaction with anthrone-H_2SO_4. The three sugars exhibited the same molar absorption coefficient at 605 nm, and the absorbance remained constant at room temperature for 15 min. An excess of free malic, citric or tartaric acid affected the results.

Contribution to conductimetric ash determination in sugar beet. J. Dobrzycki and A. Stanczyk. *Zesz. Nauk. Politech. Lodz.*, 1980, (361), 303-307; through *S.I.A.*, 1981, **43,** Abs. 81-479. — Digests prepared from 26 g brei + 178.2 cm^3 water showed wide variations in conductivity C, uncorrelated with the solids concentration (2.1-2.5%) in the digest. Gradual addition of refined sugar, to 6-9% solids, caused linear decrease in conductivity with fairly reproducible small gradient. It is recommended that the ICUMSA method (5°Bx) be adopted.

Viscosity of cane molasses. I. Viscosity and polysaccharide of cane molasses. Y. Nakasone, H. Okazaki and K. Hokama. *Sci. Bull. College Agr.* (Univ. of Ryukyus), 1978, **25,** 247-255; through *S.I.A.*, 1981, **43,** Abs. 81-515. — Ten samples of molasses from Okinawa and Tokunaga, previously diluted to 20°Bx and centrifuged free from sludge, were tested; mixtures consisting of 25% of these molasses and 75% ethanol were prepared. The precipitate obtained usually contained about 20% polysaccharides and about 65% ash, the yield being typically 10-21.5 g per litre of 20°Bx molasses. Amounts dissolving in water (22-24°C), boiling water, dilute HCl and NaOH are indicated; precipitates obtained in lowest yield contained least ash, and dissolved less in water and more in NaOH. Aqueous solutions of precipitate had much higher viscosities than molasses at equal Brix. From paper chromatograms of hydrolysates it is deduced that the polysaccharides include at least one glucan and more than two hemicelluloses.

Sugar beet sampling. M. Burba and E. Schulze. *Zuckerind.*, 1981, **106,** 303-307 *(German).* — Methods of calculating mean values and standard deviation for sugar beet constituents are compared with true values of a fully evaluated universe within given confidence limits. Graphical solutions for rapid establishment of the minimum sample size are described. Since, in practice, true standard deviations of universes are unknown, two statistical methods are suggested for calculation of mean values within the required confidence limits on the basis of minimum sample sizes. Graphs involved in these methods permit rapid, easy determination of statistical parameters in sugar beet sampling.

Investigations for analytical determination of plant protection chemical residues in sugar factory products. II. Preparation of the sample material and use of the techniques developed on cossettes, juice and white sugar samples. E. Reinefeld, K. M. Bliesener and G. Urban. *Zuckerind.*, 1981, **106,** 308-313 *(German).* — Details are given of methods based on extraction with dichloromethane which are applicable to cossettes, raw, thin and thick juices and molasses; for white sugar the methods are extended to include gas-liquid chromatography. The methods permit organo-chlorine and organo-phosphorus insecticides as well as Aldicarb and Chlordimeform pesticides and herbicides (Chlorphenprop-methyl, Isocarbamide and Pyrazon) to be separated from the other constituents and concentrated in a single operation. Juice purification tests with highly contaminated sucrose solutions and raw juice showed, however, that only a small quantity of the added contaminants was to be found in the thin juice. In model tests with large amounts of the plant protection chemicals, the concentrations found were so small that they were of no practical significance. Investigations of sugar beets treated, in field tests, with various insecticides also revealed no residues of the chemicals after harvest.

Mathematical method for determination of equivalent heat effect times for sugar degradation in juices. K. Vukov and G. Patkai. *Zuckerind.*, 1981, **106,** 314-318 *(German).* Reactions occurring at elevated temperatures obey kinetic laws within a given temperature range; the time required for the reaction is only temperature-dependent, so that the time during which a given quantity of heat must be applied to give a certain temperature can be used as reference to calculate values for other temperatures characteristic for the rate of a given reaction. The simplified Arrhenius equation can be applied, whereby the reaction time can be shortened exponentially with linear rise in temperature. The heating time can be converted to an equivalent heat effect time, and a method has been developed based on the Arrhenius equation which permits comparison of sugar degradation values at different heat effect times and temperatures. Hence, the method is applicable for calculation of the effect of juice composition on sugar losses and acid formation, as well as coloration caused by heat, as in evaporation.

The new SMRI nutsch bomb. S. Munsamy. *S. African Sugar J.*, 1981, **65,** 41, 43-44. — See *I.S.J.*, 1982, **84,** 26.

Amino-acids in Greek molasses. J. Eleftheriadis, T. Soulis and D. Noulas. *Zuckerind.*, 1981, **106,** 432-434 *(German).* — Beet molasses from the five Greek sugar factories were analysed by passage through a cation exchanger column to obtain a nitrogenous fraction, followed by deproteination and treatment with an ion exchange resin incorporated in a JEOL 5AH amino-acid analyser. Values for 1976 and 1977 are tabulated for 17 amino-acids, indicating that the molasses are suitable for use in yeast and fodder manufacture.

