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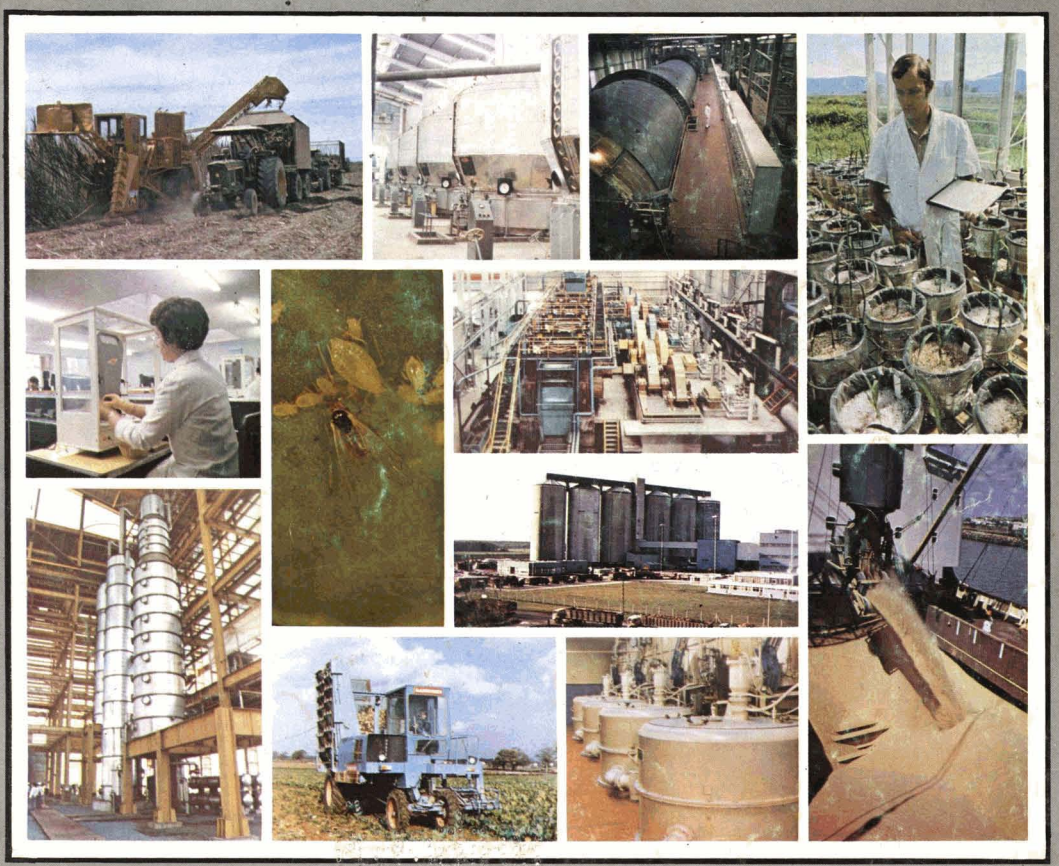

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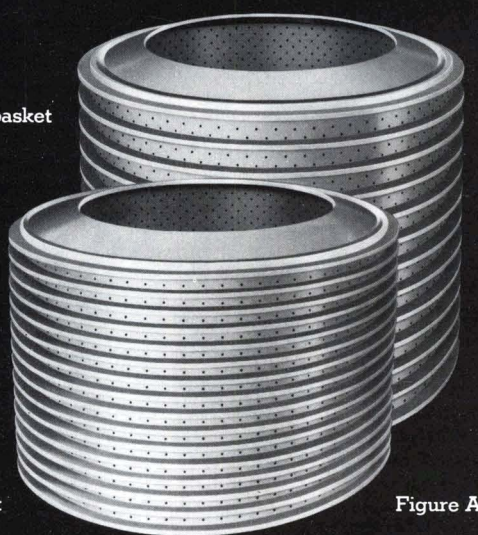

Figure A

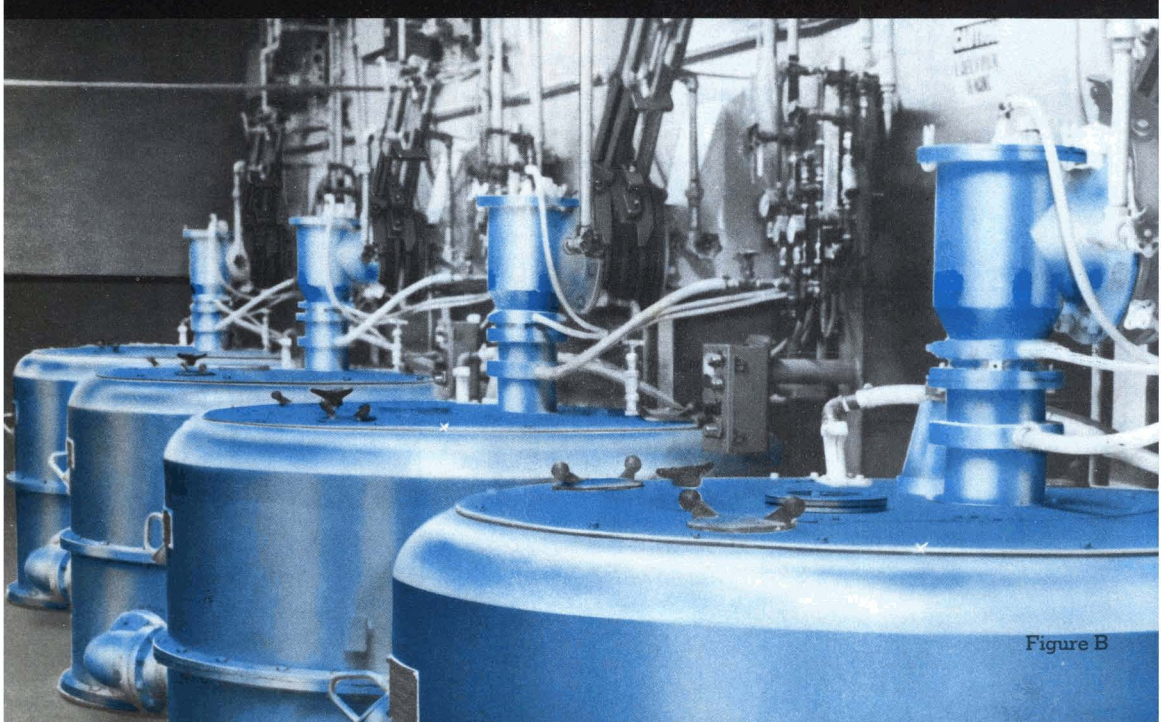

Figure B

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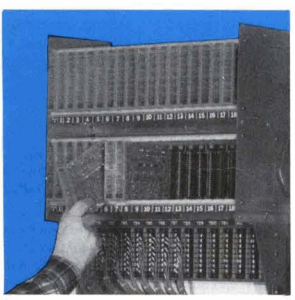

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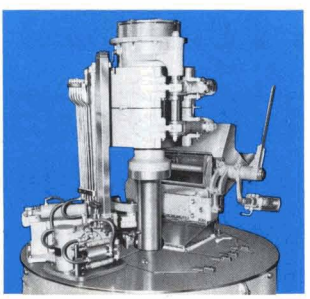

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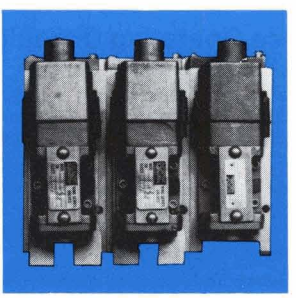

Figure E

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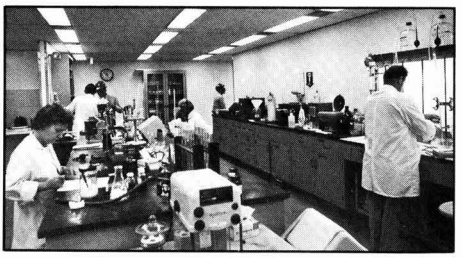
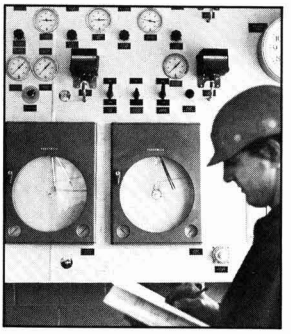
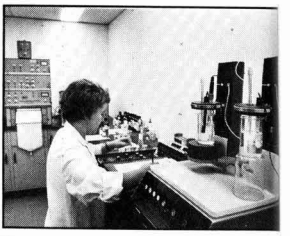
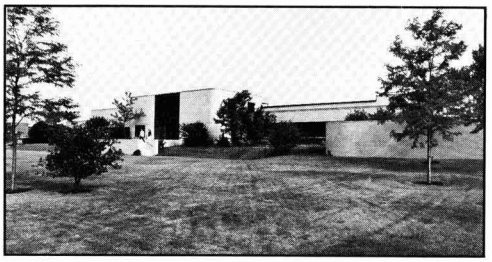
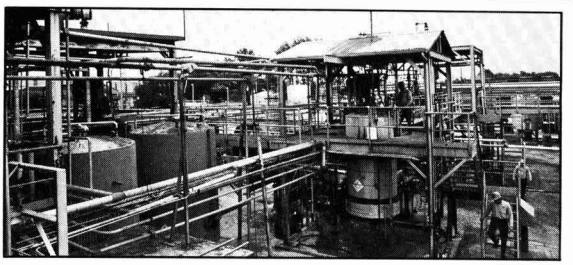
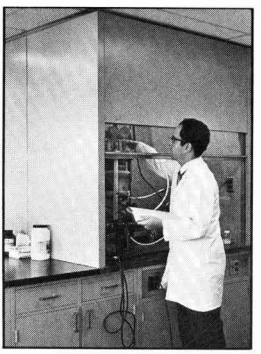


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NOTES AND COMMENTS

The EEC, the ISA and GATT

Under the terms of the Lomé Convention, the EEC imports 1,418,000 tonnes, raw value, of sugar from ACP countries. At the same time, production within the Community is higher than its consumption so that net exports are necessary and require large subsidies provided by the EEC taxpayers. Commenting on this situation, *World Sugar Journal* recently wrote[1]: "The sugar regime of the EEC not only costs the consumer substantial sums of money but it also reduces the outlets on the world free market for those sugar exporting countries where the cost of producing sugar is much lower than it is in the EEC. Most importantly, the sugar industry in those countries plays a very crucial role in their overall economy. The EEC certainly cannot be criticized for wanting to be self-sufficient in sugar but it is beyond any economic logic for it to encourage additional production for export at a substantial cost to its consumers.

"As a result of the EEC's desire to continue exporting substantial quantities of sugar, it cannot become a party to the International Sugar Agreement. (The reason given by the Community is that it cannot accept any kind of quantitative restrictions, on principle.) If the EEC were to become a Member of the ISA by accepting a lower export entitlement it would, without any doubt, make it easier for the Agreement to achieve its objectives which should, in fact, coincide with those of the EEC. If the ISA could stabilize world market prices at higher levels, the EEC could progressively reduce the subsidy it has to pay for sugar exports. The net result of selling at higher prices and paying less, or no, subsidy might even be beneficial to the EEC.

"The CAP of the EEC will be reviewed and renegotiated by July 1, 1980. Until then, the EEC is not willing to accept international commitments on sugar matters. However, if the Community is willing to participate in the ISA—and it should, as it represents an important group of countries not only for sugar but also from the economic and political points of view—it should be prepared to accept, at the very least, interim measures until such time as it is able to participate in full in the ISA. As long as the EEC remains a non-Member and continues exporting unlimited quantities of sugar to the free market at highly subsidized prices, in spite of its promise of "parallel discipline", its actions are bound to have a bearish effect on world market prices. The beet growers in the EEC will be well looked after but growers in most other countries will suffer as a result because their governments are not rich enough to subsidize sugar exports".

After bilateral talks between Australia and the EEC had proved fruitless, Australia made a formal complaint at the General Agreement on Tariffs and Trade (GATT) on October 18 regarding its earlier claim that the EEC was in breach of GATT rules[2]. On November 10 GATT decided to set up a three-member enquiry panel into the allegation that the EEC has unfairly doubled its share of the international free market in sugar through excessive subsidizing of exports. The Australian Ambassador had told the Council at its October meeting that export subsidies amounting to an estimated $830 million in 1978 were likely to increase the EEC share of the free market to at least 22% compared with 11% two years ago. EEC sugar export subsidies in 1977 totalled approximately $414 million, he said.

At the October Council meeting, Argentina, Brazil, Canada, Cuba, Hungary, India, New Zealand, Nicaragua, Peru, Philippines and the USA all supported Australia's call for an inquiry and at the end of November, Brazil also made a formal complaint to GATT after failure to reach agreement with the EEC in bilateral talks[3]. The fact that Brazil is a developing country and exports white sugar which competes directly with EEC sugar exports means that it may have a stronger case than Australia.

New York spot price resumption[4]

The Board of Managers of the New York Coffee & Sugar Exchange Inc. announced on November 8 that it anticipated resumption of publication of a world and domestic raw sugar spot price in the near future. Publication had been suspended a year earlier after a civil action was filed against the Exchange by the Department of Justice, alleging violation of US anti-trust laws. A new procedure has been devised which is acceptable to the Justice Department and approval is now being sought from the Commodity Futures Trading Commission. Under this procedure, the Exchange will establish rosters of individuals knowledgeable in raw sugar trading whose expert opinion will be sought randomly on a daily basis by an Exchange employee for use in computing the spot prices under established guide lines.

International Sugar Agreement

The first meeting of the fifth session of the International Sugar Council was held in London on November 17, 1978. The meeting was presided over by Mr. H. Tabio York of Cuba, the Vice-Chairman for 1978, in the absence of the Chairman, Mr. S. El Bous of Egypt, and was attended by representatives of 43 Members of the Organization.

The Council considered applications for accession by Zambia and the United Republic of Cameroun and agreed on the conditions of accession of those countries. Accession by those countries and by Ghana and Tanzania, for which conditions of accession were approved in August, would bring the membership of the Organization to 41 exporting and 18 importing Members

The Council adopted the first estimate of net import requirements of the free market for 1979, amounting to 17·056 million tonnes. In the light of this estimate and of the estimate of likely exports to the free market in 1979 other than under quotas in effect of Members listed in annex I of the Agreement, the Council established the global quota for 1979 at 12·591 million tonnes.

The Council also decided that the maximum cut envisaged in article 41, paragraphs 2 and 4, will apply to quotas in effect as from January 2, 1979, thus resulting

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[1] 1978, **1**, (5), 20–21.
[2] *I.S.J.*, 1978, **80**, 354.
[3] *Public Ledger*, November 25, 1978.
[4] *Lamborn*, 1978, **56**, 184.

in an aggregate of quotas in effect of 12,626,275 tonnes or an excess of some 35,000 tonnes over the global quota. The schedule of individual quotas in effect on that basis is given below.

The Council recognized that, on the one hand, a certain amount of shortfalls will be declared in 1979, but that, on the other hand, certain allocations under article 39, and possibly other provisions, may also be made in that year. On that basis, the supply/demand position in 1979 is expected to be in balance.

The Council approved the administrative budget of the Organization for 1979.

Quotas in effect on January 2, 1979

Member	*Basic export tonnages*	*Quotas at 82·5% of BET*
Argentina	450,000	366,750
Australia	2,350,000	1,997,500*
Bolivia	90,000	73,350
Brazil	2,350,000	1,915,250
Costa Rica	105,000	85,575
Cuba	2,500,000	2,037,500
Dominican Republic	1,100,000	935,000*
Ecuador	80,000	70,000†
Fiji	125,000	101,875
Guatemala	300,000	244,500
Guyana	145,000	118,175
India	825,000	672,375
Jamaica	130,000	105,950
Mauritius	175,000	142,625
Mexico	75,000	70,000†
Mozambique	100,000	81,500
Nicaragua	125,000	101,875
Panama	90,000	73,350
Peru	350,000	285,250
Philippines	1,400,000	1,141,000
El Salvador	145,000	118,175
South Africa	875,000	713,125
Swaziland	105,000	85,575
Thailand	1,200,000	1,020,000*
Trinidad and Tobago	85,000	70,000†
Total	15,275,000	12,626,275

* Quota at 85% of BET in accordance with article 41, paragraph 3.

† Maximum reduction to 70,000 tonnes under article 41, paragraph 1.

C. Czarnikow Ltd. note[1] that Zambia and the United Republic of Cameroun have both joined the ISA and have been granted the status of Annexe II exporters; that is to say they do not have export quotas but are permitted to export up to 70,000 tonnes a year. Neither country may be expected to avail itself of the authority in the near future, but both plan eventually to become net exporters.

US sugar imports policy

The US State Department has drawn up a draft proclamation that will set limits for two years on sugar imports from countries that are not members of the International Sugar Agreement, following a recent pledge by the President to monitor sugar imports and restrict them if they threatened to exceed quotas allowed under the Agreement. The proclamation also may include a provision that would reduce the US global quota from the current 7 million to 6·7 million short tons.

The two years provision is necessary because the US has already imported more than its non-Members supply quota of about 68,350 tons for 1978 under the Agreement, and imports for 1979 should thus be less than the quota for that year. A particular difficulty arises in the case of Colombia which has announced its intention not to ratify its membership of the Agreement because its ISA export quota is too low; that for 1978 was set at 70,000 tonnes, raw value, whereas Colombia plans to export 140,000 tonnes, much of this to the USA.

Impact of HFCS on the beet sugar industry

During a five-day meeting on the impact of high fructose corn syrup (HFCS) on the world sugar market, Mr. S. E. Bichsel, Director of the US Beet Sugar Development Foundation, warned that European growers should not underestimate the impact of HFCS. In the US, following the world sugar price boom in 1974, annual sucrose consumption per head declined from 45 to 40 kg by 1976. Corn sweetener consumption rose, however, from 9·5 kg per head in 1972 to 20 kg in 1978 following increases in plant capacity by the corn sugar industry in conjunction with a highly aggressive customer service and marketing programme. It was apparent that the US corn sugar industry was willing to maintain a maximum price differential of 40% at the expense of short-term profitability in order to accelerate maximum penetration of the market.

Projections for annual consumption in the US show corn sweeteners moving from 35·4% of the US market in 1980 to 50% in 1990, as compared with 23·7% in 1976. HFCS with levulose contents higher than 90% will be available commercially in the early 1980's as granular products approximately 1·4 times as sweet as sucrose per unit weight. This product, if priced equally with sucrose, will allow immediate corn sugar penetration into market areas where a liquid sweetener was not acceptable.

A recent article[2] by Ian Smith, of the University of Newcastle-upon-Tyne, England, indicates that conditions in the USA are not necessarily applicable to Europe. The EEC is a net importer of maize and a net exporter of sugar, which is the reverse of the situation in the USA. Also, the market of liquid sugar in the US is about 33% of total consumption but only 5–6% of that in Europe. The structure of agricultural support prices in the Community maintains a closer relationship between maize and sugar prices than in the US and, since the starch industry by-products—maize oil, gluten meal and gluten feed—enter the EEC duty-free, the return from the sale of these is lower than in the USA where their value reduces the net production cost of HFCS from maize starch. Information from a UK producer of HFCS and EEC prices and cost figures are used to calculate the comparative costs of production per tonne of dry solids for HFCS and sucrose; these are £233.03 and £198.85, respectively, under UK conditions. Even without the EEC-imposed levy on HFCS, the cost is higher and, with the levy, it seems unlikely that HFCS could be produced profitably.

World sugar price

During November the London Daily Price for raw sugar fell from £105 to £99, a considerable part of the fall being a consequence of currency instability. The white sugar premium started the month at £7 per ton but fell to zero during the month and on one day the LPD(W) was £3 below the corresponding raw sugar price.

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[1] *Sugar Review*, 1978, (1415), 224.

[2] *J. Agric. Economics*, through *World Sugar J.*, 1978, **1**, (2), 16–21.

Vorld sugar supply and demand in 1979

C. Czarnikow Ltd. recently examined the outlook for sugar production and consumption on a country-by-country basis and, while recognizing that a very large surplus will continue to exist, have come to the conclusion that, if ISA quotes are limited to the basic minimum, it may be possible to bring supply and demand into much closer balance in 1979 than prevailed in 1978[1].

"The flow of supplies is uneven, the market falls into distinct white and raw departments without too large a degree of overlapping, while for political reasons trade between certain countries is not possible, so it may well be that at some stage during the year extra sugar will have to be made available for export".

Czarnikow points out that the USA's purchases of non-Member sugar for 1978 already exceeded its entitlement "but that country is not alone and other ISA Members are also overlooking their commitments in this respect. One of the ways in which it was suggested that the effectiveness of the Agreement would be increased was through pressure exerted on non-Members to join, both on account of the advantages they would enjoy as Members and the disadvantages they would incur by remaining outside. To the extent that the disabilities are reduced so the pressure on non-Member exporting countries to adhere to the Agreement is correspondingly lessened.

"The other side of the coin, however, is the need for Member exporters to adhere to their quota limitations. Any major over-shipments would not only supply additional tonnage to the market, thereby making it unlikely that the desired price rise would take place, but would so remove confidence that other Member countries might be inclined to follow suit. The International Sugar Council has the opportunity to provide the climate in which prices can improve in 1979, but this can only take place if attention is paid to the real statistical position and if ISA Members adhere closely to their obligations".

French sugar situation

Sugar production in Metropolitan France is expected to reach 3,500,000 tonnes, white value, in 1978/79, against 3,926,985 tonnes in the 1977/78 campaign, according to the Centre d'Etudes et de Documentation du Sucre (CEDUS)[2]. The yield per hectare of beets, which was slightly lower this year than last, was made up for by a higher sugar content. Total 1978/79 output in the EEC is expected by CEDUS to reach around 11 million tonnes, of which 2,800,000 tonnes will be available for export. Sugar consumption in France is now returning to normal levels.

The French sugar industry intends to be firm on the principle of quotas when the EEC sugar arrangements come up for renewal in 1980. It would not be unfavourable to the entry of Spain, Portugal and Greece into the Community; CEDUS said that these three countries currently need to import around 300,000-400,000 tonnes per year and their per caput consumption could be increased sharply. But a special price system would be needed initially for Spain where prices are currently between 15 and 30% higher than Community levels.

CEDUS said that, among French Overseas Territories, Guadeloupe plans to raise sugar output to 100,000 or even 120,000 tonnes per year under the present restructuring programme, as against the 80,000 tonnes produced in 1977/78. The island of Réunion has an estimated production for 1978/79 of 245,000 tonnes, or about the same as last season, but production could be increased.

According to a study by the Bureau d'Information et d'Etudes Statistiques sur le Sucre[3], French beet sugar producers are concerned by the development of cane sugar industries in many of the ACP countries signatory to the Lomé Convention but not to the Sugar Protocol. Such countries cut down on their import costs but this squeezes French sugar exports out of an already oversupplied market. An example is Nigeria which aims to reduce its sugar imports from a current total of around 300,000 tonnes annually to about 50,000 tonnes by 1985. Sudan and the Ivory Coast are also planning to increase cane sugar production substantially. The study shows that projects planned in the ACP countries could result in cane sugar production increasing by more than 1·5 million tonnes between 1982 and 1985. Some of the countries could become self-sufficient in sugar and may, moreover, attempt to sell their sugar on the world market.

GEPLACEA meeting

The 9th meeting of the Economic Group of the Latin American and Caribbean Sugar Exporting Countries (GEPLACEA) took place in Guatemala City between October 23 and 27, 1978, with 120 delegates attending from 26 countries. Sr. Jorge Brioso of Cuba having resigned the post, Ing. Enrique Estremadoyro del Campo of Peru was elected Executive Secretary.

