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SEPTEMBER 1976

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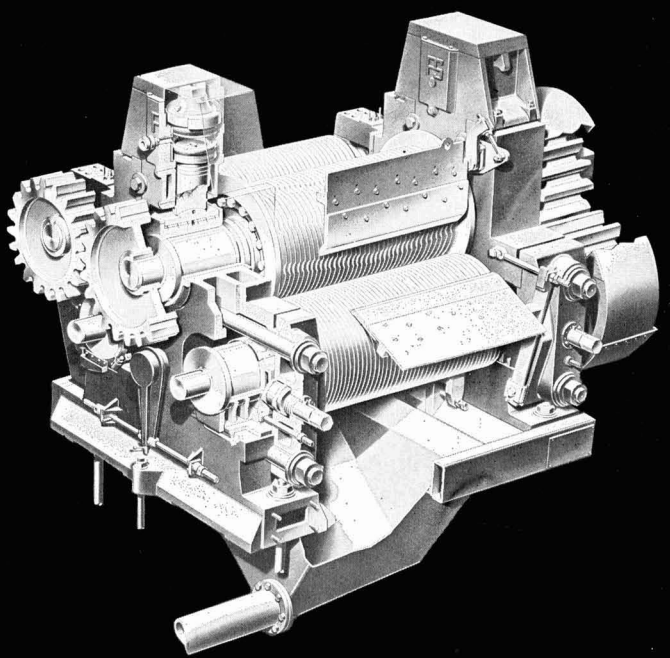

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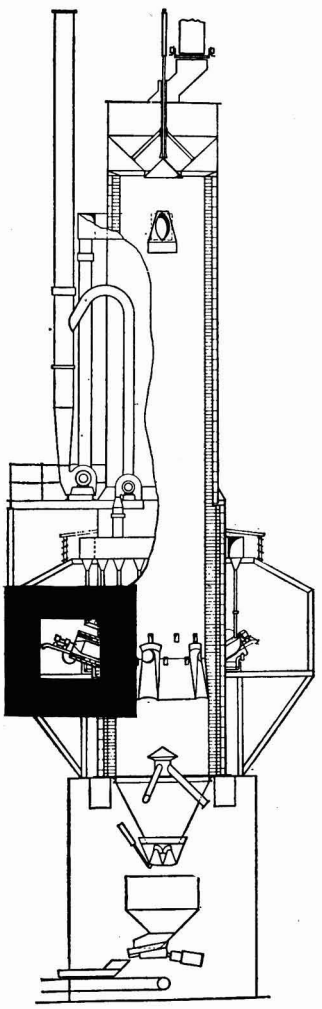