BY-PRODUCTS

Studies on the rapid treatment of the yeast waste stream. V. Treatment of the fungal waste. Y. T. Chuang and P. T. Hwang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (89), 45-56 *(Chinese).* – The fungal waste from cultivation of a mould strain A-188 on the yeast waste stream was further treated by the activated sludge process. Optimum conditions of the treatment were: initial pH 6-8, mixed liquor suspended solids (MLSS) content of the waste 3000-5000 ppm, K_La 0.77 min^{-1}, and aeration time 10 hours. Under these conditions the BOD of the fungal waste could be reduced from 2300 ppm to below 200 ppm, thus meeting government regulations. The amount of MLSS produced was about 70% of the BOD removed, and under suitable aeration the sludge volume index could be maintained below 100. The components of the wastes were analysed, and the feasibility of disposing of them by application to cane fields investigated. Abundant K and N compounds were found in each waste. Harmful elements such as Cd, As, Co, Cu, etc. were present in trace quantities. Since the main objection to the application to cane fields having a tile drainage system was considered to be the high BOD content, the effluent from the activated sludge process was thought to be more suitable than the fungal waste. Based on the results, a complete treatment system is proposed for the yeast waste stream as follows: the stream from the first separator is primarily treated by batch cultivation of mould A-188, the waste from this and the wash yeast waste are mixed together and then treated with activated sludge. The effluent from this may be discharged into the river or applied to cane fields. If there is abundant water available, the fungal waste-wash yeast waste mixture may be diluted with water and applied to cane fields to reduce operational costs.

Influence of pressed pulp silage on roughage intake and milk yield and composition with dairy cattle. D. L. de Brabander, J. V. Aerts, C. V. Boucqué and F. X. Buysse. *Publ. Trimest. Inst. Belge Amél. Betterave,* 1980, **48,** 199-215 *(French, Dutch).* – Addition of beet pulp (22% of the total base ration as dry matter) to hay, maize silage and grass silage, respectively, increased the total roughage intake in all cases, but only very slightly with the maize silage; the high energy value of the pulp contributed to an increase in milk yield, but the milk fat content was lower than without pulp addition, although its protein content was slightly increased.

Composition of vinasse. A. A. Rodella, C. Parazzi and A. C. P. Cardoso. *Brasil Açuc.,* 1981, **97,** 25-33 *(Portuguese).* – Samples of vinasse were obtained from distilleries integrated with nine sugar factories, composited and analysed for three months (July, September and November) during the 1978/79 season in order to establish the range of concentration of a number of constituents both in the same scource during the season and over the group of sources. The details are tabulated.

Production of single-cell proteins by *Candida utilis* on molasses slop. S. Grba and J. Bijele. *Prehrambeno-Tehn. Rev.,* 1979, **17,** (4), 165-168; through *S.I.A.,* 1981, **43,** Abs. 81-531. – *C. utilis* was grown on vinasses at 32°C, pH 4.5, in batch, semi-continuous and continuous cultures. In batch culture, which was the least economical, a 2% molasses addition (20 g molasses/litre of vinasse already containing 35-50 g organic substances) increased the specific growth rate from 0.2 to 0.4 per hour, with 15-20% better utilization of substrate. Continuous culture gave the highest rate of biomass production (6.16 g dry solids/litre/hr), utilizing 46-54% of the organic matter; the yield was 15-19 g dry solids/litre, with a crude protein content of 63.8%. Semi-continuous culture is also suitable for industrial biomass production, since its lower productivity is offset by its relative freedom from contamination.

Production of valine by a *Bacillus* sp. S. P. Chattopadhyay and S. K. Banerjee. *Z. Allgem. Mikrobiolog.,* 1978, **18,** (4), 243-254; through *S.I.A.,* 1981, **43,** Abs. 81-532. A strain of *Bacillus subtilis* produced valine in a synthetic medium containing glucose as carbon source. Replacement of the glucose by cane molasses stimulated growth of the organism, but the concentration of valine obtained was no higher at low substrate concentrations and was lower at high substrate concentrations. The maximum valine concentration obtained in the molasses medium was 1.50 mg/ml.

Utilization of heat from boiler flue gases in sugar factory pulp dryers. Yu. G. Shchegolev and M. P. Khazin. *Sakhar. Prom.,* 1981, (4), 34-37 *(Russian).* – Schemes for flue gas heat utilization in beet pulp dryers are described.

Studies on the utilization of molasses alcohol slops. II. Factory trial of continuous production of feed yeast with a cell recycle technique. L. H. Wang, Y. C. Kuo, C. Y. Chang and S. L. Sang. *Rpt. Taiwan Sugar Research Inst.,* 1980, (90), 45-54. – In view of a rise in the price of molasses, a study was made of the possibility of using vinasse from molasses alcoholic fermentation in place of molasses for fodder yeast manufacture. Experiments were conducted at cell recycle rates corresponding to a cell concentration in the effluent of 16 $g.l^{-1}$ (the current value used in No. 5 fermenter at Hsinying yeast plant when molasses is used as substrate) and 20 $g.l^{-1}$ (as used in Nos. 1-4 fermenters). The dilution rate was raised to a level higher than without cell recycle and permitted a fermenter cell productivity comparable to that when molasses is used as a substrate. Despite fluctuations in the flow rate and concentration of the vinasse, steady maintenance of continuous cultivation was possible, and control of yeast production was easier than without cell recycle. At a residence time of 2.6-2.7 hours, the BOD content of the vinasse was reduced by more than 34%.

Study of the interaction of the oil fraction of sugar cane wax with ammonia at different temperatures. V. M. Ledovskii, D. González R. and A. García A. *Centro Azúcar,* 1980, **7,** (3), 23-34 *(Spanish).* – The oil fraction of cane wax includes a number of glycerides, and it was reacted with ammonia in studies on the preparation of carboxylic acid amides which may have value as corrosion inhibitors. The reaction was studied at temper-

atures of 140-180°C; at the lowest the saponification number gradually declined with time, reaching zero at 70 minutes. At 150°C and higher, however, there was a sharp fall within 10 minutes to a level of 60 at which it stayed practically constant.