The meeting affirmed its support for the International Sugar Agreement, agreeing unanimously that countries which are members of the Agreement should observe its disciplines, and carrying a resolution urging the US Government to continue its efforts to ratify the Agreement as soon as possible. The attitude of the EEC on the question of the ISA was criticized, while the Dominican Republic was urged to ratify the Agreement, support being offered for its search for a solution to its quota problem within the ISA. (At the beginning of November it was announced that the Dominican Republic had withdrawn its request for additional export entitlement for 1978 under the Agreement but had asked for an additional 80,000 tonnes quota for 1979; a special working group was being set up to consider this request.)

The meeting examined their estimates of the world sugar balance for crop year 1978/79 and concluded that production, at 90,753,000 tonnes, raw value, and consumption, at 90,000,000 tonnes, were in rough balance. The next meeting of the Group is to be held in Buenos Aires in April next.

Sugar Industry Technologists Inc.—The Proceedings of the 1978 Meeting of SIT were mailed to all members in early December 1978. Extra copies are available for non-members and may be obtained from the SIT office, 288 Lancaster Pike, Malvern, PA 19355, USA at a price of $20 which includes surface postage. Cheques should be drawn on a US bank. Copies of the 1976 Proceedings are also available.

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[1] *Sugar Review*, 1978, (1414), 217.
[2] *Reuters Sugar Rpt.*, October 25, 1978.
[3] F. O. Licht, *International Sugar Rpt.*, 1978, **110**, (31), 20.

Collaborative study on the determination of trace elements in dried sugar beet pulp and molasses

Part II. Fluorine

By P. B. KOSTER*, D. HIBBERT†, R. T. PHILLIPSON† and G. STEINLE‡

Introduction

FLUORINE is extensively distributed throughout the environment and has been detected in various substances such as waters[1,2], minerals and rocks[3,4], foodstuffs[5,6], and many biological materials[7–9].

Interest in the fluorine content of these substances has its origin in the toxic properties of the element.

When fluorine is continuously ingested in sub-lethal amounts it is deposited in the bones and teeth until these organs become saturated. At this stage further ingestion leads to generalized symptoms of toxicity. There is thus a relatively long latent period between the commencement of exposure and the appearance of toxic symptoms.

Dried sugar beet pulp and molasses are important by-products of the beet sugar industry and are widely used as animal feeding stuffs. These products may form a substantial portion of the animal's diet.

To ensure that there is no possible toxicity risk from fluorine present in these products, Part II of our collaborative study (Part I: the determination of mercury in dried sugar beet pulp and molasses[10–12]) deals with the determination of fluorine.

The analyses were carried out by two of the collaborating laboratories (IRS and BSC). Both laboratories applied their own methods for replicated analyses of the samples.

Series of samples of dried pulp and molasses from three (IRS) and two (BSC) beet campaigns were investigated.

EXPERIMENTAL

Sample preparation

Except for the BSC samples from the 1971/72 campaign the same method of sample preparation and sub-sampling was followed as described in our earlier papers[10–12]. In these papers, the importance of a well-designed sub-sampling procedure was emphasized.

Determination of fluorine content

Methods used for the determination of fluorine were based on those described by Louw & Richards[8] (IRS) and by Milton *et al.*[13] (BSC).

The IRS method uses the fluoride ion selective electrode for the determination of the fluoride concentration in the final extract. This electrode is highly specific[14,15], having an approximately ten-fold selectivity for F^- over OH^-, and at least a thousand-fold selectivity for F^- over Cl^-, Br^-, I^-, HCO_3^-, NO_3^-, HSO_4^- and $H_2PO_4^-$. The electrode responds to fluoride ion activity, not concentration, and activity differs from concentration by an amount which is a function of the total ionic background and differs further if a significant fraction of the fluoride ions are in the form of complexes with ions such as Al^{3+} or Fe^{3+}. Therefore, a technique must be applied which eliminates virtually all the effect of variation in the ionic composition of the (aqueous) solutions and which allows the use of a single calibration curve for a wide range of standards and sample solutions. The technique involves separation of fluorine from the bulk of the interfering elements by leaching from a sodium carbonate-zinc oxide fusion, followed by a 1:1 dilution of the final sample solutions and standards with a total ionic strength adjustment buffer (Tisab) solution. The Tisab solution performs three functions simultaneously, *viz.* fixation of the total ionic strength, buffering of the solution in a range which avoids interference of OH^- and, finally, formation of complexes with Fe^{3+} and Al^{3+}, displacing any bound fluorine.

In the BSC method, after destruction of organic matter, followed by distillation, the fluoride solution is buffered to pH = 3·0 and titrated with thorium nitrate in the presence of "Chrome Azurol S" until the colour matches a blank consisting of a trace of thorium nitrate added to a buffered solution of the dyestuff. Substances that form complex ions with thorium are separated by distillation of fluorine as hydrofluorosilicic acid which is formed upon heating with perchloric acid using glass wool as the source of silica.

DETAILED METHODS

(*a*) Instituut voor Rationele Suikerproductie

Reagents and materials

Glacial acetic acid (Merck, p.a. grade).

Sodium hydroxide solutions: 2·5 and 5·0N solutions of sodium hydroxide (Merck, p.a. grade) in deionized water.

Sodium chloride (Merck, p.a. grade).

Hydrochloric acid solution: 5·0N solution of 25% hydrochloric acid solution (Merck, p.a. grade) in deionized water.

"Titriplex IV" (Merck, Cat. No. 8424).

Sodium carbonate/zinc oxide fusion mixture: 20 g sodium carbonate (Merck, p.a. grade) and 2 g zinc oxide (Merck, p.a. grade) are thoroughly mixed with the aid of mortar and pestle. The mixture is divided by means of a sample divider and the fractions are combined. This procedure is repeated three times. The mixture is homogenized with a spatula.

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‡ Süddeutsche Zucker AG, Zentral Laboratorium, D-6179 Obrigheim 5, Germany.

[1] Frant & Ross: *Anal. Chem.*, 1968, **40**, 1169-1171.
[2] Crosby, Dennis & Stevens: *Analyst*, 1968, **93**, 643–652.
[3] Edmond: *Anal. Chem.*, 1969, **41**, 1327–1328.
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[5] Torma & Ginther: *ibid.*, 1968, **51**, 1181–1183.
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[10] Koster, Raats, Hibbert, Phillipson, Schiweck & Steinle: *I.S.J.*, 1975, **77**, 299–305.
[11] *Idem*: *Zucker*, 1975, **28**, 555–562.
[12] *Idem*: *Sucr. Belge*, 1975, **94**, 385–393.
[13] Milton, Fiddell & Chivers: *Analyst*, 1947, **72**, 43–47.
[14] Frant & Ross: *Science*, 1966, **154**, 1553–1555.
[15] Rechnitz: *Chem. Eng. News*, 1967, **45**, 146–158.

Total ionic strength adjustment buffer (Tisab): to 500 cm^3 deionized water in a 1 dm^3 volumetric flask are added, in sequence, 57 cm^3 glacial acetic acid, 58 g sodium chloride and 4 g "Titriplex IV". The pH is adjusted to 5·0-5·5 with the aid of 5N sodium hydroxide solution, after which the solution is made up to the mark with deionized water.

Stock fluorine solution (1000 $\mu g.cm^{-3}$): 2·210 g sodium fluoride (Merck, p.a. grade) is dissolved in deionized water in a 1 dm^3 volumetric flask, after which the solution is made up to the mark.

Working fluorine solutions (0·1 and 1·0 $\mu g.cm^{-3}$): The stock fluorine solution is diluted with deionized water until 0·1 and 1·0 $\mu g.cm^{-3}$ solutions are obtained. These solutions are diluted with equal volumes of Tisab and are transferred to plastic bottles. Since a similar 1:1 dilution is used in the analytical procedure the last solutions serve as 0·1 and 1·0 $\mu g.cm^{-3}$ standards.

Apparatus

Specific ion meter: "Orion", Model 407 (Orion Research Inc., Cambridge, MA, USA.

Fluoride ion selective electrode: "Orion", Model 94-09A.

Reference electrode: "Orion", Model 90-01.

Platinum crucibles: capacity 50 cm^3, with lips to facilitate the transfer of extracts.

Rigid plastic rods: 20 cm × 5 mm o.d.

Procedure

Digestion.—The sample (500 mg) is treated with 2·5 cm^3 deionized water in a platinum crucible (in this, and all the following steps of the procedure, only plastic rods are used). The slurry obtained is thoroughly mixed with 0·5 cm^3 of 2·5N sodium hydroxide solution. The mixture is dried at 120°C in an oven for 1 hour. The sample is transferred to a muffle furnace and is ashed at 300°C for 20 minutes. Sodium carbonate/zinc oxide fusion mixture (1·1 g) is mixed with the ash using a plastic rod. The mixture is fused at 700°C for 6 minutes in the muffle furnace and then allowed to cool.

Extraction.—The fused mixture is extracted with 8 cm^3 of deionized water on a steam-bath for 30 minutes. During the extraction the mixture is stirred frequently with the plastic rod to minimize the formation of lumps. An additional 2 cm^3 of deionized water is added half way through the extraction period. The crucible is removed from the steam-bath, the residue is allowed to settle, the outside of the lip of the crucible is greased lightly with silicone grease and the clear liquid is decanted through Schleicher & Schüll 589/2 filter paper into a 100 cm^3 calibrated polyethylene beaker. The extraction procedure given above is repeated with three 8 cm^3 volumes of deionized water. After the final extraction all the contents of the crucible are transferred to the filter paper. The walls of the crucible are rubbed with the plastic rod to remove all adhering particles. The crucible is washed with 2 cm^3 portions of deionized water and, finally, the filter paper is washed with 2 cm^3 of warm, deionized water. The filtrate is evaporated on a steam-bath to about 15 cm^3 and then allowed to cool. The beaker is covered with "Parafilm" and the filtrate neutralized (methyl orange indicator) with 5N hydrochloric acid solution, by means of a Pasteur pipette through a small hole pierced in the "Parafilm". The solution is made up to 25 cm^3 with deionized water and after that diluted with 25 cm^3 of Tisab.

Calibration and determination.—The specific ion meter is calibrated with the 1·0 and 0·1 $\mu g.cm^{-3}$ standard fluorine solutions. Sample extracts with fluorine concentrations in the range of 0·1 to 1·0 $\mu g.cm^{-3}$ can be measured directly. If the fluorine concentration of the extract falls outside this range, the apparatus is calibrated with another pair of standard solutions which always differ in concentration by a factor of 10. In the calculation of the fluorine content of the sample, a recovery of 90% is taken into account. Note: Fluorine in waters an be determined directly after dilution of the sample with an equal volume of Tisab.

(*b*) British Sugar Corporation Ltd.

Reagents and materials

Perchloric acid (BDH, "AnalaR" grade, 60% w/v): redistilled.

Perchloric acid solution: Perchloric acid is diluted with distilled water to a 5% (w/v) solution.

Sodium hydroxide solutions: 1N and 6N solutions of sodium hydroxide (BDH, "AnalaR") in distilled water.

Phenolphthalein indicator solution: 0·1% (w/v) solution of phenolphthalein in 95% ethanol.

"Chrome Azurol S" solution: 0·02% (w/v) solution of "Chrome Azurol S" (BDH) in distilled water.

Chloroacetate buffer solution: 22·7 g chloroacetic acid (BDH, "AnalaR") is dissolved in 100 cm^3 distilled water. 50 cm^3 of this solution is titrated with 6N sodium hydroxide solution to neutrality (phenolphthalein). The neutralized and un-neutralized portions are combined and diluted with distilled water to 1 dm^3.

Silver perchlorate (BDH).

Calcium oxide (fluorine-free): 110 g of ammonium carbonate (BDH, "AnalaR") and 55 cm^3 of ammonia solution (BDH, "AnalaR", 0·88 $g.cm^{-3}$) are dissolved in distilled water and diluted to 600 cm^3; 200 g of dry calcium chloride (BDH, "AnalaR") is dissolved in about 600 cm^3 of warm distilled water. Into this solution is stirred 20 cm^3 of the ammonium carbonate solution. The mixture is brought just to the boiling point and the precipitate is allowed to settle for a few minutes. The mixture is filtered through a Buchner funnel using suction and the precipitate is discarded. The precipitation and filtration procedure is repeated three times, using 20 cm^3 of ammonium carbonate solution each time. Finally, the clear filtrate from the last precipitation is treated with the remainder of the ammonium carbonate reagent. The mixture is stirred well and just brought to the boiling point. The precipitate is allowed to settle, filtered, and washed several times with hot distilled water until the washings are free from chloride. The residue is dried at 100°C and ignited to oxide in a platinum dish in small quantities of 1 to 2 g as required.

Standard thorium nitrate solution (0·004N): 0·588 g of thorium nitrate [$Th(NO_3)_4$,6 H_2O; BDH, "AnalaR"] is transferred to a 1 dm^3 volumetric flask and dissolved in water. The solution is made up to the mark with distilled water.

Stock fluorine solution (1000 $\mu g.cm^{-3}$): 0·221 g of dry sodium fluoride (BDH, "AnalaR") is dissolved in distilled water in a 100 cm^3 volumetric flask. The solution is made up to the mark with distilled water.

Working fluorine solution (10 $\mu g.cm^{-3}$): 10·0 cm^3 of the stock fluorine solution (1000 $\mu g.cm^{-3}$) is transferred to a 1 dm^3 volumetric flask and diluted to 1 dm^3 with distilled water.

Apparatus

Distillation apparatus: The apparatus (borosilicate glass) consists of a 100 cm^3 Claisen flask connected to a water-cooled condenser by means of the side tube. The neck carries a funnel and a thermometer (contained in an elongated mercury pocket fitted with a ground joint) dipping below the surface of the liquid in the flask.

Procedure

Sample preparation.—Because a sample divider was not available, samples from the 1971/72 campaign were prepared according to the following procedure. A sample (about 2 kg) is thoroughly mixed and spread in a 2·5 cm layer over a sheet of brown paper. Increments are taken over the area of the sample with a small scoop to provide a sub-sample of about 200 g. This sub-sample, divided into two portions, is dried and transferred into 1 dm^3 porcelain pots with a porcelain ball charge and milled for 24 (shredded pulp) or 48 hours (pulp nuts). After this time the samples are screened through a nylon flour sifter (mesh size about 1 mm) and any oversized material is reduced with a mortar and pestle and added to the milled sample. After combining the two halves, the sample is ready for analysis.

Digestion.—A suitable quantity of sample (containing not more than 200 μg of fluorine) is weighed into a platinum dish. Fluorine-free calcium oxide (1 g) and 50 cm^3 of distilled water are added and the contents are evaporated to dryness on a water-bath. The residue is charred thoroughly at a temperature below visible red heat. The dish and contents are transferred to a muffle furnace maintained at approximately 600°C, ignited for 1·5 to 2 hours and allowed to cool.

Preparation of apparatus and blank solution.—A quantity of silver perchlorate sufficient to precipitate any chloride that may be present in the sample is measured into the Claisen flask of the distillation apparatus. Distilled water (7 cm^3) and 60% perchloric acid (15 cm^3) are added, 0·1 g of glasswool is placed in the flask and the contents are steam-distilled, adding distilled water through the dropping funnel continuously at such a rate that, with the heating suitably adjusted, the distillation temperature is maintained between 135 and 145°C. About 200 cm^3 of the liquid is distilled, the condenser is steamed out and the distillate discarded.

The steam-distillation is continued until a further 200 cm^3 of distillate is obtained. This distillate is titrated as described below to obtain the blank titration figure. This blank figure is equivalent to about 4 μg fluorine and is thought to be derived from the glass of the distillation apparatus. Higher blanks than this are usually due to impurity in the perchloric acid, which should be heated to 140°C and then redistilled before use.

Determination of fluorine.—The contents of the flask are cooled. The ash from the sample digestion is transferred to the contents of the flask, using the minimum quantity of distilled water. The steam-distillation is continued and a further 200 cm^3 of distillate is collected. This solution is titrated as described below to give the fluorine content of the samples. The distillate (200 cm^3) is diluted to a known volume with distilled water and an aliquot of this solution containing less than 100 μg of fluorine is transferred to a Nessler cylinder standing on a white tile. The solution is neutralized to phenolphthalein with 1N sodium hydroxide solution. The pink is just discharged with dilute perchloric acid, "Chrome Azurol S" solution (1 cm^3) is added, followed by dilute perchloric acid solution until the yellow colour of the dye just changes to pink, and then chloroacetate buffer solution (0·5 cm^3) added. Into a similar Nessler cylinder a volume of distilled water equal to that of the test aliquot is placed, followed by 1 cm^3 of "Chrome Azurol S" solution and 0·5 cm^3 of chloroacetate buffer solution. To the latter solution are added, from a micro-burette, 0·10 cm^3 of standard thorium nitrate solution and the colour changes from pink to bluish-purple. The test solution in the first cylinder is then titrated with standard thorium nitrate solution until its colour exactly matches that of the liquid in the second Nessler cylinder.

Calibration.—Aliquots of dilute standard fluorine solutions, covering the range 2 to 100 μg of fluorine, are measured into Nessler cylinders and are titrated as described under "Determination of fluorine" above. A graph is constructed relating titration figures to the fluorine content. Slight modifications in the conditions may influence the end-point owing to the variable composition of the colour complex formed between thorium salts and the dye. A calibration curve must therefore be prepared each time a change in the conditions is encountered.

Calculation.—The amount of fluorine in the sample and blank aliquots used in the titration is determined from the calibration graph. This information is then used to establish the amount of fluorine in each of the 200 cm^3 distillates obtained from the sample and the blank. The fluorine content of the blank distillate is subtracted from the amount in the sample distillate and the original sample weight used to calculate the fluorine content of the sample.

EVALUATION OF METHODS

In recovery experiments, known amounts of fluorine were added to samples of dried pulp and molasses. Recoveries were in the ranges 85-93% (IRS) and 98-101% (BSC). The limits of detection of the methods are 1·4 mg/kg for the IRS method, while the BSC method will detect 2 μg of fluorine in the final aliquot.

Based on the results of 42 (IRS) and 32 (BSC) duplicate analyses of dried pulp, the standard error of the mean of a duplicate determination has been found to be 0·24 and 0·56 mg/kg, respectively. Additionally, based on the results of 17 analyses of molasses in duplicate, IRS found a value of 0·19 μg/kg for the standard error of the determination in molasses. These values imply confidence limits between duplicate tests ($P = 0.05$) of $\pm$0·47 (pulp) and $\pm$0·37 (molasses) mg/kg (IRS) and $\pm$1·10 (pulp) mg/kg (BSC).

RESULTS

Samples of pulp nuts, dried (shredded) molassed pulp and molasses produced at various factories in Holland and the United Kingdom have been investigated. Two types of sample were investigated, i.e. composite samples representing an entire campaign's production (BSC) and composite samples representing a single week's production (IRS).

The results of the analyses are shown in Tables I and II. These tables show that the prospective EEC upper limit of 150 mg/kg material converted to a moisture content of 12% is never exceeded. The values are of a totally different order of magnitude from this limit. The values found for molasses are lower than those of the corresponding pulp samples. The same effect, but more pronounced, was found for mercury[10–12].

The fluorine level of the Dutch pulp was similar to that of the British pulp. The fluorine content of 5 samples from campaign composites) of dried pulp factories of Süddeutsche Zucker AG was found by IRS to range from 8·1 to 9·9 (mean: 8·9) mg/kg, being of the same order as the Dutch and British values.

Table I. Fluorine in molassed pulp nuts (mg/kg material converted to a moisture content of 12%), molasses (mg/kg material) and factory waters (mg.dm^{-3}) from the factories in Holland

	Campaign 1973			*Campaign* 1974			*Campaign* 1977
Factory	*molassed pulp nuts**	*molasses**	*factory water*†	*molassed pulp nuts*‡	*molasses*‡	*factory water*‡	*molassed pulp nuts*§
1	16·7	3·1	0·3	16·2	—	—	7·0
2	12·4	8·3	0·4	19·3	—	—	8·5
3	8·3	7·2	0·3	14·3	—	—	5·3
4	10·1	9·2	0·6	15·8	—	—	8·4
5	8·5	4·7	0·4	11·1	—	—	5·7
6	11·5	9·5	0·3	8·8	—	—	4·2
7	32·6**	6·2	12·0**	14·1	2·5	6·2	6·8
8	21·8**	4·2	12 0**	17·1	4·1	6·2	11·1
9	7·4	4·6	0·4	15·0	—	—	7·7
10	6·7	7·5	—	16·6	—	—	8·8
11	9·4	7·6	0·6	15·2	—	—	8·5
mean	12·0	5·9		13·4			7·5

* Weekly composite samples from the beginning of the campaign.
† Samples taken after the end of the campaign (January 1974).
‡ Mean value of 2 weekly composite samples from the start and the end of the campaign.
§ Weekly composite samples from the middle of the campaign.
** Mean value of 7 weekly composite samples from the whole campaign.

Table II. Fluorine in pulp and pulp nuts (campaign composite samples) from factories in the United Kingdom in mg/kg material converted to a moisture content of 12%

	Campaign 1971/72		*Campaign* 1972/73	
Factory	*shredded molassed pulp*	*molassed pulp nuts*	*shredded molassed pulp*	*molassed pulp nuts*
1	8·2	—	6·6	—
2	8·5	10·7	4·9	—
3	5·6	—	9·3	—
4	7·7	9·8	—	7·9
5	—	7·6	7·9	10·4
6	14·6	—	—	—
7	4·4	—	12·6	—
8	8·9	2·5	12·5	16·6
9	26·4	—	33·6	—
10	8·5	—	13·8	—
11	6·7	—	4·2	—
12	15·4	—	14·3	—
13	3·0	3·8	4·5	12·4
14	7·6	—	9·0	—
15	7·1	—	19·1	—
16	—	23·8	—	32·4
17	—	12·1	—	24·0
mean	9·5	10·0	11·7	17·3

The IRS and BSC methods of analysis give results which are comparable. This was indicated by the results of analyses of two samples of dried pulp which were analysed both by IRS and BSC. For these samples contents of 38·6 and 6·4 (IRS) and 37·3 and 4·9 (BSC) mg/kg were found.

The fluorine content of the pulp from the Dutch factories 7 and 8 in the campaign 1973 are significantly higher than those of the other factories. Because these factories are close to each other and situated on the same canal which was known to be heavily contaminated, the water from this canal was analysed extensively during this campaign. For comparison purposes, samples of other factory waters were also analysed. The results of this investigation, shown in Table I, demonstrate that the fluorine content of the water concerned is about 30 times higher than that of the other factory waters.

Factory 7, in 1973, used this water for the extraction process in its diffusion battery. This resulted in a much higher fluorine level in the pulp than that of factory 8 which used the water only in parts of the factory less important for pulp production, such as fluming and beet washing.

In 1974 factory 7 had its diffusion batteries replaced by tower diffusers and factory water was no longer involved in the extraction process. This is reflected in the fluorine levels of the pulp from the 1974 and 1977 campaigns which are of the same order as those of factory 8 and even reach the average levels of fluorine in Dutch pulp.

The fluorine content of the pulp from the 1977 campaign was found to be considerably lower than that of the pulp from the 1973 and 1974 campaigns.

Summary

Methods for the determination of fluorine in dried sugar beet pulp and molasses were developed by two of the collaborating laboratories. Recoveries of added fluorine ranged from 85 to 93% (IRS) and from 98 to 101% (BSC). Limits of detection of the two methods ranged from 1·4 mg/kg (IRS) to 2 μg (BSC).

The methods were applied to samples of dried pulp and molasses produced at various factories in Holland and the United Kingdom during a number of beet campaigns. The levels of fluorine found in these samples are considerably lower than the EEC standard for animal feeding stuffs (not exceeding 150 mg F/kg material converted to a moisture content of 12%).