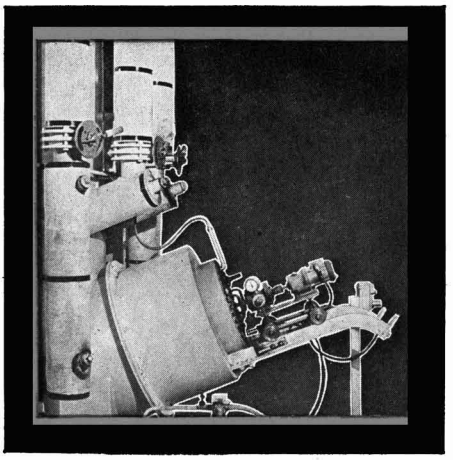

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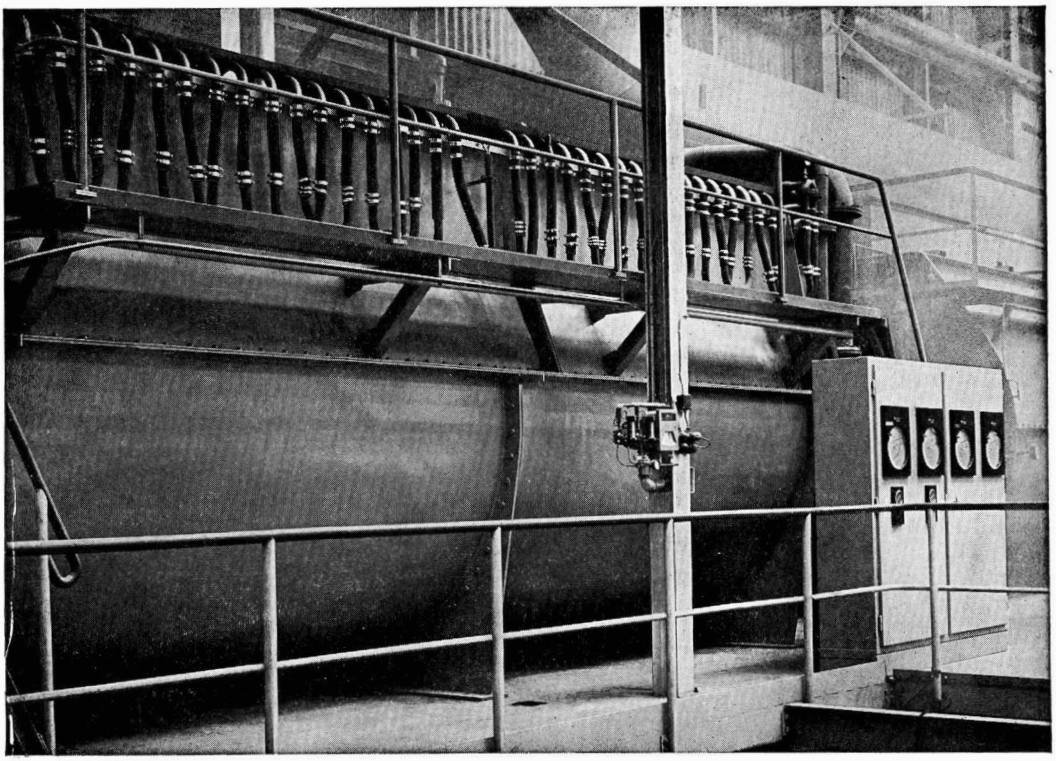

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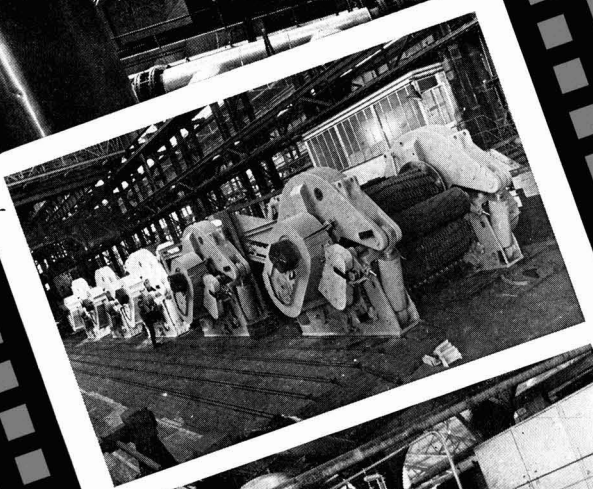

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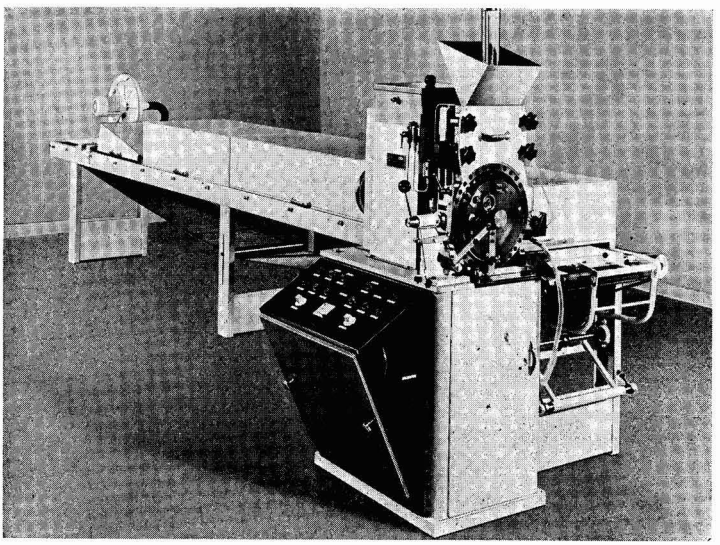