Evaluation of the products obtained from the oil fraction of sugar cane wax and ammonia as inhibitors of corrosion in a heterogeneous medium. D. González R. and A. García A. *Centro Azúcar,* 1980, **7,** 35-41 *(Spanish).* — The corrosion-inhibiting efficiency of the products obtained by the title reaction (see previous abstract) increased with the temperature of reaction and with the concentration of the inhibitor in the corrosive medium.

Energy agriculture of crops potentially useful for alcohol production. II. Technoeconomic operations in producing power alcohol from sugar cane with minimum additional requirement. S. C. Srivastava and A. K. Srivastava. *Maharashtra Sugar,* 1981, **6,** (6), 31-34. — The possibility and practicality of producing power alcohol from juice (or juice + bagasse), molasses, khandsari and gur are discussed.

Sugar cane bagasse-based ration for ruminants. N. K. Powar and A. P. Deshmukh. *Maharashtra Sugar,* 1981, **6,** (6), 35-37. — The value of bagasse as a fodder for cattle and buffalo is discussed. It is pointed out that supplementation with protein (or non-protein N), minerals and vitamins is necessary, and that the bagasse should be ground and mixed with NaOH before mixing with other ration ingredients.

Addition of molasses and urea to Panama elephant grass *(Pennisetum purpureum* PI 300-086). E. F. de Ruiloba, M. E. Ruiz and M. H. Ruiloba. *Cienc. Agropec.,* 1980, (3), 95-104 *(Spanish).* — Addition of five levels of urea and five of molasses to silage showed little effect of the latter although the former raised the pH. Only low production of organic acids occurred, and it is concluded that neither additive is necessary to give silage of good characteristics for feeding.

Application of biological nitrogen fixation in Mauritius. II. A soil-bagasse carrier for the preparation of *Rhizobium* inoculants. D. R. Vencatasamy and M. A. Peerally. *Rev. Agric. Sucr. Maurice,* 1980, **59,** 115-121. — The most satisfactory means of inoculating leguminous plants with *Rhizobium* strains is to grow the inoculant on a suitable carrier material such as peat and subsequently coat seeds of the legume with it. However, because of the absence of peat in Mauritius, investigations were conducted on locally available raw materials. Three carriers were tested, and results showed that a 50:50 (g) soil:bagasse mixture was better than a carrier containing 100 g peat or 100 g bagasse.

Sugar cane molasses in pig nutrition. C. M. Vieitas. *La Hacienda,* 1981, (Jan./Feb.), 29 *(Spanish).* — Molasses is ideally suited to feeding of pigs because they do not suffer diarrhoeic effects as do poultry, while they convert the feed better than do bovine animals. The variable nature of molasses is mentioned, however, and an indication given of ranges of constituents. It can be used in proportions of 30-40% of the ration provided fibrous material is also included, e.g. bagasse or rice hulls. Alternatively it can be diluted and offered to the animals *ad libitum.* A table records literature data on conversion levels attained in feeding trials for growth and finishing of pigs.

Production of fuel ethanol by solid-phase fermentation. K. D. Kirby and C. J. Mardon. *Biotech. Bioeng.,* 1980, **22,** 2425-2427; through *S.I.A.,* 1981, **43,** Abs. 81-858. In laboratory tests, beet was pulped into 3-5 mm particles, mixed with sulphuric acid to give pH 4.5, and thoroughly mixed with a 10% dry solids suspension of baker's yeast in water to give a yeast concentration of 9 g dry solids/litre. The solid pulp was fermented anaerobically at 25-30°C for 16 hours. It was pressed twice through rollers, and the liquor, which contained 95% of the ethanol in the fermented pulp, was centrifuged to separate the yeast for recycling. The resulting liquor contained 9.5% ethanol by weight, which was distilled off. Ethanol yields were up to 92% of the theoretical. It is considered that the process would be most economical in plants producing 2-4 Ml per annum.

Effects of treatment of bagasse with sodium hydroxide under steam pressure on chemical changes and digestibility. II. Effect on cellulose preparation. S. Shiroma. *Sci. Bull. Coll. Agr.* (Univ. of the Ryukyus), 1979, (26), 371-378; through *S.I.A.,* 1981, **43,** Abs. 81-894. — Bagasse was treated with 0, 5 or 10% NaOH at a pressure of 0, 150 or 300 $lb.in^{-2}$ for 5, 15 or 25 min. Alcohol extract increased with pressure and time. Delignification and relative cellulose content increased with pressure, but the holocellulose content decreased. All three factors affected the hemicellulose content. Recovery showed negative correlations with alcohol extract, delignification and cellulose content, but positive ones with holocellulose and cellulose contents. These results show that the treatments altered the structure of the bagasse chemically and physically. The effect of pressure was greater than that of NaOH concentration of time.

Cellulose-based speciality papers. A. K. Sanyal and A. Day. *IPPTA* (Indian Pulp & Paper Tech. Assoc.), 1977, **14,** (1), 53-55; through *S.I.A.,* 1981, **43,** Abs. 81-909. — Pulps from raw materials high in hemicellulose, e.g. bagasse, are readily hydrated by mechanical beating, which gives them excellent grease-proof properties. Their use in grease-proof paper is limited by the low tear factor; addition of starch (amount not stated) increased this from 25 to 37.