Etude en collaboration sur le dosage des oligo-éléments dans les pulpes séchées de betterave sucrière et les mélasses. IIème Partie. Le fluor

Deux des laboratoires participants à l'étude ont mis au point des méthodes de dosage du fluor dans les pulpes séchées et les mélasses de betteraves. La quantité de fluor ajouté, qui est retrouvée, varie de 85 à 93% (IRS) et de 98 à 101% (BSC). Les limites de détection des deux méthodes sont 1,4 mg/kg (IRS) et 2 μg (BSC). On a utilisé ces méthodes pour doser le fluor dans des échantillons de pulpes sèches et de mélasses produites dans diverses usines de Hollande et du Royaume Uni pendant un certain nombre de campagnes betteravières. Les teneurs en fluor trouvées dans ces échantillons sont considérablement inférieures au standard CEE pour les aliments pour animaux (ne pas dépasser 150 mg F/kg de matière convertie à une humidité de 12%).

Gemeinsame Studie über die Bestimmung von Spurenelementen in Zuckerrübentrockenschnitzeln und Melassen. Teil II. Fluor

Methoden für die Bestimmung von Fluor in Zuckerrübentrockenschnitzeln und Melassen wurden in zwei Laboratorien gemeinsam entwickelt. Das hinzugegebene Fluor wurde wiedergefunden zu 85 bis 93% (IRS) bzw. 98 bis 101% (BSC). Die Nachweisgrenzen der beiden Methoden liegen bei 1,4 mg/kg (IRS) bzw. 2 μg (BSC). Man hat diese Methoden bei in verschiedenen Fabriken

Collaborative study on the determination of trace elements in dried sugar beet pulp and molasses

in Holland und Grossbritannien produzierten Trockenschnitzeln und Melassen während mehrerer Rübenkampagnen angewandt. Der in diesen Proben gefundene Fluorgehalt ist beträchtlich geringer als nach dem EWG-Standard zulässig (die Höchstmenge beträgt 150 mg F/kg des verarbeiteten Rohstoffs bei 12% Feuchtigkeitsgehalt).

Estudio colaborativo de la determinación de elementos vestigiales en pulpa seca de remolacha y en melaza. Parte II. Flúor

Dos de los laboratorios colaborativos han desarrollado métodos para determinar flúor en pulpa seca de remolacha y en melaza. Recuperaciones de flúor añadido se han obtenido en las gamas 85% a 93% (IRS) y 98% a 101% (BSC). Limites de detección de los dos métodos estuvieron 1,4 mg/kg (IRS) y 2 μg (BSC). Se han aplicado los métodos a muestras de pulpa seca y melaza producido en varias fábricas de Holanda y del Reino Unido durante algunas campañas remolacheras. Los niveles de flúor encontrado en estas muestras son notablemente más bajo que la norma de la CEE para forraje (no más de 150 mg F/kg de materia convertido en un contenido de agua de 12%). □

Sugar cane congress in Réunion

2nd International Congress of ARTAS

THE Association Réunionnaise pour le Développement de la Technologie Agricole et Sucrière (ARTAS) is a relatively young group of sugar technologists, its first Congress having been held only in 1973. The second Congress, held between the 16th and 21st October 1978, demonstrated that members are a group highly sensitive to new ideas and keenly interested in the development of the sugar industries of their part of the Indian Ocean.

Technologists from the neighbouring island of Mauritius play an active part in the Association's meetings and it is proposed, in fact, that the 3rd Congress will be held in Mauritius in three years' time. Some 70 Mauritians participated in the 1978 meetings while its international character is demonstrated by the fact that there were 12 participants from Metropolitan France, 8 from South Africa, 2 each from England and Switzerland and one each from Brazil, Madagascar, Malawi and Austria. Wives accompanied a number of delegates and a social programme was organized for these and the wives of the 150 Réunion technologists attending.

After gathering during the week-end preceding the Congress, delegates assembled in the Conference Room of the St.-François Hotel in St.-Denis, capital of the island of Réunion, for the opening session. Here they were welcomed by Emile Boyer de la Giroday, President of ARTAS and Director of the Sugar Research Station of La Bretagne in Ste.-Clotilde. He hoped that overseas visitors would spend a pleasant week on the island and regretted that one week was not sufficient time to have more than a glimpse of its features. He surveyed the world sugar situation in relation to production and consumption, and outlined the position of Réunion as a sugar producer and exporter. Growing of cane is the principal feature of the island's economy, with some 200,000 tonnes of sugar produced per annum from 37,000 hectares of cane lands. About 10% of the population is directly dependent on cane growing or sugar manufacture for their livelihood. The industry is undergoing remarkable changes, however, with rationalization of the factories and restructuring of the cane area. Because of the divisions of land holdings over past generations, the average cane area was only about 2·8 ha per grower and the fields were small and of shapes which did not lend themselves to modern means of cultivation. With such small areas, many growers could not even afford to clear their land and replant, so that there were often ratoon crops 30 years old, with consequent low yields. By a system of acquisition of the lands and reselling in larger, more conveniently-shaped parcels plus the provision of loans by the Credit Agricole it is hoped that modern methods can be adopted and yields raised so as to increase the productivity of cane growing in Réunion.

This theme was expanded further by M. Bernard Landouzy, Prefect of La Réunion, who also welcomed visitors to the island and spoke of the agriculture of his Département, not only of cane but of other crops, and of the research carried out on their improvement. He discussed the question of sugar production in relation to Metropolitan France and the other countries of the EEC, and offered his best wishes for the success of the meetings.

M. Boyer de la Giroday then referred to the fact that the 16th October was the 50th anniversary of the entry of Emile Hugot into the sugar industry during which time he has attained a remarkable stature and reputation as a technologist. In recognition of the anniversary, M. Boyer de la Giroday presented a gift to M. Hugot on behalf of ARTAS and its members.

After a short break, during which photographs of the assembled delegates were taken, the Congress resumed and the first paper was presented. B. Despas described the programme for opening-up the higher parts of the island, inland from the littoral where agriculture has been developed and most of the population is found. The establishment of an infra-structure and introduction of new crops and activities such as cattle-raising are intended and details were given of the cost of the programme and its funding.

G. Favarel of the Société d'Aménagement Foncier et d'Etablissement Rural (SAFER) of Réunion then described the activities of these government-controlled organizations for the restructuring of agricultural lands, as mentioned above, so as to enable the adoption of modern cultivation methods and improvement of crop production. More detailed aspects of the plan for modernization of the cane industry in Réunion during 1974-81 were described by J. R. Tiercelin, with an account of progress in rock clearance from fields, adoption of mechanical methods of cultivation, replanting of higher yielding and disease-resistant varieties, etc.

L. Lincoln then presented a paper in which he discussed the reality of the threat to the cane and beet sugar industry by high fructose corn syrup. He surveyed the history and various aspects of HFCS production and

usage but concluded that, in the absence of factors which had encouraged growth of HFCS usage in the USA, the outlook for EEC sugar producers was reasonably optimistic.

After lunch, a paper by F. Langreney and L. Lincoln described a project in Réunion for the manufacture of alcohol to serve as a motor fuel ingredient. E. Buchanan of South Africa then described progress on a trial system for control of cane quality in his country in which penalties are imposed for cane consignments having fibre and impurity: sucrose ratios in excess of a certain tolerance above the average ratios for the mill in the same week. The penalties are returned only for consignments which are better than average and adoption of the system is leading to improvement in cane quality.

E. Hugot then presented a paper on the price of sugar cane payment and factory remuneration in Réunion, in which he discussed the system of prices established in the EEC and its effect on cane growing in France's overseas departments, including Réunion. He described the techniques employed for sampling and analysis of cane deliveries to the factories and the application of formulae for calculating the value of the cane.

J. M. Arquetout, of the Centre Technique Interprofessionel de la Canne et du Sucre de la Réunion, described the system of evaluation of a cane supply under the current agreement between growers and sugar factory. He acknowledged the defects of the old system of sampling of cane by means of a horizontal probe but described how these may be overcome in a new system with a probe moving at an angle to sample all levels in the cane, by elimination of shields which prevent sampling of the bottom of the load, or by sampling after unloading. The old formula for calculation of the recoverable sugar also had faults and a simpler formula has been decided upon which, being independent of the factory efficiency, gives a better basis for cane evaluation.

The final paper of the day was one by Dr. G. Heraud on sucrose and nutritional pathology, in which he summarized work on the relationship between sucrose and dental caries, obesity, diabetes and heart disease. The day concluded with a reception given by M. Landouzy and his wife at the elegant and historic Préfecture in St.-Denis.

On the following morning the factory and field groups made separate visits, the former travelling to Rivière de l'Est where they saw a 250 million francs project which will bring 10 $m^3.sec^{-1}$ of water from a catchment area through a 4500 m double tunnel and a 3-stage pipeline with reducing diameter, to a power house at sea level where three turbogenerators will provide 22MW each. The concrete-lined tunnel is being built through rock, using a laser beam for directional control, and two metal buffer reservoirs (Fig. 1) are being erected at the base of the tunnel to feed the pipeline. Access is very difficult and slow and helicopters are used to carry equipment, spare parts, explosives, etc. to the site. A bridge on the approach to the site is inadequate for the traffic to be borne and a new one is under construction. Both are seen in Fig. 2.

Fig. 1

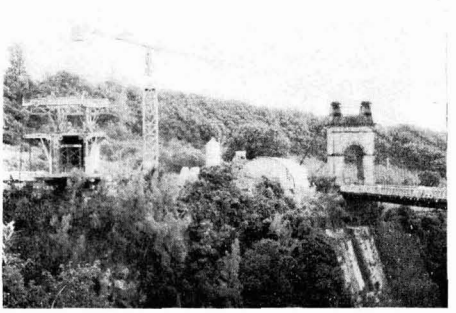


Fig. 2

After lunch, the factory group members were able to visit their choice of four sugar factories: Beaufonds, Quartier Français, Bois Rouge and La Mare. At Quartier Français stage efficiency in the milling train has been raised from about 35% to over 90% by use of a system

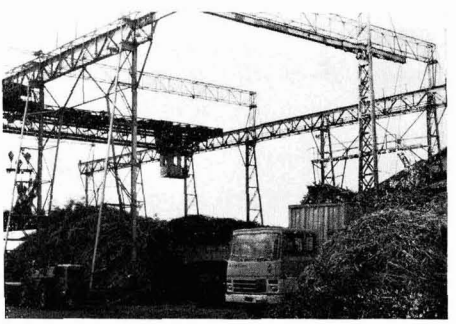


Fig. 3 Cane unloading station at Quartier Français

to achieve better mixing in which bagasse from the last but one mill is mixed with juice, pumped to a header connected to a condenser so that air is removed and better contact achieved between the extracting juice and the bagasse. The bagasse is then passed over a DSM screen to remove excess juice, with the aid of a low-pressure (2 bar) roller to help reduce the moisture content from 90% to the 70% maximum for feeding into the last mill. The juice is recycled at 70°C so that no fermentation takes place and bagasse pol is reduced from 2% to 1·2%. A mechanical fault had developed at the time of the visit so that the installation (Fig. 4) had had to be by-passed temporarily.

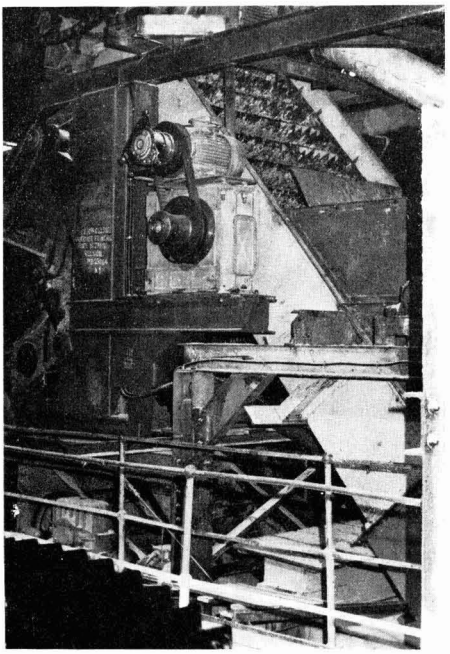


Fig. 4

Also at Quartier Français was a pan station which included the first continuous pan to be built commercially by Fives-Cail Babcock (Fig. 5). Close by were two batch pans (Fig. 6) which had been modified by installation of vertical panels with overflows to permit continuous passage of massecuite from the feed to the discharge, each sector having a conductivity control to govern syrup feed. The system operated successfully from the start and was used to persuade Fives-Cail Babcock to build the continuous pan on the same principle but in a more convenient form.

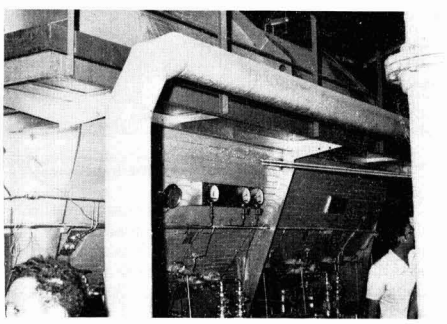


Fig. 5

Another feature unique to Quartier Français on the island is a phosphate clarification plant for production of a syrup which is boiled to white sugar for local consumption. A total of 8000 tonnes per annum is produced, part packed in 1 kg polyethylene bags for household use and part in 25 kg bags for industrial purposes. In Bois Rouge factory, delegates were able to inspect the clarifier which had been modified to give a much reduced retention time; this was to be the subject of a paper by the Technical Director of the factory, L. Lincoln, later in the Congress.

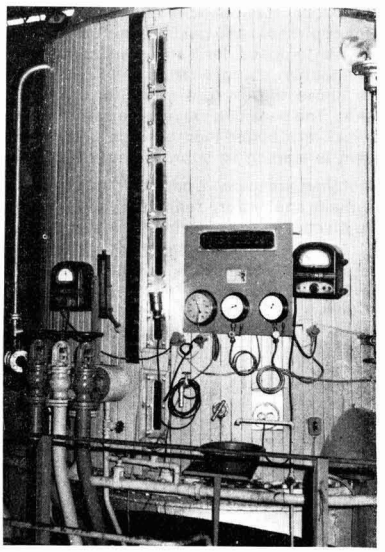


Fig. 6

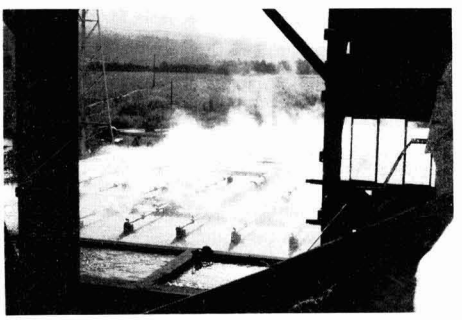


Fig. 7. Spray pond at Bois Rouge

The field group spent the morning on a visit to Convenance where they were able to inspect the workshops concerned with mechanical harvesting and agricultural reconstruction, while after lunch they visited the Rivière de l'Est hydro-electric project.

On the 18th October the factory group returned to the Conference room of the St.-François Hotel where J. d'Espaignet presented a paper describing a comparative study on the rates of deterioration of burnt and unburnt chopper-harvested cane, the former deteriorating faster as evidenced by an increase in the dextran content and in the glucose:sucrose ratio. L. Marchand then described the consequences of cane degradation for the sugar factory arising from the increased heterogeneity of the cane and so greater sampling error which imposes a penalty on the factory paying for the cane, this error

increasing with the delay between cutting and delivery of the cane, and being compounded by a platform loss, i.e. between receipt and milling, as a result of greater rate of deterioration of the older cane than the fresh cane.

J. P. Lamusse of the Sugar Milling Research Institute gave a paper on the effect of burning cane on the capacity and performance of a milling tandem. This was based on a trial at Tongaat where burnt and unburnt cane was milled separately and the cane and milling results compared. The trash content of burnt cane was 65% less than that of unburnt cane and the load in a Hilo trailer averaged 20·63 tonnes as against 18·90 tonnes for unburnt cane, indicating a potential saving in transport cost. Milling throughput was about 15% higher while extraction improved by 0·47 points when processing burnt cane.

J. Dupont de R. de St. Antoine, of the Mauritius Sugar Industry Research Institute, described a study on the effect of mechanical cane harvesting and loading on factory performance, particularly in respect of additional maintenance and repair costs. The study showed that the costs could be quite high even though only 17% of the total cane crushed was grab-loaded in 1977; costs are thus bound to increase unless appropriate measures are taken in both field and factory to remedy the situation.

The next paper, by P. N. P. Olsen, surveyed the latest progress in the area of automation, particularly the use of computers and the appearance of micro-processors, and their application in cane sugar factories, with the possibility of replacing a central control station with individual control by micro-processor of the various areas of the factory—milling, liming, evaporation, etc. The final paper of the morning was a description by A. Duval, Works Manager of Savanna sugar factory, of the recent developments in his factory which have permitted an increase in throughput from 110·9 to 119·3 t.c.h. while the reduced extraction has improved from 95·73 to 96·96% and recovery from 83·58 to 85·81%. Particular attention was given to cane preparation, milling, clarification, evaporation, and adoption of the "Talodura" process for syrup clarification.

After lunch delegates visited the rum bottling plant of G.I.E. (Fig. 8) and the terminal in St.-Denis from the silo of which a Russian ship was being loaded with sugar (Fig. 9). The final visit of the day was to the Savanna sugar factory (Fig. 10) of Sucreries de Bourbon where they were welcomed by MM. Hugot and Duval, and were able to inspect the equipment described in M. Duval's paper, including the "Talodura" syrup clarifier (Fig. 11).

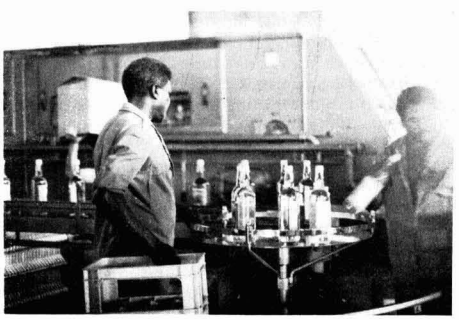


Fig. 8

Fig. 9

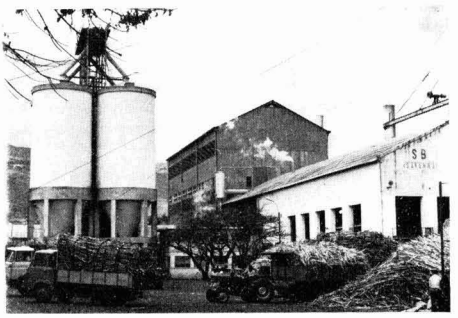


Fig. 10

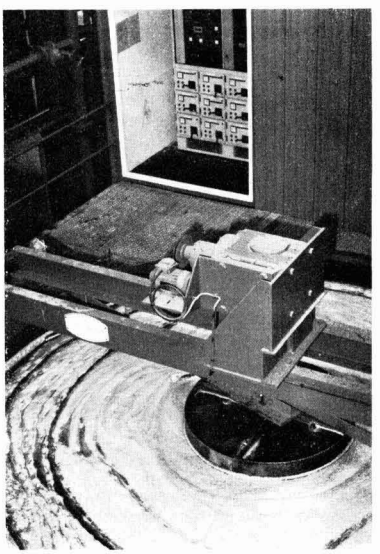


Fig. 11

The field group had, in the meantime, spent the morning visiting the cattle-breeding station at Menciol while, after lunch, they returned to the Conference room for a paper by P. K. Moberly on some nutritional problems of sugar cane grown in the highly-weathered soils of the Natal Midlands. Relations between the hydraulic properties, organic matter and amorphous substances in the soils on basaltic materials in a humid tropical climate were discussed by G. Loynet. After a paper by J. C. Legoupil on the water requirements of sugar cane, G. Dadant described trials on the cultivation of six varieties of asparagus at three locations in Réunion. The utilization of vinasse as a fertilizer was discussed by G. Auneau who also described the various methods of treatment to reduce the pollution load and to raise the pH of the vinasse before application as irrigation liquid.

The scale insect *Pulvinaria iceryi* in Mauritius was the subject of a paper by J. R. Williams; an unexpected infestation by this pest occurred in the 1976-77 harvest, affecting 4000-5000 ha and causing the loss of some 15,000-20,000 tonnes of sugar. The history and action of the pest was described as were measures adopted to minimize future attack, including destruction or processing of affected cane and elimination of the susceptible variety S 17. The final paper of the day was an account by P. Letorey of the achievements of the IRFA in Réunion.

On the following morning the field group went to Petite Plaine where they were welcomed by G. de Maupeau, Assistant to the Regional Director of the National Forestry Office, and then travelled in small parties to visit the reafforestation areas of Bebourg-Belouve, continuing after lunch to the reservoir of Herbes Blanches and the IRFA orchards at Bassin Martin.

The factory group spent the morning visiting the COGEDAL flour mill, and the SITA cigarette factory while after lunch they were able to visit the newest sugar factory in Réunion, viz. Le Gol, a 6000 t.c.d. plant (Figs. 12, 13) and an older and smaller plant, Grand Bois (Fig. 14). Both groups reassembled in the evening at a reception given in the Hotel Meridien by the Syndicat des Fabricants de Sucre de la Réunion.

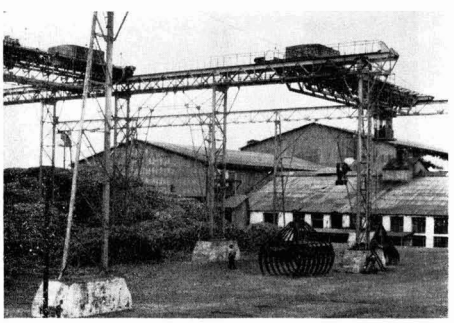


Fig. 12. Cane yard at Le Gol

On the last day of the Congress, the field group met in the Conference room of the Chamber of Agriculture where they heard papers by J. Gilibert on the problems of cattle-raising in Réunion, by M. Rouillard on the use of sugar cane by-products in feeding of cattle, by H. Saragoni on the combustibility of tobacco grown on the recent volcanic soils of the island, by Dr. E. Rochecouste on the biology of perennial weeds in relation to their control by chemical herbicides, by J. R. Terrasse on the "Handy", a new technique for application of Ciba-Geigy agrochemicals, and by R. Michellon on improvement of the vegetative multiplication of the geranium, grown as a commercial crop on the island. The final paper, by M. Bon, discussed the effects of spray irrigation on the agricultural economic development of the irrigated perimeter of Bras de la Plaine.

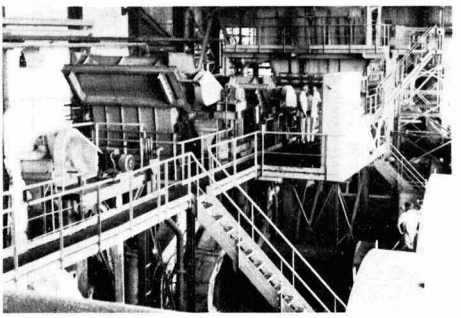


Fig. 13. Le Gol milling tandem

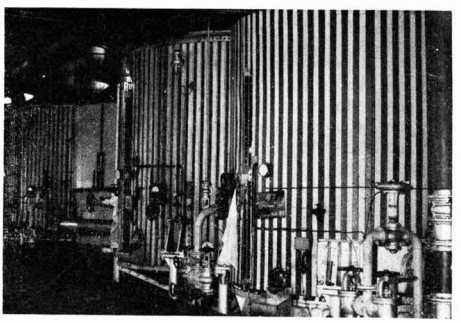


Fig. 14. Pan floor at Grand Bois

The factory group, at the St.-François Hotel, heard a paper by S. Marie-Jeanne on the separation and use of fly-ash in place of bagacillo for filtration of clarifier muds, thus solving a disposal problem and providing a convenient material for returning mineral nutrients to the fields. G. Journet, of Fives-Cail Babcock, discussed the development of the continuous centrifugal for treatment of high-grade massecuites, and L. Lincoln then described the modification of a standard Dorr-Oliver 3-tray clarifier in order to reduce the residence time and permit the throughput of juice from a greater tonnage of cane resulting from factory expansion. Y. Thirel then described work carried out at Honokaa sugar factory on his design of continuous belt filter for the separation of 1st and 2nd massecuites, the belt being in the form of a slow-speed stainless steel screen subjected to a vacuum and having zones where the separated crystals are washed with water and steamed. The separation of crystals of high quality is continuous, requires little power by comparison with a centrifugal, and is of flexible capacity.

J. P. Georget, of Fives-Cail Babcock, then described his company's patented feeder-roller design for their self-regulating mill which, because of the additional mobile roller, can handle cane or bagasse with a higher moisture content and permits a better extraction at higher throughput. Means of optimization of the work of the sugar house were discussed by R. Pouchayret, including variation of the boiling scheme and making full use of the resources in labour, investment and power available, by maximizing control and information, and training personnel.

The final paper of the morning was a description by J. C. Obert of the commercial instruments for on-line purity measurement in sugar factories, built by SERES, on the basis of the work of Ponant and Windal. After lunch the two groups came together for a discussion, led by E. Hugot and J. M. Paturau, on concentration of the sugar industry and the economics of scale in sugar production, with especial reference to the industries of Réunion and Mauritius. This produced a considerable amount of controversy on the relative merits of larger plants of high throughput and lower unit costs against the benefits for smaller plants of handling cane brought over shorter distance and thus fresher and of higher quality so that the economics of larger scale are compensated.

At the end of the discussion, M. Boyer de la Giroday closed the Congress with words of thanks to all who had taken part, to those officials of ARTAS whose organization had been so successful, to the members who had voluntarily acted as chauffeurs for the overseas visitors, and to these visitors for coming to Réunion to take part in the Congress. R. Baissac, leader of the Mauritian delegation, spoke on behalf of the visitors and thanked M. Boyer de la Giroday and the other members of ARTAS for their welcome and hospitality; he then presented a gift on behalf of the Mauritius sugar technologists to M. Hugot in token of appreciation of his work during the past 50 years.

The members then returned to the hotels in order to prepare for the final occasion of the Congress, a magnificent open-air banquet at Les Camellias, offered by the President of Credit Agricole in Réunion and Mme. Isautier.

Cane sugar refining research

AT the 1978 Technical Session on Cane Sugar Refining Research in Washington, DC, USA, on 17th to 19th September, some eighty leaders of the world's refining industry met to discuss recent advances in cane sugar technology. This Technical Session is held every two years by the Cane Sugar Refining Research Project Inc. (CSRRP) and the Southern Regional Research Centre of the US Department of Agriculture.

The sponsors of the Project include the major cane sugar refining companies of the world. The work is conducted at the Southern Regional Research Centre under the leadership of Dr. Margaret A. Clarke and Dr. Frank G. Carpenter.

In the outstanding technical paper of the Session, Mary An Godshall of CSRRP described a new method for identification of volatiles and characteristic flavour compounds in cane sugars and molasses. This technique, using a special external inlet with gas chromatography and mass spectrometry, can be used to identify both desirable and off-flavours.

Among papers on decolorization, that of Dr. J. Colin Abram of British Charcoals and Macdonalds Ltd. on the effects of various chemical treatments on the carbon and hydroxyapatite surfaces of bone charcoal aroused much interest and discussion. Dr. B. H. Kornegay of Westvaco Corp. described the design and operation of a fluid-bed unit for the thermal regeneration of granular carbon. Earl J. Roberts of CSRRP talked about the nature of some high-molecular weight sugar colorants and showed that some common colorants are linked to high-molecular weight compounds in the sugar cane plant. He also showed how similar structures in some large molecules affect acid beverage floc formation. A paper from Dr. Peter Smith of CSR Research Laboratories, presented by Dr. F. G. Carpenter, described a new procedure using ion exchange resins to isolate some of these colorants, and identified a tricin glucoside as a colorant coming from the sugar cane. Dr. R. W. Walker of Rohm and Haas Company revealed the laboratory techniques used to evaluate ion exchange resins for use in the sugar industry.

There was a group of papers on sucrose destruction and loss. Pamela Morel du Boil of Huletts Sugar Ltd. discussed a new method using gas-liquid chromatography to observe the fructose:glucose ratio in the boiling of raw sugar, and in molasses, where there is a seasonal variation in the ratio. By an elegant technique using chloride as a base for calculation, she showed that reducing substances other than glucose and fructose were formed during boiling.

Dr. Margaret A. Clarke of CSRRP described a study of sugar losses through decomposition in refinery processes, part of a continuing study by the Project on sugar loss, in which high-pressure liquid chromatography (HPLC) was used for analysis of sucrose and reducing sugars. Mary Ann Brannan of CSRRP talked about analyses of sugars in molasses using HPLC, and explained how variation in samples related these results to those of the usual methods. She advocated the HPLC method as a rapid and reliable analysis for sugars in molasses. Emory E. Coll, of the Southern Regional Research Centre, talked about sugar losses to dextran, particularly in cane field and factory, and described a satisfactory method for dextran analysis. He related levels of dextran and total polysaccharides throughout some processing steps to field conditions and mill performance.

From the ultimate analytical point of view, Dr. Arthur L. Cummings of the National Bureau of Standards described the ultraprecise polarimeter he had constructed for the redetermination of the 100°S point of sucrose. He demonstrated a laser light source and pointed out its many advantages over the conventional mercury lamp.

In a talk of great general interest, Edward S. Lipinsky of Battelle Institute showed the possibilities of sugar cane for fuel use and the state of the art for fuels pro-

SUGAR CANE AGRONOMY

Foliar diagnosis of copper, iron, manganese and zinc in 16 varieties of sugar cane (*Saccharum* spp.) cultivated in different large groups of soils. J. Orlando and E. Zambello. *Brasil Açuc.*, 1977, **90,** 244-253 (*Portuguese*).—A randomized block design was used for trials, with four replications, in which 16 varieties were grown on four soil types over a plant and one ratoon crop and examined to find the effects on the Cu, Fe, Mn and Zn content of the cane leaves. The results showed that the levels of the elements studied were within normal limits, that both soil type and variety affected the foliar contents of all but Cu, and that there was a significant decrease in Fe and Mn from plant cane to ratoon crop.

Effect of different ripening agents on quality of sugar cane juice. R. A. Sharma, R. K. Sharma and S. R. Sharma. *Indian Sugar Crops J.*, 1977, **4,** 35-36.—Three varieties of cane were treated with ripeners in an experiment in which all three benefited in terms of Brix, sucrose, purity and recovery increase as a result of treatment. The different ripeners ("Hyamine 1662", "Cetrimide" chloride and "Polaris") varied in their effects according to variety and rate of application, but all three were found to be better than other ripeners.

Effect of inter-cultivation (by bullock pairs) on the growth and yield of sugar cane ratoon in black soils. J. D. Chougule and K. D. Patil. *Indian Sugar Crops J.*, 1977, **4,** 45-46.—Inter-row cultivation in ratoon cane was found to increase yield by comparison with no inter-cultivation on a heavy black soil.

Optimum dose of N-P-K fertilizer for ratooning of sugar cane on deep black soils of Maharashtra. J. D. Chougule. *Indian Sugar Crops J.*, 1977, **4,** 49. Increase from 150 to 300 kg.ha^{-1} in the rate of N application to ratoons on deep black soil caused increase in yield, while further increase to 450 kg.ha^{-1} had little further effect. P and K at 100 kg.ha^{-1} had only negligible effect on yield.

Forward planning will produce more ratoons. T. G. Willcox. *Cane Growers' Quarterly Bull.*, 1977, **41,** 29-30. Since the cost of cane planting in Queensland is three times that of ratooning, the net return from ratoon crops is greater. Forward planning permits more ratoon crops to be grown successfully, and blocks of 2nd and 3rd ratoons do not need to be ploughed-out for fear of grub damage or loss from disease; wet spots can be removed from blocks without the need for elimination of the complete block. How to achieve satisfactory forward planning is considered under: disease control (the basis of which, it is stressed, is good planting material and good farm hygiene); drainage (which, if not adequate, will reduce soil aeration and hinder growth, increase chlorotic streak infection and increase damage caused by wet weather harvesting in low areas); grub control with BHC; varietal selection; and irrigation, whereby greater use is made of existing water supplies in drier areas.

Trash incorporation following green cane harvesting. C. M. McAleese. *Cane Growers' Quarterly Bull.*, 1977, **41,** 36-37.—The method used by a Queensland farmer to incorporate cane trash and tops into the soil is described with the aid of illustrations. The effect of incorporation on crop yield and soil structure has not yet been determined.

Copper—one of the seven (micro-nutrients). E. A. Pembroke. *Cane Growers' Quarterly Bull.*, 1977, **41,** 38-39.—The author discusses copper deficiency in marginal soils of sandy texture, generally found in coastal areas of Queensland (more of which are coming under cane). The deficiency often shows itself in the first cane crop and can be induced by broadcast application of superphosphate at the rate recommended by the Bureau of Sugar Experiment Stations. Calcium silicate and lime have caused marked increases in cane yields up to 3rd ratoon crops when applied before planting, but such increases remove greater amounts of micro-nutrients; release of copper from the soil is slow, and the sudden demand by the crop could be beyond the capacity of the soil to supply it. Heavy fertilization of cane land to give maximum yields on marginal soil may also induce the same effect; the result of the copper deficiency may be a disappointing crop yield despite good growth conditions and adequate N-P-K supply. Copper sulphate application will remedy the situation. Droopy top, a copper-deficiency disorder in cane, is briefly described.

CANE SUGAR REFINING RESEARCH—

(*Continued from previous page*)

duced by fermentation. He presented some of the production factors involved in considering sugar cane as a fuel crop, with all carbohydrates fermentable, rather than as a food crop.

From another viewpoint on the energy field, Dr. Frank G. Carpenter of the Southern Regional Research Centre showed the minimum theoretical energy requirements of a sugar refinery, pointing out that evaporation of water is the big energy consumer, and compared this minimum possible energy with that actually consumed by refineries in various countries.

Dr. C. C. Chou of Amstar Corporation described new types of microcrystalline sugars, made by processes similar to those used to make the amorphous or transformed sugars of so much current interest. He explained how various parameters were adjusted to make tabletting, fondant, or free-flow sugars.

Dr. Norman James of the USDA in a luncheon speech told delegates about the Department's research programmes in sugar crops and in sugar production.

While the delegates absorbed these technical papers, participants in the Ladies Programme enjoyed visits to Washington's museums and galleries and historical attractions. Everyone gathered at a Banquet on 18th September, to witness the presentation of the traditional CSRRP President's gavel, carved in the shape of a sugar crystal, by President Joseph A. Metzler of Godchaux-Henderson Sugars to incoming President Michael C. Bennett, of Tate and Lyle Ltd.

Factors affecting c.c.s. at harvest. C. R. Nalder. *Cane Growers' Quarterly Bull.*, 1977, **41**, 42.—To ensure as high a c.c.s. as possible, it is necessary to reduce the amount of extraneous matter accompanying the cane to the factory (among other things, by correctly topping at the last fully developed internode), to produce high-quality cane billets (short or damaged ones deteriorating much faster than those of good quality), to shorten the interval between cane burning on the one hand and harvesting and crushing on the other, to harvest cane of a given variety when it is commercially ripe, to provide adequate fertilization but avoid excessive N application, and to avoid harvesting cane having heavy yellow spot infection until the colour of the leaves returns to normal.

Farm waterways in the Isis area. C. D. Jones and P. Rudd. *Cane Growers' Quarterly Bull.*, 1977, **41**, 43-46. Advice is given on construction of waterways on cane farms and their stabilization by means of grass cover, for which couch grass is the most commonly used species, although other types of grasses are discussed Prevention of encroachment of grasses into cane blocks from the waterways is also considered, and hints are given on maintenance and repair of waterways.

High water tables mean lower yields. A. V. Rudd. *Cane Growers' Quarterly Bull.*, 1977 **41**, 47-48.—A trial was carried out to assess the effect of poor drainage on crop losses, using the variety "Triton" which performs best under such conditions. Where the land was adequately drained the average yield was 64·8 tonnes.ha^{-1}; where drainage was inadequate, yield was 34·3 tonnes. ha^{-1}. Linearity was established between yield and the number of days the water table was less than 0·5 m below the soil surface; this indicated an approximate drop in yield of 0·5 tonnes.ha^{-1} for every day ground water was located in the top 0·5 m of soil.

Power requirements for pumps in drainage systems. C. Henkel. *Cane Growers' Quarterly Bull.*, 1977, **41**, 48-49.—A simple formula is given for calculating the power requirements of a drainage pump for a given volume of water at a known static head.

Contour farming—a farmer's experience. J. D. Veurman. *Cane Growers' Quarterly Bull.*, 1977, **41**, 53. Reference is made to the experience of a Queensland cane farmer in contour farming on sloping land. Advantages include more even water distribution, more uniform crops and particularly control of soil erosion. In four years, 60 ha of land were brought under the system.

Minimizing the cost of cane production. M. L. Agarwal. *Sugar News* (India), 1977, **9**, (6/7), 28.—Ways in which cane production costs can be minimized and profitability maximized are briefly discussed.

Incidence of topping of sugar cane on its economic value as raw material. C. Hoffmann. *Rev. Ind. Agric. Tucumán*, 1978, **53**, (1), 1-16 (*Spanish*).—The inclusion of immature parts of the stalk with the milled cane is shown to reduce its value because of the additional lower purity juice introduced, and the effects are expressed mathematically and formulae derived for the industrial value. The system of payment in Argentina does not provide any penalty for the presence of immature cane, however, and some is supplied virtually untopped.

Kinetic differentiation of the acid phosphatases in sugar cane stalks. A. R. Sampietro, J. L. Etcheberrigaray, E. Quiroga and E. Arias de F. *Rev. Ind. Agric. Tucumán*, 1978, **53**, (1), 17-23 (*Spanish*).—Examination of enzymes extracted from sugar cane stalks demonstrated that, when added to various substrates, the crude extract revealed the presence of 1-β-glycerophosphatase activity as well as *p*-nitrophenylphosphatase activity. β-glycerophosphate and glucose-6-phosphate are non-competitive inhibitors of *p*-nitrophenylphosphatase activity and this property has been postulated as being due to the fact that they are analogues of the inorganic phosphate which is a reaction product and has been shown to be an inhibitor. The specificity of the cane enzyme having *p*-nitrophenylphosphatase activity is unknown and the general name arylphosphatase is suggested for it.

Effect of preplanting treatment with growth promoters and fungicide on growth and mineral metabolism of sugar cane variety Co 740. J. D. Nimbalkar and G. R. Naik. *Maharashtra Sugar*, 1977, **3**, (1), 119-124. While the positive effect of growth promoters, with which setts were treated before planting, on cane height was enhanced by combination with "Aretan", a mercuric fungicide; the fungicide on its own had greater effect than any of the five promoters with or without "Aretan". There were no significant differences between the treatments in terms of leaf P, K, Ca, Mg and Si content.

Soil test summaries and interpretation of the results of soil testing. K. V. Joshi. *Maharashtra Sugar*, 1977, **3**, (1), 139-154.—The importance of soil testing is indicated and the physical properties of six textures of soil shown. The significance of texture is discussed, particularly with regard to tilth (determined also by soil structure) and N leaching in sandy soils of poor tilth. Also discussed are the lime status of soil, its pH, the total soluble salts, organic C and available P and K contents and rating of soil samples. The interpretation of soil tests is demonstrated by means of a number of examples showing the recommended fertilizer dosage rates in each case. The author gives a number of recommendations relating to an overall soil testing scheme in Maharashtra and summarizes results of soil tests for the period 1967-68 to 1976-77.

Studies on the decline in sugar cane productivity in irrigated areas of Krishna River. G. R. Naik, G. V. Joshi and J. D. Nimbalkar. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 11-Ag. 18.—Soil and cane leaf analyses were carried out at various sites along the Krishna River in Maharashtra, Karnataka and Andhra Pradesh with the aim of determining reasons for cane yield decline. Results indicated soil pH values which, with one exception, were above 7 and many above 8, while the organic matter content was low. Cane suffered from iron deficiency and stunted growth. A marked increase in soil salinity (particularly sulphate salinity in Maharashtra and Karnataka) was blamed for these two disorders, although other reasons are also given, including poor soil aeration and, in the case of stunted growth, low soil and cane P content, poor drainage and increased N application.

CANE PESTS AND DISEASES

In vitro **effect of heteropolyanions on some plant viruses.** V. K. Srivastava, A. M. Tripathi, K. Shukla and N. Agrawal. *Sugarcane Pathologists' Newsletter,* 1977, (19), 10-11.—The effects of four high-molecular inorganic mineral heteropolyanions on cane mosaic with which sorghum was inoculated were investigated. Results showed that tungstosilicic acid had maximum inhibitory effect (90% after 7 days' incubation), followed by phosphotungstic acid (80%) and then arsenomolybdic acid (70%) at dilutions of 1000 μg of a stock 1 mg.cm^{-3} solution mixed with 1 cm^3 of virus extract. Arsenovanadotungstic acid had no inhibitory effect.

A new race of culmicolous smut of sugar cane in Hawaii. J. C. Comstock and D. J. Heinz. *Sugarcane Pathologists' Newsletter,* 1977, (19), 24-25.—The smut pathogen, *U. scitaminea,* was first detected in Hawaii in 1971, and up to 1976 only one race of the pathogen had been observed. In 1976, however, more than 25% of cane in a field was found to be infected, despite the fact that the variety, H 50-7209, was resistant to smut. The pathogenicity of smut from two different spore sources was compared, for which a number of cane clones were inoculated by dipping setts for 10 min in an aqueous suspension of spores collected from the infected H 50-7209 cane and a duplicate set of clones similarly inoculated with spores collected from variety H 49-3533 in an isolated area. From the results, the presence of two distinct races (*A* and *B*) of smut was clearly indicated. Some varieties were resistant to one race and susceptible to the other, while others were either resistant or susceptible to both. Tests on another 753 clones with a known reaction to race *A* were inoculated with spores of race *B*; again, the data indicated the existence of two distinct races of smut in Hawaii—race *A* is found on the islands of Oahu, Kauai and Maui, while race *B* is found only on Oahu, but no smut has been found on the island of Hawaii.

Resistance of sugar cane clones and varieties to frost—study of some progenies. R. Cesnik, A. I. Bassinello and F. F. S. Oliveira. *Brasil Açuc.,* 1977, **90,** 292-298 (*Portuguese*).—About 20,000 seedlings from 27 different polycrosses were kept for 3 hours in a freezer at between —4° and —9°C and their resistance to low temperature noted. Clones of the seedlings, both subjected to freezing and not, as well as commercial sugar cane varieties were planted in the field and watched for development of chlorotic leaf spots which are a symptom of cold susceptibility. The results showed that progenies of polycrosses involving the varieties L 62-96, CP 47-49 and Co 678 showed high resistance to cold treatment. No chlorotic spots were shown by the varieties F 141 or US 59-16-1 but their descendants showed high susceptibility and moderate resistance, respectively.

Incidence of *Sclerotium rolfsii* **Sacc. in buds isolated from heat-treated sugar cane.** S. Matsuoka and M. M. Aguillera. *Brasil Açuc.,* 1977, **90,** 301-302 (*Portuguese*). *S. rolfsii* has been identified as the agent causing poor bud germination in cane treated at 51°C for 2 hours. The fungus is the causal organism of red rot of leaf sheath. Control may be achieved by 10 minutes' immersion of the sett in solutions of the fungicides methoxyethyl mercury and "Carboxin" at commercially recommended dosages, while an isolate of *Trichoderma* sp., obtained from the soil, has shown antagonism to the fungus which it is hoped to develop for control under natural conditions.

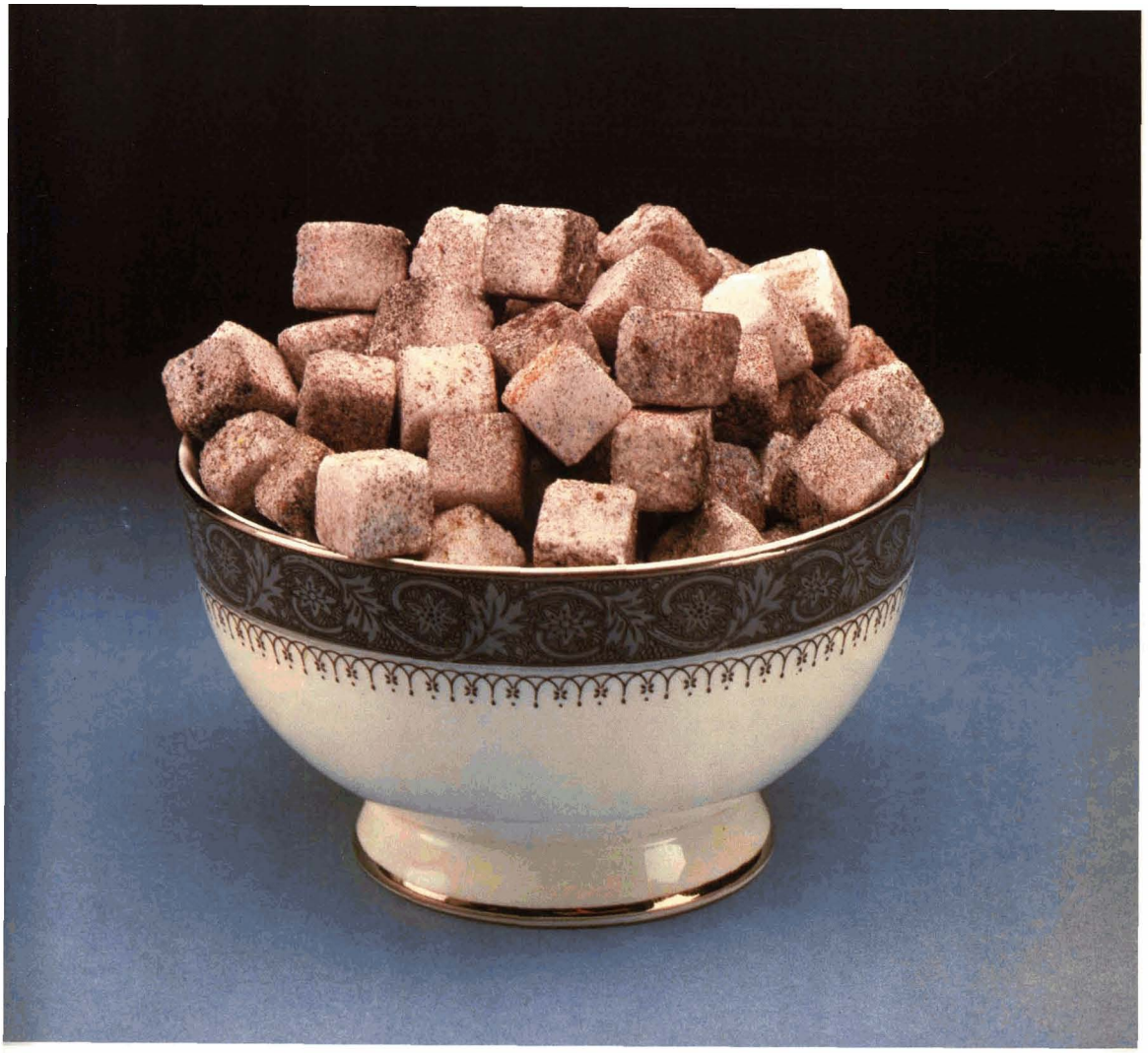
Experiences with sugar cane smut in the Caribbean. V. M. Young-Kong. *Sugar J.,* 1977, **40,** (5), 25.—Experience in tackling the problems brought about by the occurrence of cane smut in Guyana is recounted.