High-alpha pulp from bagasse. Y. Htut, S. S. Binyani, P. Kumar *et al. IPPTA* (Indian Pulp & Paper Tech. Assoc.), 1977 (Souvenir), 57-63; through *S.I.A.,* 1981, **43,** Abs. 81-910. — Tests on the feasibility of obtaining rayon-grade pulp from bagasse are described. Partially depithed bagasse was prehydrolysed with water or 0.125-1.25% H_2SO_4 at 140-170°C, and submitted to kraft pulping under stated conditions. Pulps obtained by prehydrolysis with water or under optimum acid conditions (0.5% H_2SO_4 and 160°C) were bleached by a 4-stage process. Pulp properties are tabulated; yields were 30.5 and 27.1% after water and acid prehydrolysis, respectively; brightnesses (91.0 and 93.0%) and alpha-cellulose contents were satisfactory. The low yields could perhaps be improved by more thorough depithing.

Pilot-plant studies on manufacture of furfural from cane bagasse. M. K. S. Pillai and P. K. N. Panicker. *Chem. Age India,* 1979, **30,** (8), 733-735; through *S.I.A.,* 1981, **43,** Abs. 81-911. — Tests on bagasse hydrolysis in 1-4 digesters in series are reported. At a pressure of 6.0-6.5 $kg.cm^{-2}$, optimum steam flow was about 95% (on bagasse) per hour, and optimum hydrolysis time was about 3 hr. Furfural yields were 9-10% on bagasse.

PATENTS

UNITED KINGDOM

Massecuite crystallizer. A/S De Danske Sukkerfabrikker, of Copenhagen, Denmark. **1,585,307.** January 10, 1978; February 25, 1981. – See US Patent 4,194,557[1].

Separation of a monosaccharide (fraction) from an oligosaccharide (fraction). UOP Inc., of Des Plaines, IL, USA. **1,585,369.** August 1, 1977; March 4, 1981. – A mixture of sugars, e.g. a starch hydrolysate, HFCS, a mixture of glucose and/or fructose with sucrose, is applied, under adsorption conditions (at 20°-200°C; at up to 35 atm) to an X or Y zeolite having cations of NH_4^+ or non-transition metals of Groups I and II (Ba^{++}) at its exchangeable cation sites. These sites selectively adsorb the monosaccharide and the eluate contains only the oligosaccharide (sucrose, maltose). The zeolite is then treated with a desorbent (water) and the monosaccharide (fructose, glucose) removed as an extract stream.

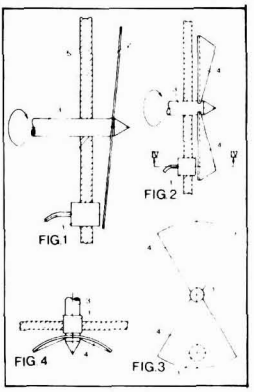
Measuring the concentration of fluids. A/S De Danske Sukkerfabrikker, of Copenhagen. Denmark. **1,585,389.** December 15, 1977; March 4, 1981. – The concentration of syrup or massecuite in a vacuum pan is measured by means of a dielectric constant antenna to which are applied electrical oscillations of constant power and constant frequency. The antenna is mounted in the bottom of the pan in a space confined by radiation screening means below the fluid level and the antenna reflection (continuously) adjusted to a minimum at a given concentration, deviations from this minimum being a measure of the concentration. The oscillations have a frequency so high (30 MHz – 1 GHz) that electrical conductivity has no substantial influence on the result of the measurement. The measure may be embodied in an automatic programmed boiling control scheme.

Bagasse as animal fodder. BP Chemicals Ltd., of London, England. **1,587,518.** December 2, 1976; April 8, 1981. The digestibility of lignocellulose materials (bagasse, cane, etc.) is improved by mixing with [0.1-5.0% (0.25-0.5%) of] formic acid or a [ionizable (Na, NH_4, Ca or Mg)] formate (plus a mineral acid, e.g. HCl) in the presence of (at least 20% of) water and (1%-400% of) a nutrient (molasses, etc.) capable of sustaining the growth of micro-organisms, and storing the mixture under substantially anaerobic conditions.

Beet harvester. Vandenende B.V., of Borssele, Holland. **1,588,492.** May 18. 1978; April 23, 1981.

Apparatus for measuring the viscosity or consistency of liquids and suspensions (massecuite). A/S De Danske Sukkerfabrikker, of Copenhagen, Denmark. **1,589,498.** December 7, 1977; May 13, 1981.

An apparatus suitable for measuring viscosities in the range 10-100,000 cp, can be of different forms which operate on the same principle. An electrical pressure transducer 1 is mounted in the wall 5 of a container (e.g. a vacuum pan) so that its sensing diaphragm is slightly inward of the inner face of the wall. A rotating shaft 3, at 200-600 rpm, carries an impeller which may



be mounted as an inclined disc 2 (Fig. 1) or as a unit having two or more blades 4 (Figs. 2, 3 and 4) such that the distance between the disc or blades and the transducer 1 decreases, passes through a minimum (e.g. 1.5-4 mm) and then increases, to give a periodically varying flow of liquid towards the diaphragm of the transducer. The maximum change of pressure is a measure of the viscosity of the liquid or suspension.

Production of fructose and fructose-base syrups. Snamprogetti S.p.A., of Milan, Italy. **1,590,266.** May 26, 1978; May 28, 1981. – Fructose, or a fructose-glucose syrup, is prepared by bringing a solution of glucose into contact with the micro-organism *Streptomyces* sp. NRRL 11.120 or NRRL 11.121 and with an enzyme originating within the micro-organism.