Need to undertake aerial spraying to control *Pyrilla* **on sugar cane.** S. K. Sharma. *Sugar News* (India), 1977, **9,** (6/7), 9-15.—Aerial spraying was carried out with a number of pesticides to control the leafhopper *Pyrilla perpusilla.* The most effective treatment was "Quinalphos" at 1·25 litres.ha^{-1}, which gave a maximum mortality of 88·5% of adults and 87·6% of nymphs 7 days after application. Aerial spraying is recommended where it will give more than 80% mortality.

Soil application of insecticides for the control of the early shoot borer and white grub in sugar cane. A. S. Patil, P. R. Moholkar and B. S. Shewale. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 61-Ag. 65.—Seven different treatments were tested for their efficiency in controlling the title pests. While all gave higher cane yields than did absence of treatment, the most effective was "Quinalphos 5 G" at 5 kg a.i. per ha, which gave 101·66 tonnes.ha^{-1} in contrast to only 42·03 tonnes.ha^{-1} for the control.

White grub (*Holotrichia serrata* **F.)—a pest of sugar cane in Maharashtra state.** P. R. Moholkar, A. S. Patil, B. S. Shewale and D. G. Hapase. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 67-Ag. 77.—Investigations showed that a cane plant completely withered within one month of release on it of two larvae of *H. serrata,* while even just one larva caused withering within three months. A number of treatments were tested against the pest. All reduced the number of grubs and extent of damage caused while increasing yield by comparison with untreated controls.

Assessment of losses caused by the internode borer of sugar cane in Maharashtra state. P. R. Moholkar, A. S. Patil, B. S. Shewale and D. G. Hapase. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.,* 1977, Ag. 79-Ag. 92.—It is stated that internode borers (*Chilo infuscatellus, C. partellus* and *Sesamia inferens*) are serious cane pests in Maharashtra, although they have failed to attract sufficient attention because the damage they cause is not visible on the outside of the cane (the newly hatched larvae entering the cane one week after feeding on the leaf sheath) and because cane is paid for on a weight basis. Reductions in quality and yield of cane caused by the pest have been determined for a number of varieties, and values are tabulated.



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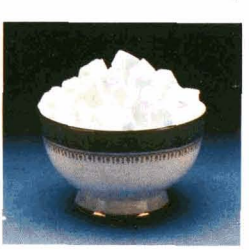

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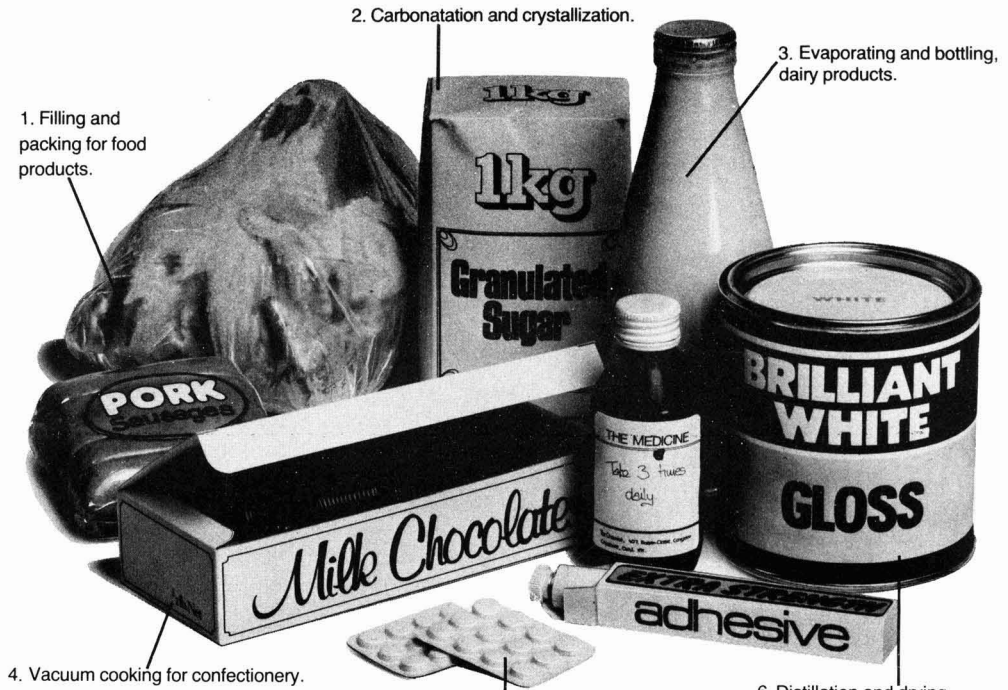

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SUGAR BEET AGRONOMY

Organization of harvesting and transportation of sugar beet. Z. Stanescu and N. Bria. *Prod. Veg., Cereale si Plante Tehn.*, 1977, **29,** (9), 24-29 (*Rumanian*).—While mechanical harvesting of beet offers many advantages, it is pointed out that there are many potential risks to the crop if proper attention is not paid to essential factors in the growing season as well as during the actual harvesting. Particular attention is drawn to the question of correct topping height and the level of losses that could result from non-optimum topping. Mention is made of harvesting equipment available in Rumania. Beet transport is also discussed; it is pointed out that it is better for the beets to be conveyed straight to the factory rather than to intermediate points for storage in clamps. A table is given showing the number of hauls ages to be made according to distance and beet yield per ha where specific harvesters are used.

Towards a higher yield of sugar beet with a better processing quality. P. S. Bhatnagar and G. B. Pant. *Indian Sugar Crops J.*, 1977, **4,** 40-43.—Advice is given on how to achieve a high yield of beet of good processing quality under Indian conditions. The article covers variety, climate and agronomic practices, and includes recommendations on treatment for control of *Sclerotium* root rot and *Cercospora* leaf spot.

Improved methods for sugar beet cultivation. D. S. Oberoi and H. G. Singh. *Indian Sugar,* 1977, **27,** 207-211. Recommendations are given on agronomic practices for optimum beet yield. The advice is based on results obtained in the Sri Ganganagar district of Rajasthan, where beet cultivation started on a trial basis in 1968.

Effect of nitrogen fertilization on yield and quality of winter beet with varying water supply in Khuzistan (southern Iran). A Kaschani and H. Farazdaghi. *Zuckerind.*, 1978, **103,** 46-51 (*German*).—In 2-year trials, five different N dosage rates were tested (60, 120, 180, 240 and 300 kg.ha^{-1}) under three irrigation regimes and at three harvest times. As usual, beet and leaf yield rose with increase in N application while sugar content fell. At 300 kg N per ha, the beet K content was 50% greater and the Na content 300% greater than at the minimum dosage rate. Optimum N dosage rate with respect to sugar yield was 120 kg.ha^{-1} at an irrigation water rate about one-third of that normally used in the area, while late harvesting in June was better than in April or May.

Economic study on sugar beet growing in Iran. M. Baghestani. *Agron. Trop.*, 1977, **32,** 427-428 (*French*). After very rapid development of beet agriculture in Iran over a number of years, the pace has been slowed by the increase in pay and scarcity of labour in the villages, while other factors have also contributed to a crisis in the beet sector, including technical problems in agriculture, problems associated with soils and fertilization and disregard for rotation, failure to develop mechanization, the high cost of beet plus that of irrigation, and competition from cane in the south of the country. The author sets out the costs of growing sugar beet, and concludes that beet agriculture will become viable only if the yield per ha and the price paid by the sugar producers for the beet are increased. It is stated that the Iranian Government has decided to raise the beet price substantially to a level just above that which the author considers the threshold at which beet agriculture would become viable without increase in yield per ha.

Which agronomic measures affect the costs of beet cultivation? W. C. von Kessel. *Die Zuckerrübe,* 1978, **27,** (1), 8-12 (*German*).—It is stated that in West Germany the costs of beet cultivation can vary by as much as 300% between farms and even between individual fields on one farm. The author examines various factors which can affect these costs, including the type of pre-crop, type of organic manure or green fodder (where this is used), sowing data, row spacing, type of seed (mono- or multi-germ), seed spacing and herbicide costs.

Tests on limestone weathering soils with sodium- and magnesium-containing fertilizers for sugar beet. W. C. von Kessel. *Die Zuckerrübe,* 1978, **27,** (1), 18-19 (*German*).—Some of the beet-growing regions of West Germany contain soils which are the result of lime or chalk weathering. Mixed with loess, such soils give very high yields in years of adequate rainfall, but in dry years they give unsatisfactory crops because of their poor moisture capacity. Investigations have shown that they are usually deficient in Mg and have only little Na. Tests were conducted in 1975-77 to determine the effect of Na and Mg applications on the beet crop. On marl, application of 0·4 tonnes of kainite per ha in addition to the normal N fertilization as calcium nitrate and a supplementary application of K_2O:MgO:Na_2O (48:24:96 kg.ha^{-1}) increased beet yield by about 12% compared with the results when only N was applied. The sugar content was only slightly affected but the overall effect was a marked increase in sugar yield. While this was the best result, addition of Na and/or Mg in other forms and dosage rates also had a positive effect, whereas on degraded loess none of the treatments significantly affected crop yields, and in most cases the sugar yield was lower than without supplementary fertilization.

Post-emergence spraying against grass weeds in sugar beet. D. Kirsten. *Die Zuckerrübe,* 1978, **27,** (1), 21 (*German*).—An outline is given of the properties of "Fervin" (a product of the Nippon Soda Co.), which is effective against a number of grasses including wild oats, witch grass, barnyard grass and black grass when used on its own or in combination with "Betanal". It is tolerated by sugar beet as well as many other crop plants, and breaks down relatively quickly in the soil, with a half-life of 20-40 days according to soil type and organic content.

Herbicide application at Wierthe in 1977. G. Ebers and R. Wüstemann. *Die Zuckerrübe,* 1978, **27,** (1), 22-23 (*German*).—Results are summarized of small- and large-scale herbicide tests, showing the effects on weeds and grasses (as indicated by a grading system) as well as treatment costs per ha.

Phytotoxicity to beet of a soil-incorporated "Pyrazon"-"Diallate" mixture in relation to the structure of the seedbed. E. Dalleinne. *Hautes Etudes Betterav. Agric.*, 1978, **10**, (39), 29-31 (*French*).—Marked phytotoxicity was found where a "Pyramin"-"Avadex" herbicide mixture was used in loam soils, although the "Pyramin" doses were not excessive at 2·5 and 3·5 kg.ha^{-1}. While the problem occurred where liquid manure was applied, a close relationship was found between the phytotoxicity and soil structure, particularly after passage of tractors. The role of the ruts left by the wheels is discounted, but two soil conditions are suggested as causes of the problem: a very fine tilth created by earlier breakdown of the soil, and the presence of very hard and thick clods. In the former case, absorption of the herbicide by the roots is promoted, while in the latter case the herbicide solution cannot descend through the soil but stays at a higher concentration in the upper layers at the level of the young roots.

Weed control in sugar beet. J. M. Belien and J. F. Salembier. *Le Betteravier*, 1978, **12**, (117), 12B-12C (*French*).—Recommendations are given on choice of pre- and post-emergence herbicides and their application rates, according to whether drilling is carried out before or after mid-April. Factors to be considered in selection of a herbicide system are listed.

Cut beet nitrogen for bigger profits. G. Hanslip. *The Furrow*, 1978, (Jan./Feb.), 16-17.—Reference is made to the call from the British Sugar Corporation for a reduction in the amount of N applied to beet supplied to UK factories. It is stated that nearly £2 million is wasted annually in the form of excessive N fertilization (which should be optimum at 125 kg.ha^{-1}). However, there has been a gradual fall in the dosage rate in recent years, but the amount used is still far too great. Of the £2 million mentioned, about £1$\frac{1}{4}$ is forfeited because of the payment system which favours higher sugar contents. The disadvantages of excessive N in beet with respect to processing and losses in the factory are also mentioned.

Feasibility of growing a monsoon crop of sugar beet in Nira Valley. A. D. Karve, O. P. Singh, A. R. Ghanekar and A. C. Bhalerao. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 35-Ag. 38.—While September/October was found to be the optimum beet drilling time in trials conducted in the Nira Valley of Maharashtra, it is also the time of heavy rain, so that it has generally been impossible to sow before the end of October; as a result, yields have fallen below the theoretical maximum. Subsequent trials at various locations in the Nira Valley showed that the yield of beet sown in July and harvested the following January was comparable to that of the October-planted crop. However, the earlier-planted crop requires 180 days to mature compared with 165 days for the autumn-planted beet, while the July-planted crop is more susceptible to leaf spot diseases occurring during the September/October rains and hence needs treatment with fungicides. Both crops responded similarly to N fertilization, although there were seasonal differences between the yields of specific varieties and in response to fungicidal treatment.

Use of "Nitrofen" for controlling weeds in sugar beet. A. C. Bhalerao, O.P. Singh, A. R. Ghanekar and A. D. Karve. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 103-Ag. 106.—See *I.S.J.*, 1978, **80**, 243.

Studies on the effect of gibberellic acid with reference to genotypic specificity in respect of flowering and economic characters in sugar beet (*Beta vulgaris* L.). P. S. Bhatnagar and B. Raj. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 125-Ag. 132.—Trials were carried out in a randomized block design with five replications and ninety treatments in which gibberellic acid (GA) of three concentrations was applied to three varieties (of low, medium and high bolting resistance) in one, two or three doses 81, 111, 126 or 141 days after drilling. Root yield and sucrose content were recorded. Data indicated a favourable effect of treatment on both parameters in some cases, but further investigations are thought necessary. In no case did treatment induce flowering, although, coupled with thermal induction, the acid may possibly have a positive effect.

Use of maleic hydrazide in increasing the sucrose content of sugar beet. O. P. Singh, A. C. Bhalerao and A. R. Ghanekar. *Proc. 6th Joint Conv. Indian Sugar Tech. Assocs.*, 1977, Ag. 153-Ag. 156.—See *I.S.J.*, 1978, **80**, 340.

Effects of water table depth and irrigation on sugar beet yield and quality. G. A. Reichman, E. J. Doering, L. C. Benz and R. F. Follett. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19**, 275-287.—In 1971 and 1972 trials were conducted in North Dakota to establish the effect of irrigation and water table depth on beet and sugar yields. Three water table depths were studied in each year, *viz.* a shallow water table at 43 and 34 inches below the soil surface, a medium one at 69 and 64 inches, and a deep one at 83 and 79 inches. Irrigation was applied at 0, 0·5, 1·0 and 1·5 times the calculated evapotranspiration. Results showed that in the case of the shallow water table, irrigation did not affect yields which were always higher than with the other two depths, while yields with both medium and deep water tables rose appreciably with the amount of irrigation water applied.

Effect of harvest date on performance of sugar beet hybrids. R. K. Oldemeyer, A. W. Erichsen and A. Suzuki. *J. Amer. Soc. Sugar Beet Tech.*, 1977, **19**, 294-305. Five varietal × harvest date trials are reported, results of which are tabulated in the form of beet and sugar yield, sugar content and thin juice purity. It was found that delaying harvesting by one month from mid-September to mid-October increased all four parameters and generally had a greater effect than did variety, although significant variety × date interactions did occur in some trials in regard to all the parameters except juice purity. In many cases, the sugar content of the variety having the highest content on the earlier harvesting date was lower than that of the variety having the lowest content on the later date; this also applied to sugar yield. Delay in harvest from mid-October to mid-November caused no increase in sugar yield, a rise in beet yield being accompanied by a reduction in sugar content because of considerable rainfall and the onset of severe frost.

BEET PESTS AND DISEASES

A new sugar beet pest in Rumania: the root aphid (*Pemphigus fuscicornis* Koch). V. Ciochia, Z. Stanescu and T. Tarabuta. *Prod. Veg., Cereale si Plante Tehn.*, 1977, **29,** (11), 27-29 (*Rumanian*).—*P. fuscicornis* was first detected in two districts of Rumania in 1975, although the pest has been recorded in other East European countries. The major symptom of attack is loss of turgescence, although if the attack is not severe the beet may recover. In most cases investigated, the infested plant showed a marked drop in sugar content by comparison with unaffected beets. The pest attacks only the root system. Details are given of the aphid's biology. Control depends on proper attention to agronomic practices, including destruction of host weeds (particularly *Chenopodium* spp.), fertilization, irrigation and rotation (with avoidance of beet growing two years running in the same field).

Economical prerequisites for soil disinfection to prevent damage from beet cyst nematodes (*Heterodera schachtii*). Anon. *Die Zuckerrübe,* 1977, **26,** (6), 14-15 (*German*).—The various chemicals available for control of *H. schachtii* are surveyed and their advantages and disadvantages indicated. The economics of treatment and non-treatment are compared for 3-, 4- and 8-year rotations under West German conditions.

Prerequisite for identification of beet nematodes. -. Bötger. *Die Zuckerrübe,* 1977, **26,** (6), 20-21 (*German*). It is stressed that, in contrast to other beet pests, the nematode *Heterodera schachtii* is already beyond control once it is visible, and that a check must be made to see how many cysts are present in the soil before sowing or establishment of a rotation plan. Guidance is given on soil sampling for cyst counting, and a table is given showing a classification system from 0 to 5 (corresponding to between nil and more than 41 cysts per 100 cm^3 of soil), possible damage to the crop and recommended measures.

The Beet Cyst Nematode Order, 1977. R. A. Dunning and T. P. J. Dyke. *British Sugar Beet Rev.*, 1977, **45,** (4), 13-14.—The Beet Cyst Nematode Order of the UK Ministry of Agriculture, Fisheries and Food came into effect on 7th July, 1977, and provides reserve powers to control the pest (most probably by controlling crop rotation) should infestation rise to such an extent that statutory control is necessary. The authors briefly examine the development of beet growing in the UK from about 1925, and show how little regard to crop rotation led to marked infestation by the nematode until by 1941 it was widely scattered throughout the country, but most abundant in the Fenland of East Anglia. The 1977 Order was drawn up because of the feeling that official regulations did little to prevent spread and the belief that farmers themselves should be made responsible for adopting a rotation which would prevent increase in the nematode population and thus reduce the risk to beet. Advice is given on the most suitable crops and rotations to use, according to past field infestation history (or lack of attack).

Herbicides for 1978—points to bear in mind. N. V, Turner. *British Sugar Beet Rev.*, 1977, **45,** (4), 35-36. Guidance is given on choice of herbicides for successful weed control. It is pointed out that 93% of the UK beet crop is grown on mineral soils, and that experience has shown the best results to be obtainable with a programme which includes a residual herbicide followed by two post-emergence treatments.

Pesticide interactions in sugar beet. II. Synergism —antagonism. K. N. Giannopolite. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (31), 446-472 (*Greek*).—The importance of interaction between pesticides in a combination is discussed with regard to particular combinations frequently used in beet. The pesticidal and phytotoxic effects of the two can be additive, greater than that of the sum of the two individual effects (synergism) or lower than that of the sum of the two individual effects (antagonism). Possible interaction can be established only by using each pesticide at a number of dosagd rates and then in combination with another chemical, again at various rates. The expected response for the combination is then calculated from the individual responses and compared with the actual response. The isobole method of Tammes[1], although more time-consuming, is preferred to that of Cowing or Colby[2] for calculation of expected response.

New facts concerning the fight against mildew of seed beet. A. Lebrun. *Hautes Etudes Betterav. Agric.*, 1978, **10,** (39), 9-17 (*French*).—Mildew caused by *Peronospora farinosa* has been found to cause severe losses in seed beet grown in the Beauce region (to the south-west of Paris) and in certain areas of south-western France. The plant comes under attack as soon as it emerges—the oospores may be present on the seed when sown or may be left in the soil by a previous crop (even as much as three years before). At the end of winter the diseased beet may be exposed to a secondary attack, the severity of which is governed by the climatic conditions. The result is marked deformation of the plant. Once it has reached the 14-leaf stage, however, it is no longer at risk. Tests have shown that DPX 3217 combined with "Mancozeb" is effective as a partial curative, while "Propineb" has considerable preventive properties. Varietal differences in susceptibility have been found.

Regulation and control of micro-granulators. A. Vigoureux and R. Vanstallen. *Le Betteravier,* 1978, **12,** (117), 12D (*French*).—The need to regulate the dosage rate of granular pesticides such as "Temik" and "Dacamox" arises from the fact that an insufficient rate causes an appreciable fall in their effectiveness. Guidance is given on how to determine the required rate in the field, either by weight or by volume, and for a given speed (5 $km.hr^{-1}$) where the rate adjustment means is or is not proportional to speed (the types of micro-granulator and their regulation means are given).

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[1] *Neth. J. Plant. Pathol.*, 1964, **70,** 73–80.
[2] *Weed Sci.*, 1970, **18,** 625–628.

CANE SUGAR MANUFACTURE

Ivory Coast seeks sugar self-sufficiency plus exports. R. E. Haresnape. *S. African Sugar J.*, 1977, **61,** 487.—A brief survey is presented of the Ivory Coast cane sugar industry and development plans whereby, by 1985, the aim is to produce 600,000 tonnes of sugar, of which 100,000 tonnes would cover domestic requirements while the remainder would be available for export. Such a production level will involve the operation of 12 plantation-factory complexes; it is hoped that six such complexes will be in full operation by 1982 to provide 300,000 tonnes of sugar.

Sugar production in Malawi. A. McMartin. *S. African Sugar J.*, 1977, **61,** 493-503.—Details are given of the development work leading to establishment of the cane estate and factory at Nchalo in Malawi. The author, commissioned by the Malawi Government in 1960 to examine and advise on the practical possibilities of cane growing in areas suitable for development, reported favourably on the suitability of the Lower Shire Valley, which is where the Sucoma (Sugar Corporation of Malawi) estate is sited. The factory had its first trial year in 1966, using the combined milling and diffusion process to produce both raw and refined sugar, and made an estimated 93,466 tonnes in 1977.

A preliminary report on a continuous *C*-pan. W. S. Graham and D. J. Radford. *S. African Sugar J.*, 1977, **61,** 507-513.—See *I.S.J.*, 1978, **80,** 180.

Critical studies on the progress of development in the methods of heating of *C*-massecuite in a sugar factory. R. C. Sharma. *Sugar News* (India), 1977, **9,** (4), 7-13.—The author describes a number of massecuite resistance heaters and discusses their suitability for use in connexion with low-grade batch centrifugals. After deciding that none of them are applicable, he then briefly describes a heater of his own design which is suitable for operation with both continuous and batch centrifugals.

Dessin's formula for quadruple-effect evaporation and its application for expansion. B. B. Khochare. *Sugar News* (India), 1977, **9,** (4), 15-23.—The Dessin formula for calculation of the evaporation coefficient $c\ [= \frac{(100 - B)\ (T - 130)}{16{,}000}$, where B = Brix of the juice leaving a given vessel, T = temperature of the heating steam in the calandria (°F) and c is expressed in $lb.hr^{-1}.ft^{-2}.°F^{-1}$] gave an average value of 5·37 as opposed to an average observed value of 5·65 $lb.hr^{-1}.ft^{-2}.°F^{-1}$ for the quadruple-effect evaporator at the author's sugar factory. The steam consumption at the various process stations with and without vapour bleeding is investigated, and the evaporator requirements for an expansion of the factory crushing capacity from 1250 to 2200 t.c.d. are calculated. The steam consumption by the various processes is also recalculated for the increased crushing rate.

Estimation of overall recovery from fibre and non-sugar in cane. II. S. N. Sinha, S. K. Srivastava and M. Prasad. *Indian Sugar*, 1977, **27,** 197-199.—Regression equations have been developed which are based on the inverse relationship between overall extraction and fibre % cane and non-sugars % cane. The equations have been modified for the different Indian cane-growing states and regions, and are set out in a table, as are regression coefficients and partial regression coefficients.