Continuous production of pulp from fibrous lignocellulose materials. Defibrator AB., of Stockholm, Sweden. **1,590,704.** November 21, 1977; June 10, 1981. – The title fibrous material, e.g. bagasse, is defibrated and/or refined in the space between relatively rotatable refining discs in a steam atmosphere at an elevated temperature (100°-150°C) and in the presence of alkali (added to the fibrous material before feeding it to the refiner), introducing the fibrous material to a feed-in section to the space between the discs in a steam-tight manner, thereby reducing the exposure time of the fibrous material before entering the space, and adding substances (bleach liquors containing H_2O_2 or Na_2O_2) to the fibrous material that have a chemcial action on it only when the material is in the feed-in section or at some subsequent point (only after the freeing of the fibres has begun). Alkali in solution may also be added to the material between the refining discs to maintain an alkaline environment. The refining stage may be repeated with further addition of bleaching agent. The pulp leaves the refiner at a concentration of 30-60% and a temperature of 50°-100°C.

[1] *I.S.J.*, 1981, **83**, 348.

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

Norway sugar imports[1]

	1981	1980
	— *tonnes, white value* —	
Austria	10,370	18,022
Belgium	3,379	5,063
Czechoslovakia	165	2,009
Denmark	87,209	75,784
Finland	12,606	18,525
France	1,143	5,426
Germany, East	0	23
Germany, West	32,333	8,730
Holland	9	11
Poland	0	200
Sweden	72	2,648
Switzerland	26	150
UK	27,365	21,787
Total	174,677	158,378
Total, raw value	189,866	172,150

Finland sugar imports and exports, 1981[7]

	1981	1980
	— *tonnes, tel quel* —	
Imports		
Australia	0	4,885
Cuba	99,456	98,665
France	10,296	13,172
Poland	0	1,000
Zimbabwe	12,961	51,678
Other countries	6	84
	122,719	169,484
Exports		
Algeria	5,250	18,148
Norway	13,226	18,837
USSR	58,877	16,274
Other countries	5,181	1,182
	82,534	54,441

Puerto Rico sugar industry contraction[2]. — The 1982 season in Puerto Rico, due to start in January, was delayed because of unresolved labour negotiations. More than 2,000,000 short tons of cane were likely to be processed but, because of the lower recovery at the end of the season, overall sugar output will have been reduced by the delayed start to the season. Five factories were scheduled to crush the 1982 crop, two fewer than in 1981. Puerto Rico's sugar production continues to decline and could drop to 135,000 tons in 1982, 11% below last year. In 1983 one of the remaining five factories is scheduled to change to production of high-test molasses for processing to rum.

Senegal sugar situation[3]. — Compagnie Sucrière Sénégalaise plans to expand production to around 400 tonnes a day in response to a shortage of sugar in the country in late 1981. It was overcome at the time by imports of some 3000 tonnes, mostly from neighbouring countries. In 1980 production reached 48,000 tonnes but current consumption is roughly double this. In order to minimize the foreign exchange burden of imports, the government tried to discourage consumption; the price was raised by 25% and per caput consumption fell to 14.1 kg in 1980 against 16.9 kg in 1977. Sugar imports in 1980 were only 28,389 tonnes as against 48,336 tonnes in 1979, and this may have precipitated the 1981 shortage. The expansion program is aimed at increasing the cane crushing capacity of the Richard Toll factory from 3000 to 5000 t.c.d., to raise production capacity from 60,000 to 100,000 tonnes of sugar per year. Even if the factory performs as planned, however, it will still be able to meet only the equivalent of current domestic sugar needs when fully operational in the mid-1980's, by which time consumption is likely to have advanced by at least 25% to around 120,000 tonnes.

China sugar refinery capacity[4]. — China increased its sugar refining capacity by 210,000 tonnes last year, a rise of 60% over 1980, according to the semi-official China News Agency. Refineries in Zhangzhou and Putian in Fujian Province, and Zhongshan in Guangdong doubled their capacity, it added.

US corn sweetener outlook for 1982[5]. — As domestic sugar prices rise to reflect the new price support program in the USA, corn sweetener prices are likely to follow. This will tend to raise the profit margins for wet millers, particularly because of abundant corn supplies and low prices. However, much depends on growth in demand for HFCS in 1982 and the operating rate. There is indication that capacity expansion (at least temporarily) outstripped demand growth at the end of 1981 — even after allowing for seasonal decline. HFCS is expected to total around 3,000,000 short tons, dry basis, in 1982, up from 2,650,000 tons in 1981. Use of 55% fructose HFCS is likely to increase substantially again in 1982, largely in soft drinks, and is expected to account for more than 40% of 1982 sales against something over 30% in 1981.

Colombia bagasse paper project[6]. — Creusot-Loire Enterprises of France and a Spanish financial group have signed a contract under which they will own 7.6% and 24.9%, respectively, of a paper pulp and newsprint plant to use bagasse as raw material and to be built jointly with the Colombian government in the Cauca area, 700 km south-east of Bogatá. The plant will have an annual output of 75,000 tonnes of paper pulp and 87,000 tonnes of newsprint and is to be completed within two years. Initial capital is 5000 million pesos (US $93 million).

Mexican sugar problems[8]. — Field reports from Veracruz indicate that sugar production might be reduced in the area by 50% during the crrent campaign. The problem is not a lack of cane but of field labour. Seasonal workers contracted during the cane harvesting season prefer to seek employment as field workers in the United States, either legally or illegally, and Veracruz is short of 5-6000 workers. As a consequence, Ingenio Potrero, for instance, has had to reduce its throughput from the normal average of 7000 t.c.d. to 5000 t.c.d. Deterioration of sugar production in the area is also attributable to the rising costs of producing cane and discouragement of growers who are more and more switching to more profitable crops.