Effect of sugar cane quality on its processing parameters. B. Pasricha. *Indian Sugar*, 1977, **27,** 249-251, 256. The question of cane quality and its effect on processing is discussed within the light of Indian experience, particular attention being focused on fibre content and juice composition. Mention is also made of a scheme for granting financial aid to sugar manufacturers to enable them to modernize their plant, particularly with the aim of improving the thermal efficiency and increasing electricity generation and use. This would permit processing of cane of varying quality while maintaining a desirable extraction.

Critical studies about the basis of designing resistance heaters for heating *C*-massecuites in sugar factories. R. C. Sharma. *Sugar News* (India), 1977, **9,** (5), 15-19.—Factors which can affect the performance of a massecuite resistance heater are discussed, including voltage supply, the point at which voltage is applied in the circuit and type and arrangement of electrodes.

Progress in the sugar industry. V. R. R. Bhosale *et al. Sugar News* (India), 1977, **9,** (5), 24-29.—Modifications made to equipment at the 2000 t.c.d. factory of Shri Bhogawati Sahakary Sakhar Karkhana Ltd., Shahunag ar, over a 4-year period are described and performance data given for the period 1972/73-1976/77.

Brazil—the world's largest producer of cane sugar. L. V. Gentil. *Sugar y Azúcar*, 1977, **72,** (9), 81-91.—A survey is presented of the Brazilian sugar industry.

How to achieve effective sugar boiling. S. Y. Hsiung. *Taiwan Sugar*, 1977, **24,** 422-424.—Boiling practices in sugar factories of Taiwan Sugar Corporation are analysed and defects in the system used discussed. Seed slurry preparation and the effects of non-uniformity on boiling are examined, and recommendations given on means of improving boiling.

TSC exports expertise and technology to Liberia. S. N. Wu and P. W. Ho. *Taiwan Sugar*, 1977, **24,** 427-433. Details are given of cane agriculture and of the 100 t.c.d. factory at Harper City, Liberia, which carried out its trial run in March 1977. The factory, designed and constructed by Taiwan Sugar Corporation personnel, is intended to produce 10,000 tons of sugar from 123,000 tons of cane growing on 6000 acres per year. The defecation process is used for manufacture of Grade A sugar, and it is planned that one-quarter of this sugar will be remelted to produce white sugar.

Why "DO" and not "BOD_5"? J. C. P. Chen. *Sugar J.*, 1977, **40,** (4), 36-37.—While the BOD_5 of factory effluent requires 5 days for its determination, dissolved oxygen (DO) can be rapidly established and serves as a good indicator of the BOD level; but, although a high DO value at 6 inches below the water surface indicates a low BOD_5, the reverse is not necessarily true, especially in flat land where streams and impounding ponds are stagnant and covered with e.g. water hyacinth. A graph is presented of dissolved oxygen ($mg.litre^{-1}$) as a function of oxygen solubility in distilled water and of temperature in the range 0-30°C. It is stated that the generally acceptable level of DO of effluent fed into a stream is 3·5-4·0 ppm and of the BOD 10-15 $mg.litre^{-1}$. The surface water will have the highest DO level under the effect of wind or sunlight penetration and active photosynthesis, the value being maximum at mid-day and then falling towards evening. In order to discharge water from an impounding pond at highest DO, the water should be withdrawn from the surface. A DO monitoring system designed by the author for a raw sugar factory in Louisiana is shown and briefly described; it permits continuous measurement of DO of water being discharged from a pond and is linked to a signal flashing system. Since the equipment can operate on only two car batteries, it is suitable for remote areas having no power supply or where installation of a power line is too costly.

Energy inventory for Hawaiian sugar factories: 1975. D. Murata and W. Gibson. *Sugar y Azúcar,* 1977, **72,** (9), 104-109.—In view of the concern expressed by Hawaiian sugar factory owners about the high costs of fuel oil and electricity, about the revenue they receive for electricity sold to the public utilities and about replacement of worn-out power generation equipment, the Hawaiian Sugar Producers' Association appointed an *ad hoc* committee to examine the problems. The committee decided to draw up an inventory of fuel produced, fuel purchases, energy purchased and sold by all factories in 1975. The details are reproduced, and a diagram presented which summarizes the results. These showed that the Hawaiian industry produced and consumed its own fuel in the form of bagasse and trash in an amount equivalent to over 2·7 million barrels of oil. At the current efficiency levels, there was only a small amount of excess bagasse (equivalent to about 117,000 barrels of oil). A 5% increase in thermal efficiency would increase the amount of excess bagasse by about 175,000 tons, equivalent to about 170,000 barrels of oil. It was estimated that the total leaf trash from cane cleaners could produce energy equivalent to that provided by about 515,000 barrels of oil, but that only about 15% of the trash was used in 1975. However, the economics of using excess bagasse and cane cleaner trash to provide additional energy are unknown and studies are needed to determine capital costs, the effect on operating costs, and the income required to produce a reasonable return on capital.

Mill maintenance. Anon. *Sugar y Azúcar,* 1977, **72,** (10), 31-36.—After the end of its first crushing season, the W. R. Cowley Sugar House in Texas had to spend nearly $65,000 on new bearings to replace damaged ones in the cane mill low-speed gear reducers, the teeth of which had become so worn and pitted that the gears had to be dismantled for treatment, all of which added further to the repair costs. Consequently, the company converted from use of conventional gear oil in the reducers to high-performance, solid-film lubricants and introduced a special preventive maintenance programme. As a result, the mills operated for three seasons (crushing 3·5 million tons of cane) without any damage to the gear surfaces and without need to replace bearings. During that time, the lubricant was not changed. Similar benefits were obtained with the use of solid-film lubricant in the steam turbines and associated reduction gears after damage had been caused by excessive boiler water contamination, resulting in carbon gland failure and condensate entering the system.

Harvest and processing data following the November 30, 1976, freeze. G. J. Durbin. *Sugar Bull.,* 1977, **56,** (2), 8.—After a severe frost on 30th November 1976, cane quality fell so much that by 15th December factories in Louisiana were near to closing down. The growers and sugar producers then improved their harvesting, delivery, handling and processing practices sufficiently to effect some improvement in cane quality and permit a continuation of harvesting and sugar manufacture. A table indicates the average results obtained by 25 factories on 30th November, 15th December and after 15th December. The interval between harvesting and crushing fell from 55 hours in the first week to 29 hours in the fourth week, and the improved practices permitted a marked increase in sugar produced per gross ton of cane and a marked reduction in trash content after 15th December by comparison with the values on 15th December, while the sugar produced per net ton of cane, normal juice sucrose content and normal juice purity were slightly higher after 15th December.

Polymers in cane juice clarification. J. C. P. Chen. *Sugar J.,* 1977, **40,** (5), 11-14.—See *I.S.J.,* 1976, **78,** 214.

Thermal characteristics of evaporators. I. R. Espinosa P. *Centro Azúcar,* 1976, **3,** (1-3), 3-14 (*Spanish*). On a basis of mass and heat balances, two quadruple-effect evaporators were compared in respect of evaporation coefficient, thermal efficiency, total heat transfer coefficient and behaviour at maximum throughput. Only the evaporator No. 2, of equal heating surface in each effect, was able to reach full capacity, while its thermal efficiency was about the same as evaporator No. 1 of the "Honolulu" type. The total heat transfer coefficient was within the range predicted from the literature in both cases, and slightly better in case No. 2. The latter was slightly better thermally, but other factors (design objects, total heating surface, normal operation at less than full capacity) mean that the difference is not appreciable.

Heat transfer in deformed tubes. II. R. Pons M. *Centro Azúcar,* 1976, **3,** (1-3), 27-39 (*Spanish*).—Induction of turbulent flow in a tube, by means of an inserted element or, more cheaply, by partial constrictions close to each other but at right angles, was found to increase markedly the heat transfer film coefficient, and an equation was developed for the Nusselt number in terms of the Reynolds number, Prandtl number and the dimensions and spacing of the constrictions which is valid and of high precision within the Reynolds number range 25,000-160,000.

BEET SUGAR MANUFACTURE

Direct and indirect methods of controlling the efficiency of industrial boilers. P. Christodoulou. *Hellenic Sugar Ind. Quarterly Bull.*, 1977, (31), 440-445 (*Greek*).—The direct methods used to control boiler efficiency are those relating to combustion (e.g. checking fuel volume, size and calorific value) and steam (e.g. measuring its temperature and pressure and determining enthalpy), while indirect methods include the determination of flue gas CO + CO_2 content. The direct method was applied to determination of No. 2 boiler performance at Platy sugar factory, while the indirect method was used to determine the efficiency of No. 5 boiler at the same factory. Results are given, and errors and fluctuations in values that can occur with both methods are indicated.

Aspects of the energy economy in French sugar factories. J. Ledoux. *Sucr. Belge*, 1977, **96**, 447-456 (*French*).—After recalling the development in energy costs since 1973 and its effect on the cost price of sugar, the author describes measures adopted in France to encourage a reduction in energy consumption by sugar producers, *viz.* introduction of a parafiscal tax on consumption where this exceeds a set value, and introduction of premiums to be paid where investment has been made for purposes of reducing fuel and energy consumption. The steam consumption at each process station of a hypothetical sugar factory is indicated. The point is made that the values given are only approximate and that the total consumption is below the average for a French sugar factory; but the energy balance is claimed to correspond to that of a new factory operating an optimum heat exchange scheme. Advice is given on how to obtain optimum conditions in boiler and hot water heat exchanger operation, diffusion and boiling. An example is described of a sugar factory slicing 3900 tonnes of beet daily which reduced consumption by means of certain measures which are described; the investment costs were somewhat high, but it is calculated that, with 20% of the costs paid by the Government, 2·7 campaigns would suffice to cover them.

Muds and wastes in the sugar industry. F. Kastner. *Listy Cukr.*, 1977, **93**, 277-280 (*Czech*).—It is stated that insufficient attention has been paid to the question of solid wastes at sugar factories, and that the problem becomes even more important when large factories are designed. The amount of space needed for storage of coal, clinker and ash, carbonatation mud and solids separated from liquid waste is considerable. Moreover, with mechanical harvesting, there is need to clean the beet, resulting in still further waste material for disposal. One answer to the problem of boiler fuel and waste is the replacement of solid fuel with oil. The carbonatation mud and mud from beet cleaning should have a solids content of 40-50% in order to reduce the volume and facilitate their handling and transport. Farmers must be made more aware of the benefits of waste application to the soil.

The development of the beet pump and its effect on beet damage. S. Dušek and J. Dyntar. *Listy Cukr.*, 1977, **93**, 280-284 (*Czech*).—Information is given on a new single-stage, horizontal centrifugal pump of Czechoslovakian design in which the impeller shaft rotates in roller bearings. Photographs and tabulated data show the extent of damage suffered by beets delivered by the pump (the 400-NXD); the amount of damage is 40% lower than with an earlier pump, the PXO 19.

Heat balance of a shaft lime kiln. W. Lippold. *Zeitsch. Zuckerind.*, 1977, **102**, 795-798 (*German*).—The heat balance of a lime kiln having a nominal daily output of 150 tonnes of lime (as CaO) was determined over a period covering five campaigns. Details are given of the heat consumption and of the various heat loss factors, and advice, based on the results, is given on operation and construction of a kiln.

The RZ-PPZh-1.5 hydropneumatic beet elevator. N. D. Khomenko and V. G. Yarmilko. *Sakhar. Prom.*, 1978, (1), 36-40 (*Russian*).—Details are given of a beet elevator capable of lifting beet to a height of 30 m at a daily rate of 1500 tonnes. The elevator is a combination of an air lift pump and a conventional beet pump of low impeller speed which acts as a hydraulic seal-type feeder. An experimental version operated successfully throughout the 1976/77 campaign at a sugar factory.

The use of pocketless gas distribution grids in a SPS-20 unit at Kamenka sugar factory. A. A. Dmytryuk *et al. Sakhar. Prom.*, 1978, (1), 40-42 (*Russian*). Because of non-uniformity and undersizing of apertures in grids used for air feed through the white sugar layer in a SPS-20 fluidized bed dryer/cooler, dead zones occur where the air does not penetrate sufficiently through the under-size apertures to fluidize the sugar, which tends to fall below the grids. To overcome this, a stepwise arrangement of grids has been devised in which the trailing edge of a grid overlaps the leading edge of the grid below; the grids are separated by a slotted section in the centre of the lower grid, thus permitting flow of air into the sugar layer above. In experiments, the cooling rate was faster, especially in the initial stages of the process, than with conventional grids.

Separating sugar dust. I. I. Prilutskii and P. A. Lyubarets. *Sakhar. Prom.*, 1978, (1), 45-47 (*Russian*).—As a result of answers from 105 Soviet sugar factories and refineries to which a questionnaire was sent, data are given on the dust separation equipment used. From these and investigations of sugar dust particle size distribution in dryers, it is concluded that in no case could the equipment be recommended for use in the sugar industry. A new dust separator has been designed and a prototype installed at one factory. The level of water in a small tank rises when the vertical shaft of an electric motor which passes up through the tank rotates. The water passes into a chamber having a floor which slopes very slightly upwards from the tank. The water then reaches the surface of a disc carried at

the top of the shaft, the spinning action of which throws the water to form a curtain which then comes into contact with dust particles entering the system with air fed through a tangential pipe. Large dust particles are thrown onto the wall and slide down. Air, having undergone circular motion, then changes direction by 90°, enters the aperture created within the ring of water and, partially freed of its dust, travels upwards again to pass through the curtain of water. To prevent entrainment of dust particles during its upward passage, the water is guided by a deflector to a dust separator. The deflector imparts further rotary motion to the water, which then passes into the aperture between the concentrically arranged cylinders of a separator, onto the walls of which are thrown water droplets which then slide down as a continuous film. The air, now free from dust and water droplets, passes into an upper section whence it is ejected to the atmosphere. Capacity of the unit is 50 $m^3.hr^{-1}$ and its dust removal efficiency is given as 99·83%.

Small-dimension diaphragm valve. A. F. Kravchuk, N. G. Stegnii and V. N. Golodnik. *Sakhar. Prom.*, 1978, (1), 61-62 (*Russian*).—Details are given of a small diaphragm control valve designed for use in automatic feeding of priming material into a tank for surfactants and anti-foaming agents.

The microbiology of beet sugar manufacture. Practical considerations on operational checks and measures against micro-organisms. F. Hollaus. *Sucr. Belge*, 1978, **97**, 3-11.—See *I.S.J.*, 1978, **80**, 84.

Calculation of the air flow for forced ventilation of beet piles. T. Baloh. *Zuckerind.*, 1978, **103**, 28-35 (*German*).—The thermodynamic processes taking place in beet piles subjected to forced ventilation are explained, starting with a Mollier diagram for moist air and extending the discussion to cover different sets of conditions, e.g. different relative humidities and variations in air temperature relative to that of the beets. Formulae are presented for calculation of sucrose degradation as a function of temperature and for calculation of the heat generated in the pile by beet respiration. It is pointed out that cooling air has the combined goal of removing this heat as well as cooling the beets; however, in its passage through the pile, the air takes up not only the CO_2 generated by respiration but also water of varying origin, so providing adiabatic cooling. Even when the fans are switched off, heat is released from the pile into the surrounding air, although the pile will be cooled by natural draught when the air temperature is lower than that of the beets; small piles can be cooled by wind to a considerable extent. While the heat of respiration was found to compensate the loss of heat to the air, so maintaining a constant pile temperature, air temperature fluctuations had no marked effect on heat liberation. A worked example demonstrates the applicability of the calculations.

Reconstruction of the juice purification station at Osijek sugar factory, Yugoslavia. K. Vojin. *Zuckerind.*, 1978, **103**, 41-42 (*German*).—With expansion of Osijek factory to a daily beet slice of 6000 tonnes in 1968, a Novi Sad carbonatation system, which had hitherto been used only in small factories in Yugoslavia, was installed. However, CO_2 utilization was inadequate and other major problems occurred. Despite increasing the capacity of the four carbonatation vessels, there were still many difficulties, and the station became a major bottleneck as capacity could not be increased and excessive foaming took place. The absence of filter-thickeners was discounted as a contributory cause of the problems, since other factories with filter-thickeners had still encountered problems with the Novi Sad system. In 1974, the system was replaced with a DDS plant. This operated completely satisfactorily in 1975 and 1976, even where changes were made to adapt the system more to conditions at Osijek. Filter-thickeners are used for both 1st and 2nd carbonatation juice. Advantages of the scheme are listed.

Calculation of the massecuite centrifugalling process. I. E. Svoboda and J. Klepal. *Listy Cukr.*, 1978, **94**, 1-9 (*Czech*).—A mathematical study was made of massecuite curing and of affination in a centrifugal, and experimental results obtained with ARO 1250 low-grade machines operating at 1500 rpm were analysed and compared with theoretical values. For the theoretical investigations, the entire curing process was divided into four phases: (1) separation of crystal sugar from the mother liquor, (2) mixing of the residual syrup adhering to the crystals with wash syrup of higher purity and hence eventual conversion of the initial mother liquor to a higher quality syrup, (3) dilution of the adhering syrup with water and attainment of the required solids content, and (4) dissolution of the syrup adhering to the screen. An algorithm is presented which describes the individual stages of the process. Modification was made after the original equation for calculating the moisture content of the spun sugar was found to err on the optimistic side, as confirmed by experimental data. Graphs illustrate the relationship between crystal size and sugar moisture content. The water content fell by 37% with increase in crystal size from 0·37 to 0·57 mm and 10°C rise in temperature during spinning under typical conditions, the effect of temperature rise being greater than the increase in spinning time from 210 to 300 sec.

Efficient operation of centrifugal beet slicers. V. G. Belik and A. M. Shcherbakov. *Sakhar. Prom.*, 1978, (2), 8-11 (*Russian*).—Tests are reported on beet slicing with the aim of establishing the optimum speed in terms of energy consumption and cossette quality. This was found to be 4-6 $m.sec^{-1}$; above 6 $m.sec^{-1}$ the energy consumption rose and cossette quality fell. At 6 $m.sec^{-1}$, 43% of the total energy was taken up by actual cutting, 35% by beet friction against the drum wall and 22% by rotation of the drum. At below 4 $m.sec^{-1}$ presentation of the cossettes to the knives was not adequate. The average cossette length was 11 m/100 g.

Shapes of beet cossettes and beet slicer throughput with use of ribless knives. V. N. Nechitailo and V. P. Zubchenko. *Sakhar. Prom.*, 1978, (2), 11-15 (*Russian*). There has been a growing tendency in the USSR to use ribless beet knives (of the Goller type), although there is lack of knowledge on their performance. It is shown how various shapes of cossettes can be obtained with these knives, and mathematical expressions are given for calculation of cossette cross-section area for each shape.

SUGAR REFINING

On the automatic control of a vacuum pan by rheometer. T. Kawamura and F. Kawata. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1977, **27**, 64–74 (*Japanese*).—The Yokohama refinery of Ensuiko Sugar Refining Co. Ltd. has six vacuum pans, of which two used for granulated sugar were provided, in 1966, with an automatic control system based on mother liquor supersaturation in the first half of the boiling cycle and on massecuite consistency (as measured by massecuite stirrer) in the second half. Later, investigations were carried out to decide on suitable control means for the other pans (low-head pans without massecuite stirrers used for white soft sugar and 1st, 2nd and 3rd crop boiling). It was found that supersaturation measurements were affected by fluctuations in purity, temperature and pressure, while rheometric measurements were hardly affected, so that the rheometric method was chosen. The system has operated successfully since 1975 and consists of five control loops, *viz.* rheometric, vacuum, level and steam valve control loops and a temperature record loop. Each stage in the boiling process is governed by the signal from the sequence control circuit. During boiling, the rheometer set point gradually increases as the massecuite level rises. While it is impossible to follow the line of the ideal boiling curve (according to which small seed crystals grow at a maximum rate without conglomeration or secondary nucleation), three upper and three lower set points have been established within a relatively narrow supersaturation band. When the rheometer value reaches the first upper set point, a programmed quantity of water is fed into the pan and concentration carried out according to each pre-set gradient. This periodical set point method in the graining stage results in more uniform crystals, a reduction in the amount of balancing water needed and a shorter boiling time than with the constant set point method. After syrup is drawn in, the massecuite is concentrated to the lower set point, while after balancing water is introduced concentration is carried out until the first higher set point is reached. Hence, an optimum ratio between evaporation rate and massecuite mobility is maintained. Comparison between manual and automatic boiling shows that, while massecuite and molasses analyses were almost the same, the boiling time was much shorter (less than 11 hours) with automatic boiling than with manual boiling (15 hours).

Change in the non-sugar composition during yellow sugar affination. A. P. Kozyavkin and N. I. Odorod'ko. *Sakhar. Prom.*, 1977, (12), 36-39 (*Russian*).—Investigations were conducted into the non-sugar removal efficiency of low-grade yellow sugar affination. Earlier, it had been found by Silina[1] that most of the non-sugars occurred in the molasses film surrounding the crystals, and the present studies indicated linearity between sugar purity and the amount of film. The quantity of film remaining after affination was found to be governed by crystal size: with increase in the mean size from 0·2 to 0·3 mm, the quantity of film fell by an average of 30%; with increase from 0·3 to 0·4 mm, the amount fell by 19% of the initial quantity. Affination efficiency was increased by an average of 20% by double washing with water, although some crystals (8–12% on weight of sugar) were also dissolved. Moreover, although the quantity of molasses film was very much reduced, it included some non-separable non-sugars. Hence, it is recommended to use the method described earlier[2] in which affination is carried out with *A*-molasses. Analyses of yellow sugars before and after affination showed that lime salts fell by 0·025%, reducing sugars by 0·05%, sulphate ash by 0·365% and amino-N by 1·47 ppm with 1% rise in purity, while K and Na contents fell sharply, and colour decreased by 5·3 units of optical density on 100 g dry solids. The overall change in composition with complete removal of molasses film from yellow sugar is shown in a table. It is not recommended to grow yellow sugar crystals larger than 0·4 mm, since, although K and Na are present in greater quantities in smaller rather than larger crystals, large crystals were found to include quantities of mother liquor as well as containing it in crevices and excrescences.

Increase in the colour of cane raw sugar during prolonged storage. N. V. Kostenko, A. F. Zaborsin and S. A. Brenman. *Sakhar. Prom.*, 1978, (1), 42–44 (*Russian*).—Cane raw sugar samples taken from refinery warehouses were subjected to spectrophotometric analyses in the U.V. band. The effects of temperature, moisture and colorant group on colour increase during storage in heated and unheated warehouses were determined. Results showed that in the temperature range between —13 and +25°C and 50–90% relative humidity, the colour of Grades I and II raw sugar in an unheated warehouse rose by 16·4% and 18·0%, respectively, under the effect of increase in the concentration of reducing sugar decomposition products; in the range +18 to +26°C and 26–65% R.H. in a heated warehouse the colour rise was 18·2% and 28·4%, respectively, as a result of increase in the reducing sugar decomposition products and (in respect of Grade I sugar) increase in melanoidins; at 18–25°C and 65–95% R.H. a 30–34·9% increase in colour was attributed to invert sugar alkaline decomposition products. When cane raw sugar is stored at sugar factories in the Soviet Union, it is often exposed (in unheated conditions) to a temperature in the range between —2 and +9°C and a relative humidity of 60–95%, under which conditions colour also increases as a result of rise in temperature within the sugar; this is unassociated with the properties of the surrounding air. There is marked bacterial activity (as demonstrated by cases of spontaneous heating, a marked fall in quality, change in the nature of the organic non-sugars and a fall in the starch content).

A new automatic line for wrapping refined tablet sugar. M. E. Balyasnyi and A. F. Livshits. *Sakhar. Prom.*, 1978, (1), 58–61 (*Russian*).—Details are given of an automatic unit for wrapping sugar tablets together in pairs at the rate of 160 packets a minute, each tablet measuring 30 × 22 × 10 mm. Full details are given of the unit's operation.

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[1] *I.S.J.*, 1956, **58**, 50.
[2] Kozyavkin *et al.*: *ibid.*, 1978, **80**, 280.

LABORATORY STUDIES

Temperature corrections in polarimetric determination of sugar. A. Emmerich. *Zucker*, 1977, **30**, 658-661 (*German*).—In polarimetric determination of sugar, temperature has a number of effects. It affects the volume of the test solution and of the measuring flask, the coefficient of expansion of which depends on the type of glass. If the flask is filled at a temperature above 20°C, but all other stages in the determination are carried out at 20°C, the volume of the solution will decrease between filling of the flask and actual measurement. If the measuring tube of the polarimeter is filled at 20°C, but measurement carried out at a different temperature, the optical rotation will be affected as well as the length of the tube, the linear expansion coefficient of which will depend on the metal used. Quartz wedge saccharimeters are also affected by temperature in three ways: the effect on the rotation of the quartz, on the linear expansion of the wedge perpendicular to the optical axis, and on the linear expansion of the scale attached to the wedge. Correction for temperature is, however, affected by the invert sugar content of the solution. A general formula is given for temperature correction which combines all the effects mentioned above, while simpler formulae are given for the specific cases described.

Hydration of sugars. V. I. Buravleva, A. V. Zubchenko and A. Ya. Oleinikova. *Izv. Vuzov, Pishch. Tekh.*, 1977, (5), 129-131 (*Russian*).—The vapour pressure of solutions of sucrose, maltose, dextrose and levulose were determined in the temperature range 30-90°C at concentrations in the range 1-7 mole.kg^{-1} water for the disaccharides and 1-13 mole.kg^{-1} for the monosaccharides. The mean degree of hydration W was then calculated by the formula $W = \frac{55{\cdot}51}{m} - \frac{a}{1-a}$ mole/mole, where $a = P/P_o$ = activity of the water, and P and P_o are, respectively, the vapour pressure of the sugar solution and water at the same temperature. The values of W obtained were in good agreement with data in the literature for dilute solutions of adequate concentration, where the amount of bound water is small and the effect of the method used to determine the hydration degree is of great significance. The value of W fell with increase in concentration and temperature, under which conditions the "weak" hydrogen bonds were ruptured. At higher concentrations or temperatures than used in the investigations, the reduction in the number of hydrogen bonds becomes less noticeable as a consequence of the increase in relative proportion of water molecules strongly bound by a sugar molecule, so that rupture requires much more energy. Concentration was found to affect hydration more than did temperature, especially in dilute solutions. The ratio of hydrophilic to hydrophobic surfaces and the spatial arrangement of the hydroxyl groups and hydrocarbon rings had a marked effect on the structure and strength of the hydrogen bonds formed by the sugar molecule. The order of the sugars in respect of the reduction in mean value of W was: sucrose, dextrose, levulose, maltose.

White sugar quality. Distribution of ash and Crystal Regularity Index (CRI). D. Hibbert, R. T. Phillipson, and W. Woodwark. *Sucr. Belge*, 1977, **96**, 459-469.—See *I.S.J.*, 1978, **80**, 87.

Limiting solvation saturation of the solid phase in a saturated solution. A. Smelík. *Listy Cukr.*, 1977, **93**, 270-277 (*Czech*).—See *I.S.J.*, 1977, **79**, 295.

High-invert liquid sugars. K. Vukov, G. Pátkai and J. Monszpart-Sényi. *Zeitsch. Zuckerind.*, 1977, **102**, 792-795 (*German*).—The technology of sorghum syrup, date sugar and isomerized glucose production is outlined and properties of these high-invert syrups described, including chemical composition, heat and cold resistance, microbial content (very low because of their high osmotic pressure), viscosity and sweetness. Twenty-eight references are given to the literature.

Quantitative determination of sugars in foodstuffs by high-performance liquid chromatography. D. C. Hunt, P. A. Jackson, R. E. Mortlock and R. S. Kirk. *Analyst*, 1977, **102**, 917-920.—Dextrose, levulose, sucrose and lactose were determined quantitatively by high-performance liquid chromatography using a column of aminopropylsilane bonded to microparticulate silica. Base-line separation of the sugars was achieved with solvent systems comprising 87% acetonitrile in water at a flow rate in the range 1-3 cm^3.min^{-1}. Increase in the flow rate of the solvent caused a fall in retention time, which resulted in faster separation with peaks becoming sharper and more acceptable for measurement at a fixed recorder speed. With a high flow rate, separation was incomplete because of inadequate mass transfer and column efficiency fell, leading to insufficient peak resolution. The optimum flow rate was therefore 2 cm^3.min^{-1}. The column and refractive index detector were maintained at 37°C; increasing the column temperature to 60°C caused a slight reduction in the retention times, mainly because of a fall in solvent viscosity, but there was a noticeable increase in the background noise level of the detector. Optimum injection volume of test solutions containing 10% of each sugar was 10 μlitre. At greater volumes than this, there was tailing and overlapping of the peaks, while at lower volumes than 10 μlitre the peaks were so small that they could not be measured accurately. Under optimum conditions column efficiency in terms of the number of theoretical plates was 14,200 plates.m^{-1} and the height equivalent to a theoretical plate was 0·070 mm for the levulose peak. Ribose was chosen as internal standard, giving a sharp, well resolved peak (after 2 min) by comparison with a trisaccharide, e.g. raffinose. The concentration of the working solutions was limited (by solubility in water and resultant viscosity) to a maximum of 50% of total sugars, while individual sugar concentrations were limited to 20%. While the major advantages of high-performance liquid chromatography are speed and selection (the sugars being completely separated and individually detected in less than 9 min), enzymatic analysis is more precise and sensitive although often requiring preliminary chromatographic analysis to give information on relative concentration and identity of each component. The major disadvantage of high-

performance liquid chromatography is the overall lack of sensitivity.

Automated determination of sugar in molasses. H. Janshekar and J. R. Mor. *Anal. Chim. Acta*, 1977, **90**, 201-207; through *Anal. Abs.*, 1977, **33**, Abs. 6F27.—Difficulties and sources of error in determining total sugars are discussed, and the development is described of an "AutoAnalyzer" version of the inverse colorimetric method of Hoffman[1] which is based on the redox reaction between $Fe(CN)_6^{---}$ and dextrose. The sugars in the sample are first hydrolysed with 1M HCl at 68°C, the solution is membrane-dialysed against a stream of alkaline $Fe(CN)_6^{---}$, the latter solution heated at 95°C and the decrease in its extinction measured at 425 nm. Two manifolds are described for respective concentration ranges of 0-1 and 1-9 g.litre^{-1}; 40 samples can be processed per hour. Raffinose is incompletely recovered, but recoveries are greater than 96% for most other sugars.

Tests on molasses exhaustion. P. Devillers, R. Detavernier and J. Roger. *Sucr. Franç.*, 1977, **118**, 453-460 (*French*).—The method of Wagnerowski *et al.* for determination of molasses exhaustion[2] is based on the linear relationship between the saturation coefficient and the non-sugars:water ratio. However, at a fixed non-sugars:water ratio for standard molasses, anomalous results have been obtained, with some factories which normally obtain good low-grade massecuite exhaustion not managing to achieve the theoretically possible exhaustion, while others (including those using the Quentin process) have achieved molasses exhaustion better than the standard. The problem was attributed to viscosity—too high a viscosity retarded mother liquor percolation through the sugar and screen in a centrifugal, some batch centrifugals being much more limiting than continuous machines. The relationships between viscosity on the one hand and concentration and temperature on the other were studied, and an equation derived for calculating the viscosity of molasses at temperatures and concentrations other than those actually used in the test. A linear relationship was also established between the sugar:water and non-sugar:water ratios. The viscosities of molasses solutions of known composition are measured at a given temperature; since viscosity varies linearly with molar concentration, the latter variable can be determined, and hence (using the formulae of Wagnerowski & Dabrowski[3]) the purity and sugar:water and non-sugar:water ratios established. The purity found corresponds to optimum exhaustion at any selected temperature and viscosity. The applicability of the modified method using viscosity instead of the non-sugars:water ratio is demonstrated. The coefficient of variation between values found for molasses and standard molasses parameters was 0·3%, while the non-sugars:water ratio was found to vary between 2·45 and 3·2 at a given viscosity. Optimum exhaustion took place at a temperature in the range 35-50°C. The effect of viscosity and temperature on centrifugal performance was studied, as was the use of the values given by the tests to control massecuite cooling.

Levels of extraction of sugar cane juice with a laboratory mill. H. G. Ayala, A. A. Delfini and D. Bravo L. *Bol. Estac. Exp. Agric. Tucumán*, 1977, (126,) 7 pp. (*Spanish*).—Cane samples of five varieties, weighing 100 kg each, were passed three times through a 3-roller laboratory cane mill and the juice extracted in each pass collected, weighed and analysed, a similar analysis being carried out on the composite juice. The juice from the second and third passes was of lower Brix, pol and purity than the primary juice, but the quantities were sufficiently smaller that the difference between primary and composite juices (extractions 56·74-57·59% and 68·21-72·35%, respectively) was not great. The authors consider that the composite juice gives a valid indication of results to be expected in an industrial mill so that the analysis could be used as a basis for cane payment.

Method of precise determination of the sugar content in dark coloured sugar products. A. Ya. Zagorul'ko, E. S. Boiko, L. A. Korobeinikova, A. A. Ponomarenko and T. F. Burlyai. *Sakhar. Prom.*, 1978, (1), 65-66 (*Russian*).—Tests showed that active carbon added to a dilution of a highly coloured product after clarification with lead acetate removed a considerable amount of colouring matter but not sucrose and thus permitted the sugar content of the product (massecuite, run-off, molasses or yellow sugar) to be determined by saccharimeter. Details are given of a procedure developed for preparation of the product.

Quantitative sugars analysis with the help of an automatic integrating densitometer. S. N. Karchik, E. M. Mel'nikov and A. I. Korolev. *Primen. Vychisl. Tekh. i Elektroniki dlya Pishchev. Prom.*, 1974, **1**, 251-254; through *S.I.A.*, 1978, **40**, Abs. 78-99.—Principles of such analysis are outlined. The quantity of a substance present is directly proportional to the integral of extinction of its spot, separated e.g. by descending paper chromatography using 12-15 runs of the solvent *n*-butanol:ethanol:water (3:2:1). The smallest quantity determinable is 0·1 μg, compared with 10 μg for non-densitometric quantitative methods, but best results have been obtained with 0·01-0·05 mg dextrose or levulose, 0·05-0·15 mg sucrose or raffinose.

Automated liquid chromatographic system for analysis of carbohydrate mixtures. H. D. Scobell, K. M. Brobst and E. M. Steele. *Cereal Chem.*, 1977, **54**, (4), 905-917; through *S.I.A.*, 1978, **40**, Abs. 78-100.—An automated system for the high-performance liquid chromatographic determination of mono- and oligosaccharides in mixtures is described. It includes a conventional liquid chromatograph, a computing integrator and a custom-built automatic sample injector-system controller. The columns were packed with various grades of "Aminex" cation exchange resin in Ca^{++} or, in some cases, in Ag^{+} form, and the eluant was water. The columns were used to separate the carbohydrates in glucose syrups, high-fructose corn syrups and a medium invert sugar syrup. Rapid, high-resolution separations were obtained on a stable baseline; since carbohydrate recovery was complete, and all components gave a linear relation of peak area to weight of sample, no internal standard was needed. Accuracies of about ±0·2% absolute could be achieved for a wide variety of sample compositions.

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[1] *J. Biol. Chem.*, 1937, **120**, 51.
[2] *I.S.J.*, 1962, **64**, 115.
[3] *ibid.*, 1977, **79**, 206.

BY-PRODUCTS

Introduction to the technology, application and commercialization of concentrated vinasse (slops) from the cane and beet molasses fermentation industry. W. Lewicki. *Sucr. Belge*, 1977, **96**, 421-424 (*French*).—See *I.S.J.*, 1978, **80**, 88.

With 350 cattle to feed, Dairy Farm relies heavily on sugar beet tops. D. Charlesworth. *British Sugar Beet Rev.*, 1977, **45**, (4), 45-46.—Details are given of the system used at a Suffolk farm to feed cattle on beet tops, ensilaged or otherwise.

Manufacture of sugar cane bagasse pellets. H. G. Ayala, A. Delfini and D. Bravo L. *Rev. Ind. Agric. Tucumán*, 1978, **53**, (1), 63-65 (*Spanish*).—Mill bagasse was dried to less than 10% moisture, triturated in a hammer mill, treated with direct steam to soften the fibre, and pressed into pellets which were then air-dried. Similar pellets were made in which 2-10% of molasses and soya flour were incorporated. The pellets were found to be perfectly acceptable as animal fodder and showed no significant changes in composition after four months' storage.

Vacuum alcohol fermentation. A. Ramalingam. *Ph.D. Dissertation* (Cornell University), 1975, 140 pp; through *Diss. Abs. Int.*, 1976, **36B**, 5707.—Batch and continuous fermentations of media containing 18% sugar were carried out under vacuum; cell densities, yield coefficients and rates of sugar utilization were greater than under atmospheric pressure. In the continuous tests, additional nutrients such as ergosterol and oleic acid were needed for stable operation; with these supplements and a dilution rate of approx. 0·091 per hr, the sugar level decreased from 18% to less than 0·1%. With molasses media under atmospheric pressure and vacuum, the same trends were observed, but the presence of unfermentable sugars caused difficulties in analysis, and inhibitory substances also affected the fermentation. 50% sugar media could be used directly as feed in continuous fermentation; the sugar concentration decreased to less than 1% in approx. 20 hours' residence time.

Feedlot performance and carcass traits of Santa Gertrudis and Charolais × Brahman bulls fattened with green forage, final molasses or concentrates. A. Molina. *Cuban J. Agric. Sci.*, 1977, **11**, 277-287.—In trials to determine the effect of breed and energy source on feed-lot performance and carcass characteristics of calves slaughtered at a live weight of 420 kg, the chief differences between forage, molasses and concentrates were in the duration of the fattening period, age at which the animals were slaughtered and percentage of excess fat. In all three factors, molasses was intermediate between forage and concentrates. Breed × diet interactions occurred in daily weight gain, carcass weight and yield.

Use of bovine ensiled manure and final molasses as a new feeding source for fattening pigs. P. Lezcano, A. Elías and C. Hardy. *Cuban J. Agric. Sci.*, 1977, **11**, 289-294.—Pig feeding trials are reported in which the feed was composed of ensiled dairy cow manure, final molasses, urea, mineral pre-mix and ammonium sulphate. Results were in agreement with previous ones for diets of high final molasses content; the health of the pigs was good during the trials and the carcasses were normal.

Molasses feeding in the dairy cow. Changes in rumen, blood and milk composition. C. M. Geerken. *Cuban J. Agric. Sci.*, 1977, **11**, 295-309.—Molasses fed to two lactating cows in a diet containing hay, fish meal and maize meal caused a drop in milk yield in one case and an increase in the other, by comparison with non-molasses controls. The results did indicate, however, that for a high yield cow, molasses feeding can cause a highly inefficient use of energy. The adverse effect on milk yield may be a result of reduction in rumen acetate production.

Production of fodder yeast by *Saccharomyces cerevisiae* grown on Egyptian blackstrap molasses. A. Madi, A. el-Nagar, Y. M. Shehata *et al. Pakistan J. Biochem.*, 1975, **8**, (1/2), 49-52; through *S.I.A.*, 1978, **40**, Abs. 78-53.—*S. cerevisiae* grown in media containing 75 g cane molasses per litre and either 2 g $NH_4H_2PO_4$ per litre or 6 g urea per litre contained 42% and 52% protein on dry solids, respectively; contents of certain vitamins and trace elements are tabulated.

Utilization of different sources of carbon by *Azotobacter* species. M. A. el-Sayed and A. Abo-Shady. *Pakistan J. Biochem.*, 1975, **8**, (1/2), 32-35; through *S.I.A.*, 1978, **40**, Abs. 78-54.—Three strains of *Azotobacter chroococcum* and one strain of *A. vinelandii* were cultured in media in which the C source was 20 g dextrose/litre, or Egyptian cane molasses diluted to 20% sugars, or 5 vol.% of one of various hydrocarbons. Maximum growth and maximum N fixation and lipid production were obtained with the dextrose- and molasses-based media.

Laboratory elaboration of the main parameters of a fermentative process for tryptophan producers. L. K. Smirnova, M. A. Shilova, L. L. Gubanova *et al. Trudy Biologichesk. Inst.* (AN SSSR, Sibirsk. Otdel.), 1975, **25**, 98-102; through *S.I.A.*, 1978, **40**, Abs. 78-55. Tyrosine-dependent, auxotropic mutants of *Azotobacter suis* and *Corynebacterium luteum* were grown in media similar except for the C source, and tryptophan accumulation was observed. Maximum yields from various C sources are shown; best results were obtained with 20% (beet) molasses for *A. suis* and with 25% molasses for *C. luteum*, both at 23-24°C and pH of approx. 7·2. A maximum yield of 1 g tryptophan/litre was observed after 6 days for 2 strains; another *A. suis* strain gave 0·8 g.litre^{-1} after 3-4 days.

PATENTS

UNITED STATES

Soil irrigation methods and apparatus. B. A. McElhoe and J. G. Tabrah, *assrs.* Hawaiian Sugar Planters Association, of Honolulu, HI, USA. **3,921,905.** 11th November 1974; 25th November 1975.—The system of irrigation for e.g. cane includes a number of drip tubes having apertures through which pressurized water is applied continuously to the soil. Flushing valves are connected to the remote ends of the tubes to flush them clean periodically. Each valve comprises an inlet communicating with a drip tube, an outlet for discharging water from the tube, a pilot opening arranged to introduce pressurized water to the valve, and a valve element of resiliently deformable material (plastic or rubber). The valve element is recessed to enable it to extend longitudinally forwards and radially outwards in response to the water pressure at the pilot opening to prevent discharge of water from the drip tube end. When water pressure at the pilot opening is relieved, water pressure from the drip tube shifts the valve element to an open position whereby water is flushed from the tubes. A valve manifold is provided to conduct pressurized water to the pilot openings of the drip tubes so that they are closed, allowing a flow of irrigation water through the apertures and to relieve the pilot pressure simultaneously so that the tubes are all flushed simultaneously.

Prehydrolysis and digestion of fibrous lignocellulosic material. E. J. Villavicencio, of New York, NY, USA, *assr.* Process Evaluation & Development Corp. **3,923,591.** 21st February 1974; 2nd December 1975. Lignocellulosic material (bagasse) is prehydrolysed at pH 4·0–6·0 (and 75–150 psig and 320–390°F for 5–30 min) in the presence of 70–100% moisture on dry weight, and the prehydrolysed material then digested with a solution of Na_2CO_3 buffered at pH 8·5–11·5 (at least 10·0, about 10·0) and having a Na_2O content of 10–14% (about 12%) by weight and 1·1–3 (1·5) moles $NaHSO_3$ per mole of Na_2CO_3 so that the pH remains above 8·5 during digestion. The weight ratio of bagasse to digestion solution solids content is 1:2–1:6 and the total alkali metal oxide concentration is about 12% w/w.

Cane harvester trash separator. D. J. Quick, of Bundaberg, Queensland, Australia, *assr.* Massey-Ferguson Services N.V. **3,925,199.** 16th October 1974; 9th December 1975.

Cane harvester. O. Shunichi, of Korimoto, Kagoshima, Japan. **3,925,969.** 20th December 1973; 16th December 1975.

Production of cane sugar. J. T. Rundell and P. R. Pottage, *assrs.* Tate & Lyle Ltd., of London, England. **3,926,662.** 23rd September 1974; 16th December 1975. Evaporator syrup in a cane sugar factory, or affination syrup in a refinery, is treated to remove suspended solid impurities by forming in it a primary insoluble calcium phosphate floc by addition of a soluble phosphate (sodium phosphate) [100 — 600 ppm (200-400 ppm) P_2O_5], aerating the liquor containing this floc with agitation and distributing uniformly through it 1-40 ppm (1-20 ppm) on weight of sugar in the liquor of anionic flocculating agent which is an acrylamide/acrylate copolymer [with 20-80% (40%) anionic units] having a mol. wt. of 1-10 million [4-8 million (6 million)] to initiate formation of a secondary floc which is retained in a flocculator vessel for 15 sec-5 min (30 sec-3 min) with non-turbulent agitation to prevent segregation of the floc from the liquor, thereby allowing the floc to grow. The liquor containing the floc is transferred with minimal agitation to a separator vessel where the floc is allowed to segregate and the clear liquor and floc are collected separately.

Process for large-scale chromatography. A. J. Melaja, L. Hämäläinen and L. Rantanen, of Kantvik, Finland, *assrs.* Suomen Sokeri Oy. **3,928,193.** 14th February 1975; 23rd December 1975.—Cylindrical baffle-free columns of more than 1 metre diameter and 2·5-5 m high are packed with particulate ion exchange resin [a sulphonated polystyrene cation exchange resin (in Ca^{++} form) (with 3% divinyl benzene cross-linking) of mean size 0·25–0·5 mm (0·38 mm) (0·27 mm)] having a permeability coefficient k of 1-4 $\times$ 10^{10} l/m^2 (2·2 $\times$ 10^{10} l/m^3) (2·6 $\times$ 10^{10} l/m^2). The resin is saturated with water and back-washed to provide uniform packing. The liquid to be separated into its components, e.g. a birchwood hydrolysate or a mixture of dextrose and levulose, is introduced while initiating a downward flow at a velocity 0·5–2 times the critical velocity of the system (0·25-1 m.hr^{-1}; 0·15-0·6 m.hr^{-1}) and eluting with water to recover the successive fractions.

Beet diffuser. C. H. J. Pinet, of Hoegaarden, Belgium, *assr.* Raffinerie Tirlemontoise. **3,930,801.** 20th March 1974; 6th January 1976.

The diffuser is in the form of a rotating drum having a series of solid walls 3 with slanting wall sections 27 which form two staggered helical screws for transfer of cossettes from one end of the diffuser (compartments N′ and N″) to the other (compartments I′ II″) from which they are discharged. Extraction water delivered to the diffuser through pipe 17 passes through the perforations in the axial walls 6 and passes in counter current to the cossettes, extracting their sugar content, to be discharged at the feed end.

The drum is extended by section 8 beyond cell N′-1 as a perforated drum with a perforated end-plate 9, this providing a supply compartment of similar size to two diffuser compartments with a baffle element so that feed material (cossettes from the scalder introduced

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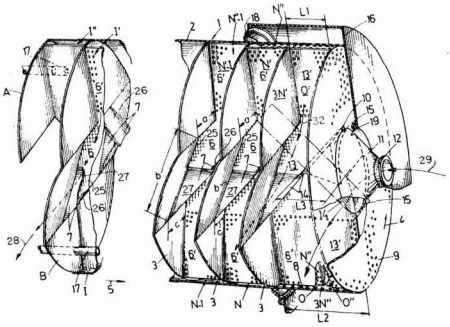

through the tube 12 on cone 11 mounted centrally in plate 9) is conveyed into the two diffuser screw channels. Scalder juice and juice obtained by diffusion pass through the perforations of the supply compartment and are retained by the fixed liquid header 16 surrounding the end of the diffuser, from which they are recovered for processing.