Burundi sugar project[9]. — Société Sucrière du Mosso (SOSUMO) was established to set up and operate a $70.6 million integrated sugar complex near Brigumbura. It has appointed Mehta Group International of Nairobi to manage the new complex. Plans include the construction of a mill with 1000 t.c.d. crushing capacity and development of a 2000-hectare irrigated cane plantation. Sugar production is expected to satisfy domestic demand and make substantial savings in foreign exchange.

Cameroun sugar development plan[10]. — Sugar production in Cameroun in 1981/82 is estimated at 45,000 tonnes, against domestic requirements of some 65,000 tonnes. Production is to be raised to some 90,000 tonnes by 1985/86 with expansion of Camsuco to 48,000 tonnes by 1983, stabilization of Sosucam output at 28,000 tonnes and completion of the Lagdo sugar complex to cover the remaining 14,000 tonnes. Production of the Lagdo complex is scheduled to reach 30,000 tonnes by 1985/86 and eventually 50,000 tonnes, which will provide a surplus for export.

St. Kitts sugar losses[11]. — A study of the sugar industry of St. Kitts by Booker Agriculture International showed that the industry was riddled with inefficiency and suffered from financial and other problems. It could lose up to US $14.92 million in 1982, against $1.12 million in 1975 when the then government nationalized sugar lands to ensure survival of the sugar industry. The three basic problems indentified are: disease, currently affecting one in three cane plants, an unnecessarily inflated employment roll, and a levy on sugar exports which has been draining vital funds from the National Agricultural Corporation which manages the industry for the government. The government now seems to appreciate these difficulties and is prepared to remove or significantly reduce the export levy, thereby releasing more funds for re-investment in the industry.

---

1 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, S80.
2 *USDA Sugar and Sweetener Outlook & Situation*, Feb.1982,10.
3 *African Business*, February 1982.
4 *Westway Newsletter*, March 1982, 10.
5 *USDA Sugar and Sweetener Outlook & Situation*, Feb.1982,14.
6 *Westway Newsletter*, March 1982, 10.
7 C. Czarnikow Ltd., *Sugar Review*, 1982, (1584), 29.
8 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 126.
9 *World Sugar J.*, 1982, **4**, (9), 42.
10 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 157.
11 *World Sugar J.*, 1982, **4**, (9), 45-46.

Australia sugar exports, 1981[1]

	1981	1980	1979
	tonnes, raw value		
Canada	361,065	340,331	399,325
China	367,239	300,590	119,274
Japan	597,244	762,479	769,743
Korea, South	266,650	227,087	246,161
Malaysia	326,897	276,399	249,423
Morocco	30,147	0	0
New Zealand	94,573	109,028	20,013
Papua-New Guinea	15,198	19,068	22,576
Singapore	83,346	51,951	55,098
USA	811,047	314,103	112,519
USSR	21,235	0	0
Other Oceania	4,971	9,020	8,695
Other countries	2,445	500	26
	2,982,057	2,410,556	2,002,853

Guyana sugar statistics[2]. – In 1981 sugar production rose to 320,168 tonnes, raw value from 286,230 tonnes in 1980. Consumption also rose, from 34,624 tonnes to 39,452 tonnes, as did exports, from 258,271 tonnes to 279,605 tonnes. The last figure included 10,639 tonnes to Canada (37,877 tonnes in 1980), 13,064 tonnes to France (0), 188,206 tonnes to the UK (159,123) and 67,696 tonnes to the USA (56,047 tonnes in 1980). No sugar was delivered to Tanzania, against 5224 tonnes in 1980. Carryover stocks were reduced from 12,839 to 9349 tonnes.

Record sugar production in Turkey[3]. – Sugar production in Turkey during the 1981/82 campaign proved to be substantially higher than expected earlier. Turkey, which had become self-sufficient in sugar from 1976/77, became a net importer again in 1979/80 and 1980/81 owing to lower domestic production which was mainly caused by unsatisfactory prices for sugar beets. In 1980/81 the support price for beet was increased by 112% but this did not have any effect because it was announced after plantings were complete. In 1981 the support price and other incentive payments were announced before planting and the beet area rose by 107,000 ha or 40.7%. This resulted in a bumper beet crop of 10.5 million tonnes, 4,050,000 tonnes or 63% more than in 1980/81. Sugar production is estimated at 1,395,000 tonnes, white value, equivalent to about 1,515,000 tonnes, raw value, which is 135,000 tonnes, raw value, or 10% more than expected earlier and 61% more than in 1980/81. With consumption estimated at 1,150,000 tonnes, raw value, Turkey has an export surplus of some 300,000 tonnes, even allowing for an increase in carry-over stocks, and has signed an agreement[4] to sell this amount of white sugar to Iran in 1982 in exchange for oil.

Mexico beet sugar studies[5]. – The Mexican National Sugar Commission has initiated studies for the establishment of a beet sugar industry in two states – Baja California and Jalisco. In the latter a feasibility study has been undertaken for the establishment of a beet sugar factory in Bajio de San José, in the municipal district of Encarnación de Díaz. The Commission is apparently considering the erection of another beet sugar factory in the Mexicali Valley. It is intended to erect a small plant with an annual production capacity of 52,000 tonnes of sugar from a beet slice of 400,000 tonnes, to serve as a pilot model. Total investments are said to involve some US $74.6 million, claimed to be far less than needed for the production of the same amount of cane sugar. Apparently it is intended to use geothermal steam to reduce costs.

Barbados sugar statistics[6]. – Production of sugar in Barbados in 1981 reached 96,462 tonnes, raw value, against 135,107 tonnes in 1980. Exports were reduced to 62,868 tonnes (119,357 tonnes in 1980), including 45,234 tonnes for the EEC (55,171), 5255 tonnes for Canada (4791) and 12,379 tonnes for the USA (59,395 tonnes). Domestic consumption fell from 17,793 tonnes in 1980 to 16,935 tonnes in 1981 while carryover stocks rose from 3404 to 20,066 tonnes.

Nicaragua sugar exports, 1981[7]. – Of the 88,763 tonnes of sugar, raw value, exported by Nicaragua in 1981, all but 3778 tonnes, i.e. 84,985 tonnes, went to the USA, the balance being sent to Mexico. In 1980, the bulk of the 69,000 tonnes of exports, i.e. 55,714 tonnes, had gone to the USA but 13,286 tonnes had been sent to the USSR. In 1979, all the 110,899 tonnes exported by Nicaragua were sent to the USA.

Switzerland sugar imports, 1981[8]

	1981	1980
	tonnes, tel quel	
Cuba	2,180	2,782
France	49,868	38,888
Germany, West	86,828	81,082
UK	13,289	2,767
Other countries	1,615	1,472
	153,780	126,991

Yugoslavia sugar exports, 1981[9]. – Exports of sugar from Yugoslavia in 1981 increased to 321,083 tonnes, raw value, from 76,836 tonnes in 1980.

St. Kitts sugar statistics[10]. – The St. Kitts sugar crop in 1981 totalled 33,256 tonnes, raw value, against 35,609 tonnes in the previous year. Exports included 15,912 tonnes to the UK (12,805 tonnes in 1980) and 14,094 tonnes to the USA (19,861), i.e. a total of 30,006 tonnes (32,666 tonnes in 1980).

Belize sugar statistics[11]. – Production in Belize fell from 104,928 tonnes, tel quel, in 1980 to 99,289 tonnes in 1981. Exports were also reduced, from 98,669 tonnes to 91,870 tonnes in 1981; this figure included 42,190 tonnes to the UK (35,812 tonnes in 1980) and 49,680 tonnes to the USA (62,857 tonnes in 1980).

Singapore sugar imports[12]. – Imports of sugar into Singapore in 1981 totalled 129,948 tonnes, tel quel, almost all of which came from Australia (101,984 tonnes) and Fiji (25,500 tonnes). These two suppliers provided only 48,517 and 16,000 tonnes, respectively, of the 122,248 tonnes imported in 1980, other major suppliers including Cuba (12,001 tonnes) and Thailand (37,941 tonnes).

Hawaiian sugar factories temporary shutdown[13]. – Amfac Inc. has said it will shut down four of its five Hawaiian sugar plantations twice in 1982 for two-week periods, owing to depressed prices and heavy losses on sugar. The shutdowns are in addition to the phased permanent closing of the fifth plantation, Puna Sugar. Amfac said its 1982 first-quarter sugar loss is expected to be "an historic high". The company said that the first of the two shutdowns would begin March 15 and the second will be determined later.

New cane breeding newsletter. – The Sugarcane Breeding Institute at Coimbatore, India, has launched a newsletter intended to carry information on research, extension programs and other activities carried on at the Institute, which was established in 1912 to evolve high-yielding sugar cane varieties suitable for the agro-climatic conditions of sub-tropical India.

PERSONAL NOTES

As a result of a merger between the Tongaat Group Ltd. and Huletts Corporation Ltd., under which Hulett are taking over the sugar interests of the Tongaat Group, Mr. **C. Saunders** has retired from South African sugar industry affairs (he was Chairman of the South African Sugar Association) to become Chairman of the new Tongaat-Hulett Group. His seat on the Council of the Sugar Association will be taken by Dr. **C. van der Pol**, who becomes Chairman of Hulett Sugar Ltd. and Vice-Chairman of the new Group. Dr. **T. G. Cleasby** has relinquished his post as Chairman of the South African Sugar Association Experiment Station to become Group Managing Director.

1 *I.S.O. Stat. Bull.*, 1982, **42**, (2), 2.
2 C. Czarnikow Ltd., *Sugar Review*, 1982, (1588), 47.
3 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 136-137.
4 C. Czarnikow Ltd., *Sugar Review*, 1982, (1587), 41.
5 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 141.
6 C. Czarnikow Ltd., *Sugar Review*, 1982, (1588), 46.
7 *I.S.O. Stat. Bull.*, 1982, **41**, (2), 28.
8 C. Czarnikow Ltd., *Sugar Review*, 1982, (1584), 29.
9 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, S92.
10 C. Czarnikow Ltd., *Sugar Review*, 1982, (1588), 47.
11 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, S135.
12 C. Czarnikow Ltd., *Sugar Review*, 1982, (1588), 47.
13 F. O. Licht, *International Sugar Rpt.*, 1982, **114**, 154.