Recovery of sugar cane wax. A. W. Lake, *assr.* Chemical Services (Pty.) Ltd., of Johannesburg, South Africa. **3,931,258.** 4th December 1974; 6th January 1976. Filter cake is slurried with (1-5 volumes of) water and (0·05–0·5% of) a quaternary ammonium compound (myristyl dimethyl benzene ammonium chloride) as a cationic surfactant to weaken the bond between the wax and fibres in the slurry. If the slurry is alkaline its pH is adjusted to the acid side (pH 4–5) (by addition of HCl), and the slurry heated to melt the wax and (10–30% of) an extractant (kerosene) added which is a solvent for the wax (with gentle agitation by boiling the slurry, after which the mass is allowed to stand so that the extractant and aqueous phases separate) and the extractant removed (and cooled, whereupon the wax crystallizes and is recovered by filtration or centrifuging).

Process for obtaining cellulose from ligno-cellulose raw materials. A. Fogarassy, of Paris, France, *assr.* Société de Promotion et d'Exploitation Industrielle de Procédés de Brevets S.A. **3,932,207.** 5th March 1973; 13th January 1976.—The fragmented raw material, e.g. bagasse, is impregnated with a solution in a solvent having a boiling point higher than the subsequent cooking temperature [ethylene glycol, dipropylene glycol, glycerol, aniline, diethanolamine or triethanolamine or a mixture of one or more of these (aniline, ethylene glycol and aniline) with water] of a reactant (NaOH, a NaOH/Na stearate mixture, the acetone sodium bisulphite compound, Na phenate, ammonium thiosulphate or Na benzoate) for converting lignin present into a derivative soluble in water or a water-miscible organic solvent. The impregnated material is immersed in a liquid which is substantially non-miscible with the reactant's solvent and having a boiling point higher than the cooking temperature [a paraffinic mineral oil, a siloxane, *n*-butyl acetyl-ricinoleate, *n*-butyl benzoate, diethylene glycol monolaurate, propiophenone, dibutyl ether or mixtures of these] and the mixture cooked until the lignin has been converted, when the soluble derivatives are extracted with an (azeotropic) aqueous medium to leave the separated cellulose.

Cane harvester topper with curved deflectors. D. J. Brassette, of Raceland, LA, USA, *assr.* Thomson International Company. **3,932,984.** 25th July 1974; 20th January 1976.

Liquid animal fodder supplement. F. M. Snyder, of Omaha, NE, USA. **3,934,041.** 30th October 1972; 20th January 1976.—A mixture of water, urea (as a precondensation product with an aldehyde) and [0·5·5 (5·5) moles per mole of urea] of formaldehyde, acetaldehyde, propionaldehyde or a mixture of these is reacted together in the presence of molasses and 0·001–1 parts by weight on urea weight of a catalyst which may be phosphoric acid, ammonium sulphate, ammonium phosphate or ammonium polyphosphate for sufficient time to permit the urea to react with the aldehyde, providing nutrients for the animal.

Sweet syrup production from a dextrose mother liquor. M. Suekane, S. Hasegawa, M. Tamura and Y. Ishikawa, *assrs.* CPC International Inc., of Englewood Cliffs, NJ, USA. **3,935,070.** 22nd May 1975; 27th January 1976.—A starch hydrolysate (of >50% solids content), containing dextrose, maltose, isomaltose and oligosaccharides, is subjected to enzymatic action (with xylose isomerase) (by passage through columns) to isomerize at least part of the dextrose content to levulose, (diluted,) and then treated with (25,000 units.g^{-1} dry substance of) an isomaltase or transglucosidase enzyme (derived from *Aspergillus niger, Paecilomyces varioti* or *Penicillium brefeldianum*) (absorbed on bentonite clay). The dextrose isomerization may be preceded by the isomaltase or transglucosidase enzyme treatment.

Production of citric acid. A. J. Kabil, of Vienna, Austria, *assr.* AG Jungbunzlauer Spiritus- und Chemische Fabrik. **3,936,352.** 12th October 1973; 3rd February 1976.—A decationized solution of e.g. 20–25% sugar content is subjected to submerged fermentation with a citric acid-producing strain of *Aspergillus niger* at pH about 2·8 and in the presence of a piece of refined steel (1–2 cm^2 area per 100 cm^3 of nutrient solution) which in addition to iron and 2% copper contains at least one member of the group consisting of 0·07% C, 1% Si, 2% Mn, 17·5% (18%) Cr, 2·25% (2·75%) Mo, 20% (22%) Ni, >5·6% Nb and Ti.

Animal fodder. R. Teissier, J. L. Colas and D. Taisne, *assrs.* Produits Chimiques Ugine Kuhlmann, of Paris, France. **3,937,846.** 2nd June 1975; 10th February 1976. A dry mixture of 35-48 parts of urea with 65-52 parts of urea-phosphate (giving a material containing 61·5% urea and 38·5% phosphoric acid) is melted at 72°–90°C [(trace elements,) vitamins and a sulphate added to give a final product N:S ratio of at least 13:1], absorbed in an animal feed mixture (e.g. dried beet pulp) and cooled. The mixture may be made by reacting together, at 50°–80°C, phosphoric acid containing 45%–65% P_2O_5 with sufficient urea to give a 60–64% urea/36–40% phosphoric acid composition which is cooled to crystallize the urea/urea phosphate mixture and the latter separated from the aqueous liquor. During the cooling of the feed, or before absorption of the molten mixture, a basic material (soda, lime, magnesia, potash or a mixture of these) may be added, and molasses is added to the feed in the proportion of 0·1–20 parts per part of feed.

TRADE NOTICES

In-line pumps. SPP Group Ltd., Oxford Rd., Reading, Berks., England RG3 1JD.

SPP has introduced a new range of close-coupled, in-line centrifugal pumps for applications involving clean or slightly turbid non-corrosive liquids. Known as the "Instream" range, the pumps have maximum capacities of 30 litres.sec^{-1} at 1450 rpm and 60 litres.sec^{-1} at 2900 rpm (at corresponding maximum heads of 16 and 65 m, respectively). Operating temperatures are within the range between —10°C and +120°C, while maximum operating pressure at 120°C is 10 bar. The units are very compact and hence ideal for installation where there are space restrictions and pipework bends are undesirable. They are simply mounted by their suction and delivery flanges, so that no special couplings are needed, additional support being possible under the pump casing; the only position excluded is with the motor directly beneath the pump. Servicing is helped by the possibility of removing motor, support frame and impeller without disturbing pipework and seals. The pumps are available in all ferrous materials or with a bronze impeller. The twelve models have pipe diameters of 40 to 80 mm.

Diaphragm pump with PVC head. Neptune Chemical pump Co., P.O.Box 247, Lansdale, PA 19446, USA.

Available from Neptune is a high-pressure diaphragm pump having a PVC (polyvinyl chloride) head which permits handling of corrosive liquids such as chlorine, sulphuric and hydrochloric acids. The Series 500-PVC pumps operate at up to 36 gal.hr^{-1} and pressures up to 400 psi. They have removable valves which can be cleaned without disturbing the pump piping. Other features include the possibility of adjusting capacity over the complete capacity range and a hydraulically balanced "Teflon" (polytetrafluoroethylene) diaphragm. The power train is submerged in an oil bath.

Dissolved oxygen meter. Electronic Instruments Ltd., Hanworth Lane, Chertsey, Surrey, England KT16 9LF.

Electronic Instruments Ltd., a member of the George Kent Group, announce the introduction of the Model 9440 dissolved oxygen meter which uses a single sensor to give a value in ppm or % saturation. The meter is housed in a rugged, weather-proof case suitable for mounting in process control or effluent treatment applications. The incorporation of automatic self-calibration permits measurement even under worst possible conditions and minimizes on-site checks, while also ensuring optimum electrode performance over long periods.

PUBLICATIONS RECEIVED

Stainless steel products for the food and drink industry. Pegler & Louden Ltd., 8 The Midway, Nottingham, England.

A catalogue is available which lists stainless steel products maufactured by Pegler & Louden Ltd. for the food and drink industry, including smooth-bore welded tubing, pipeline fittings, flow gauges, flow meters, valves, agitators, manways and tank cleaning equipment.

Micro-processor weighing system. Richard Simon & Sons, Weigher Division, Park Lane, Basford, Nottingham, England NG6 0DT.

A new leaflet from Richard Simon & Sons describes the "Microbatch" micro-processor system for automatic batch weighing, which enables a single weigher to handle a number of programmes and permits several weighers and micro-computers to be linked to a host computer programmed for a particular application.

Volumetric metering feeder. Simon-Solitec Ltd., Bristol Rd., Gloucester, England GL2 6BY.

A new brochure from Simon-Solitec, a member of the Simon Engineering Group, describes the Mk II volumetric metering feeder developed by the company to handle materials on a batch or continuous basis at up to 0·8 m^3.hr^{-1}. The material, powdered or granular, is fed from a vertical hopper to a trough and thence to a horizontal feed screw and finally to a discharge tube. Five different drives are available, while the amount of material delivered may be adjusted manually or automatically. A vibrator motor ensures constant density of the material in the supply hopper.

Barrier seals. Actuated Controls Ltd., Vale Lane, Hartcliffe Way, Bristol, England BS3 5RU.

A leaflet from Actuated Controls describes the Model BDS chemical seal, available in four patterns, which is intended to isolate a pressure sensing instrument from the process fluid. The space between the diaphragm seal and instrument is filled with a suitable fluid; pressure acting on the diaphragm is transmitted to the fluid, and this in turn activates the instrument. The pressure range is 1–250 bar. The main body is made of stainless steel.

"Farrel worldwide". Farrel Machinery Group, USM Corporation, 25 Main St., Ansonia, CT 06401, USA.

A 36-page booklet with four-colour illustrations describes Farrel activities in the manufacture of machinery and design of production systems for various industries including the sugar industry, in which the company is particularly well known for cane mills.

Centrifugal orders.—The Western States Machine Co. has been awarded contracts for the supply of 31 automatic batch and continuous centrifugals, 12 for Dwangwa factory in Malawi and 19 for the factory being built for the Royal Swaziland Sugar Corporation in Swaziland.

Packaging division formed.—Darenth Weighing Equipment Ltd., specialists in industrial weighing equipment and systems, have formed a packaging division which will manufacture fully automatic materials handling systems, including sack applicators, flatteners, conveyors and palletizers to add to the existing Darenth product range of valve sack packers, open top sack fillers, continuous check weighers and drum filling equipment.

Sugar dryers for Mauritius.—To meet the demand for a dry export sugar (to be despatched in bulk from a new sugar terminal at present under construction and planned for completion by 1980), six Mauritian sugar factories will install dryers to be supplied by Newell Dunford Engineering Ltd. The main parts of the dryers and dust separation equipment will be manufactured locally by Forges Tardieu Ltd.

"Golden Syrup" tanks at Tate & Lyle.—With expansion of "Golden Syrup" production at Plaistow Wharf refinery, seven stainless steel tanks supplied by the Braby Group Ltd. were installed for use as cisterns for product processing before storage in a further three Braby tanks. Another four Braby tanks form part of the raw material store.

BREVITIES

Dutch factory resumption of operation[1].—The Groningen sugar factory of Suiker Unie which was damaged by fire[2] on September 20, 1978 resumed operations on October 21. The four-year plan for enlargement of the factory from 7000 to 11,000 tons daily beet slice has not been affected and will be completed by 1980.

Egypt sugar situation[3].—Egyptian sugar production in the 1977/78 season is estimated at 593,200 tonnes, down from 618,000 tonnes in the previous season, while net imports of white or refined sugar are put at 355,000 tonnes, compared with 204,000 tonnes in 1977, according to the US Department of Agriculture. The area under cane increased from 170,000 feddans in 1976/77 to 183,700 feddans in 1977/78 (1 feddan = 1·038 acres). However, the yield declined from 5,800,000 tonnes of cane containing 10·7% sugar in 1976/77 to 5,750,000 tonnes of cane of 10·3% sugar content in 1977/78. Yields and sugar content have been declining steadily over the past five years, caused by a combination of the lack of chemical inputs and of adequate cultivation equipment, poor drainage and increasing salinity. Sugar consumption has increased in the past few years and is forecast at about 900,000 tonnes in 197 against 810,000 tonnes in 1977. The USDA said that the Egyptian Ministry of Supply has been the exclusive importer and distributor of sugar for consumers and industrial users, but plans are for factories to import their own sugar requirements.

Togo sugar complex[4].—Planting began in May of the sugar cane for the Sokodé complex which is now reported as covering 6000–7000 hectares. Yield is expected to be 35–45 tonnes per hectare and the factory will have a processing capacity of 300,000 tonnes of cane, to produce 15,000 tonnes of tablet sugar and 10,000 tonnes of granulated sugar. The French company SOMDIAA will be responsible for the first five years. The total investment is put at $93,000,000. China has offered a second aid project to Togo[5], following the construction of the dam at Kpota (Tsévié) in the form of another sugar complex but with less than half the capacity of Sokodé.

Mexico sugar expansion[6].—While the world is concerned with an excess of sugar production over consumption, Mexico is struggling to produce sufficient sugar to meet domestic requirements so as to avoid the need for imports (which require foreign exchange) and to meet the export quota of 75,000 tonnes allocated under the International Sugar Agreement. To this end, during the period 1977-1982 plans call for an additional 172,000 ha planted to cane and building of 4–6 new sugar factories of about 6000 t.c.d. capacity each, in addition to four new factories which went into operation this year (Ingenio Tres Valles in Veracruz, Ingenio Alvaro Obregón in Quintana Roo, Ingenio Huixtla in Chiapas, and Ingenio Juchitán in Oaxaca).

Tunisia sugar expansion[7].—It is hoped to increase the area devoted to sugar beet from 3500 hectares, yielding 100,000 tonnes of beet per year, to 10,000 hectares with land to the north and east of Béja. The factory at Béja produces 70,000 tonnes of sugar per year—6% of domestic consumption—and it is hoped to increase production with the aid of a second factory[8] to reach 22%.

Guatemala sugar crop, 1977/78[9].—The sugar season in Guatemala normally runs from December to July or August but, during the 1977/78 season operations closed in May, as a consequence of low prices for cane and sugar, both domestic and export sales. Of the intended 91,000 hectares, only 81,000 were harvested for centrifugal sugar manufacture, the balance being diverted to non-centrifugal sugar production. The sugar outturn is estimated at 450,000 tonnes, compared with 527,000 tonnes from the 1976/77 crop.

Algeria sugar imports[10]

	1977	1976	1975
	tonnes, raw value		
Argentina	18,580	0	0
Brazil	200,742	225,817	172,786
Cuba	51,145	35,191	46,495
Czechoslovakia	6,315	0	0
Dominican Republic	0	0	4,167
EEC	62,497	26,323	66,960
Egypt	37,615	0	0
Finland	5,764	0	0
Germany, East	9,663	0	0
Guyana	0	44,364	5,227
India	0	1,085	0
Philippines	33,696	37,939	0
Poland	58,962	6,012	651
Sweden	4,717	0	0
Switzerland	1,438	0	0
USSR	0	5,467	0
Other countries	0	2	0
	491,134	382,200	296,286

West Indies sugar crops, 1978[11].—Crops have ended in Barbados, Jamaica, St. Kitts and Trinidad (although Jamaica probably started the new crop in early December or even late November, which will add to the tonnage for the 1978 calendar year) and only Guyana remains with the autumn crop running to the end of the year. In round figures, 1978 production will be:

Barbados	99,000
Guyana	325,000*
Jamaica	310,000
St. Kitts	40,000
Trinidad	145,000
	919,000 long tons, tel quel.

*F. O. Licht estimate.

With local consumption and local exports at around 204,000 tons, this would give an export availability of some 720,000 tons, taking into account carry-over stocks from 1977. Weather in the early part of the growing season for the 1979 crop has, in general, shown an improvement on previous years with better rainfall. With continuation of good weather in November and December, better industrial relations and a real attempt to reduce the incidence of illegal cane fires, a production of 950,000 tons may be hoped for in 1979.

USSR beet crop, 1978[12].—According to official sources, more than 3,730,000 hectares has been sown to sugar beet for the 1978 crop and planned beet production is around 96,000,000 tonnes, 4,000,000 tonnes more than in 1977. Weather conditions have been such that, in the majority of beet growing regions, harvesting of beet will coincide with that of cereals, sunflower, potatoes and other crops. Because of this it is likely that there will be difficulties with transport and delays in delivering beet to the factories. Further, while 78,000 beet harvesters are planned to be used in the 1978 crop, including 14,000 six-row machines, lack of spare parts will make their overhaul impossible and may lead to delays in lifting. It may be, therefore, that production of sugar in 1978/79 will not exceed that of 1977/78.

New Indian sugar factory.—Punjab Khand Udyog Ltd., a subsidiary of the Punjab State Industrial Development Corporation, is in the process of setting up a sugar mill at Gurdaspur.

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[1] *Zuckerind.*, 1978, **103,** 987.
[2] *I.S.J.*, 1978, **80,** 351.
[3] *Reuters Sugar Rpt.*, 12th September 1978.
[4] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (26), 19.
[5] *I.S.J.*, 1977, **79,** 119.
[6] *Sugar y Azúcar*, 1978, **73,** (8) 30–31.
[7] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (27), 15.
[8] *I.S.J.*, 1978, **80,** 128.
[9] *World Sugar J.*, 1978, **1,** (4), 27.
[10] *I.S.O. Stat. Bull.*, 1978, **37,** (8), 17.
[11] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (29), 18–19.
[12] *World Sugar J.*, 1978, **1,** (4), 26.

BREVITIES

Dominican Republic sugar situation.—Sugar production for 1977/78 is reported[1] to be 1,197,536 tonnes, raw value, compared with the earlier estimate of 1,320,000 tonnes, as about 1,300,000 tonnes of cane was left uncut to reduce production and surplus stocks[2]. With 153,000 tonnes of stocks from the 1976/77 crop year, and domestic demand of about 173,000 tonnes, there will therefore be a total surplus of 1,177,000 tonnes. If about 10% is kept in reserve, according to the aims of the International Sugar Agreement, the country's exportable surplus will be reduced to about 1,060,000 tonnes, while its quota limit remains at 935,000 tonnes.

US cane varieties[3].—The US Department of Agriculture, Science and Education Administration, the Louisiana Agricultural Experiment Station and the American Sugar Cane League of the USA Inc., working cooperatively to improve sugar cane varieties, have jointly developed two new varieties for commercial planting. The variety CP 70-321 equalled the leading commercial variety CP 65-357 in a total of 46 replicated tests, in tons of cane per acre, sugar per ton and sugar per acre. It is moderately resistant to mosaic and infected plants are tolerant. It is susceptible to ratoon stunting disease but yield reduction is moderate; seed cane should be heat-treated. It is well adapted to light soils but less well to heavy soils. Being moderately erect, with a tendency towards brittleness, it is well suited to mechanical harvesting. The second variety, CP 70-330, gives moderate yields of cane but high sugar % cane on light soil. On heavy soil, however, it gives as good sugar per acre as CP 65-357. It is moderately resistant to mosaic, susceptible to ratoon stunting disease, and also well adapted to mechanical harvesting. It is resistant to borers but susceptible to freezes.

Hawaiian cane harvester design[4].—A chopper-type harvester is being used to cut green cane at Laupahoehoe Sugar Company on the island of Hawaii. It includes features of the Toft 564 and Stubenberg S-75 machines with a Caterpillar 3408 engine and mounted on Caterpillar D-7 tracks. All drives, including the tracks, are hydrostatic. The cutting assembly, feed rolls and chopper are similar to the Toft unit, except that the base cutters are driven independently of the vertical feed rolls to allow variable control of the latter and maintenance of a fairly high cutter tip speed. The horizontal feed rolls are independently powered with variable speed control, while the chopper assembly is from the Toft harvester, but with the direction of rotation reversed. The 4 ft wide primary elevator has a maximum speed of about 500 ft.min^{-1} which thins out the flow of cane before it passes through the air-blast. A similar speed can be reached by the discharge conveyor which throws cane into the following transport unit.

Niger sugar complex[5].—Niger has commissioned two French firms to build a sugar complex at Tillabury on the River Niger, some 110 km to the north-west of the capital. Feasibility studies will start on the complex which is expected to have an annual capacity of at least 20,000 tonnes, although this is not yet certain. The project will use irrigated land, as Niger is about 80% desert. The French firms TECHNIP and CFDT will run the project for the first five years of its operation until they have trained local staff within the organization which has launched the plan, Société Sucrière Nigérienne.

Nepal sugar factory[6].—China is to build a sugar factory for Nepal under an agreement signed on October 1, 1978 by the Nepalese Prime Minister and China's Senior Vice-Premier. Daily crushing capacity will be 1000 tonnes of cane and it will have the facility to divert surplus cane for the manufacture of industrial alcohol[7].

India sugar statistics[8]

	1977	1976	1975
	tonnes, raw value		
Initial stocks ...	1,339,554	1,237,148	1,096,231
Production	5,018,798	5,033,400	5,047,579
	6,358,352	6,270,548	6,143,810
Consumption ...	4,232,089	4,016,087	3,858,801
Exports:			
Afghanistan...	0	11,390	10,848
Algeria	0	1,085	0
Egypt	21,459	83,745	184,086
Hungary	0	0	12,529
Indonesia ...	106,818	167,571	48,325
Iran.....	0	135,127	416,311
Iraq.....	0	9,763	0
Jordan	0	11,933	9,852
Kenya	5,261	0	0
Maldives	1,139	380	434
Nepal	0	4,696	2,897
Oman.....	271	0	0
Portugal	0	13,126	0
Qatar	0	0	1,627
Rumania	0	68,450	0
Seychelles ...	868	0	0
Somalia.....	0	22,780	0
Sri Lanka	29,863	13,668	10,750
Sudan	21,207	114,232	84,350
Tanzania	21,044	11,933	0
Tunisia	0	6,617	12,366
UK	29,419	29,940	38,076
USA	0	152,534	178,365
Yemen	39,052	55,937	23,919
Yemen Dem. Rep.	0	0	13,126
	276,401	914,907	1,047,861
Final stocks ...	1,849,862	1,339,554	1,237,148

Bulgaria sugar factory[9].—According to Polish press reports, the first test runs of a new sugar factory in Mitropolia have started. This factory has a daily processing capacity of 3000 tonnes of beet, to be doubled during the next 2–3 years. The factory will then be the largest in the Balkans. Another factory with a processing capacity of 5000 tonnes of beet per day is to begin operation in 1979, and will be the third supplied by Poland. Polish experts are also participating in the modernization of sugar factories in Bulgaria.

International Sugar Agreement export quota shortfalls[10]. Four members of the ISA have declared shortfalls against their export quotas for 1978. Guatemala has declared a shortfall of 95,000 tonnes out of its total quota in effect of 244,500 tonnes. Jamaica has declared a shortfall of 45,950 tonnes of its 105,950-tonnes quota in effect while Mozambique has declared a shortfall of 45,500 tonnes out of 81,500 tonnes and Trinidad a shortfall of 32,826 of its 70,000 tonnes quota in effect. Total declared shortfalls amount to 219,276 tonnes and, as they cannot be redistributed while the prevailing price is below 12·00 cents per pound, will reduce the surplus of availabilities over estimated free market requirements for the year.

Sweden sugar factory closure[11].—The Karpalund sugar factory of Svenska Sockerfabriks AB, which has a capacity of 2200 tons of beet per day, is to be shut down after the 1979 campaign.

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[1] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (29), 20.
[2] *Bank of London & S. America Rev.*, 1978, **12,** 570.
[3] *S. African Sugar J.*, 1978, **62,** 462.
[4] *Sugar y Azúcar*, 1978, **73,** (10), 14–15.
[5] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (29), 20.
[6] *Westway Newsletter*, 1978, (60), 13.
[7] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (32), 20.
[8] *I.S.O. Stat. Bull.*, 1978, **37,** (8), 57.
[9] F. O. Licht, *International Sugar Rpt.*, 1978, **110,** (31), 2.
[10] *World Sugar J.*, 1978, **1,** (5), 27–28.
[11] *Zuckerind.*, 1978, **103,** 988.

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