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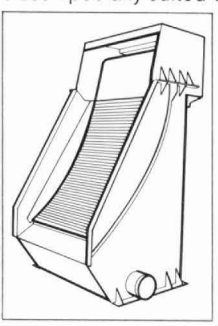

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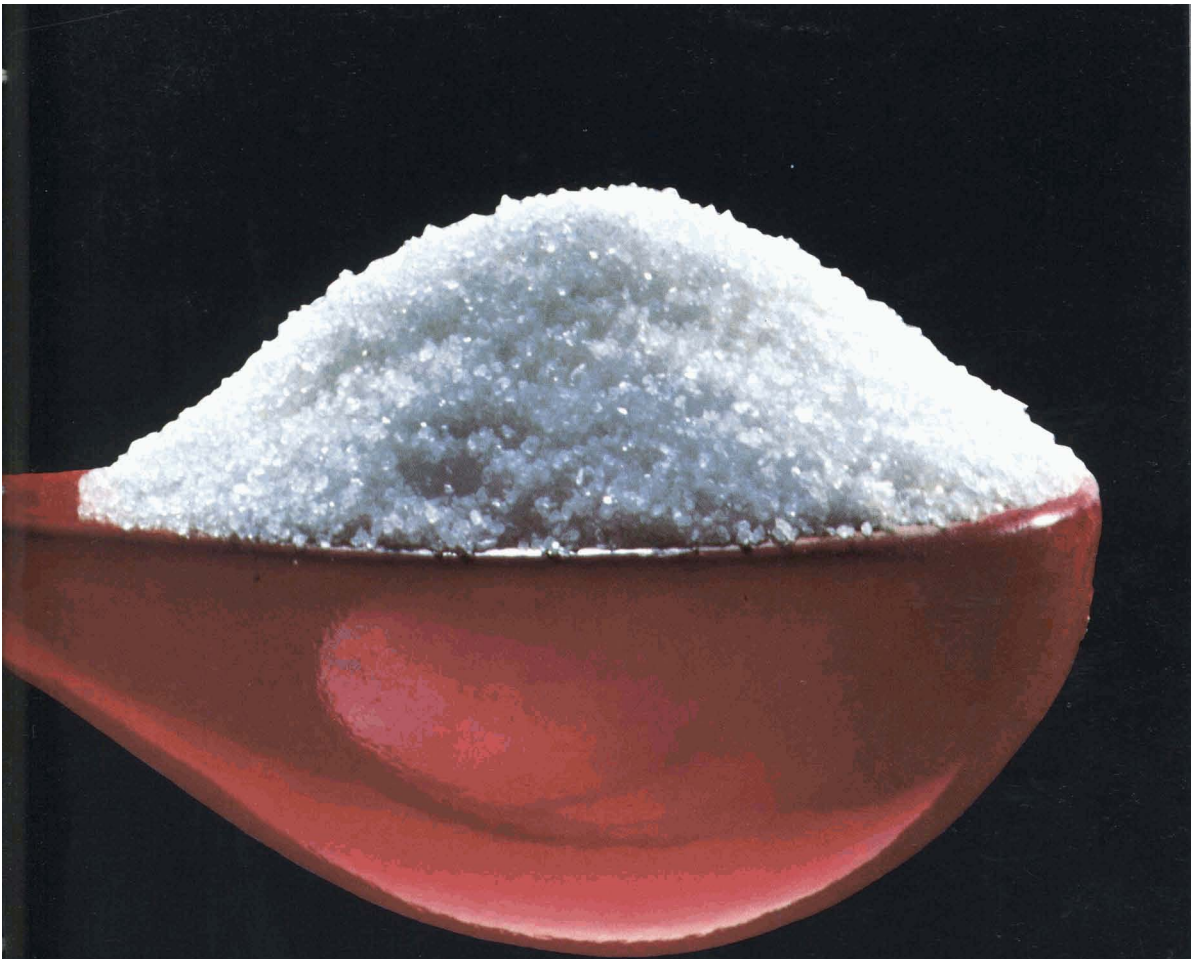

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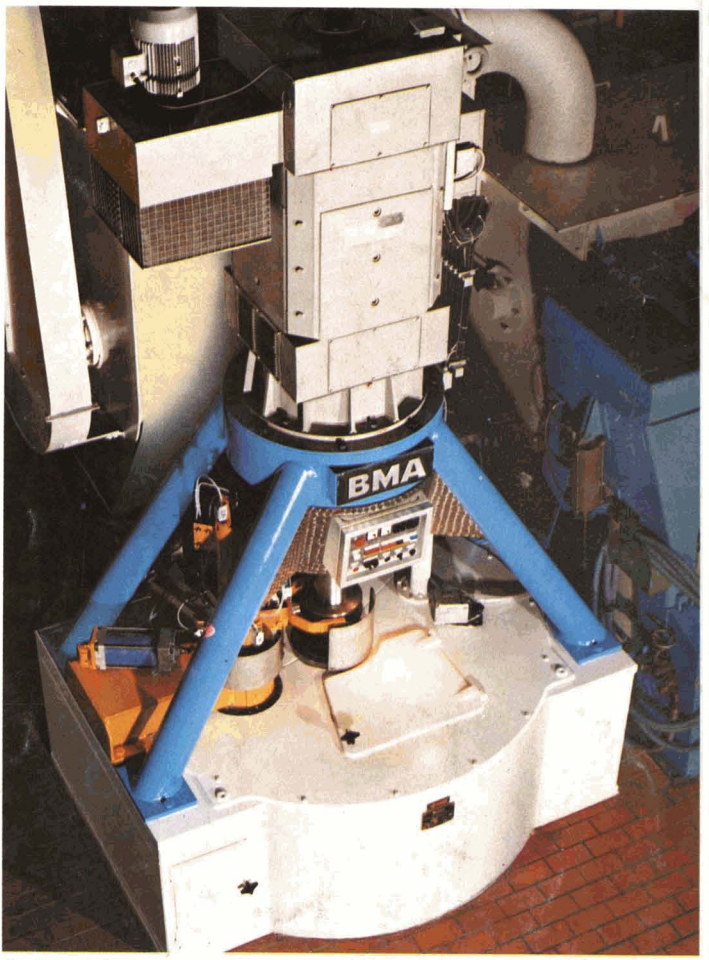

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