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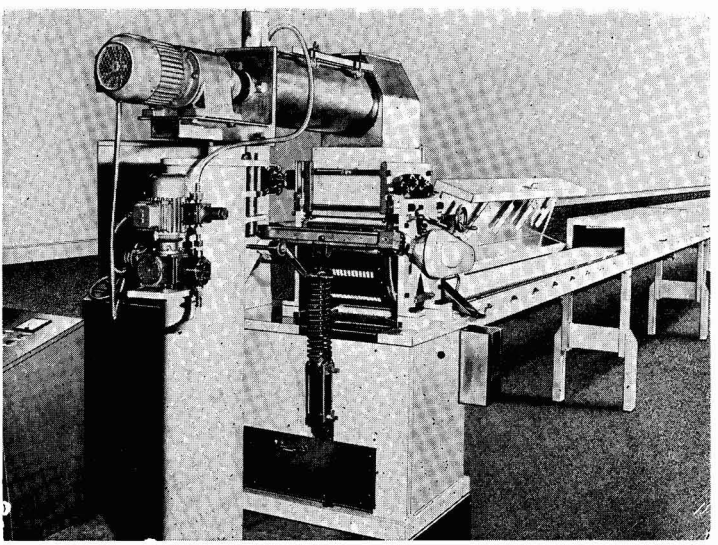

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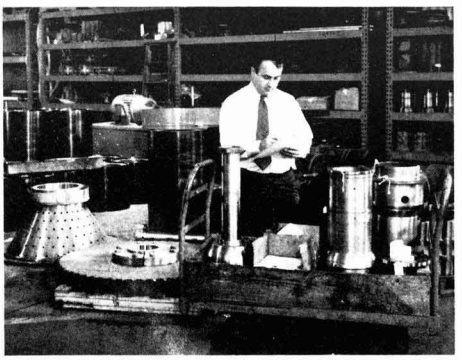

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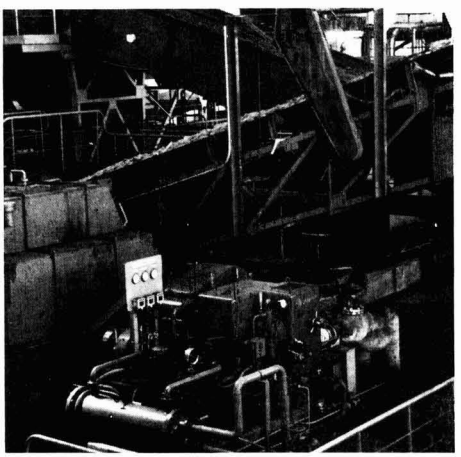

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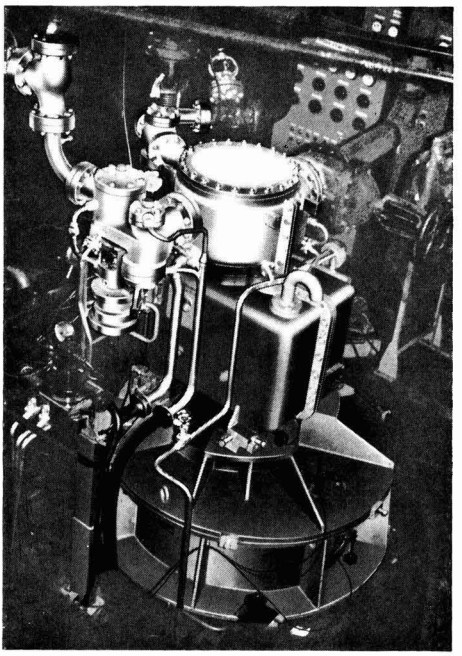

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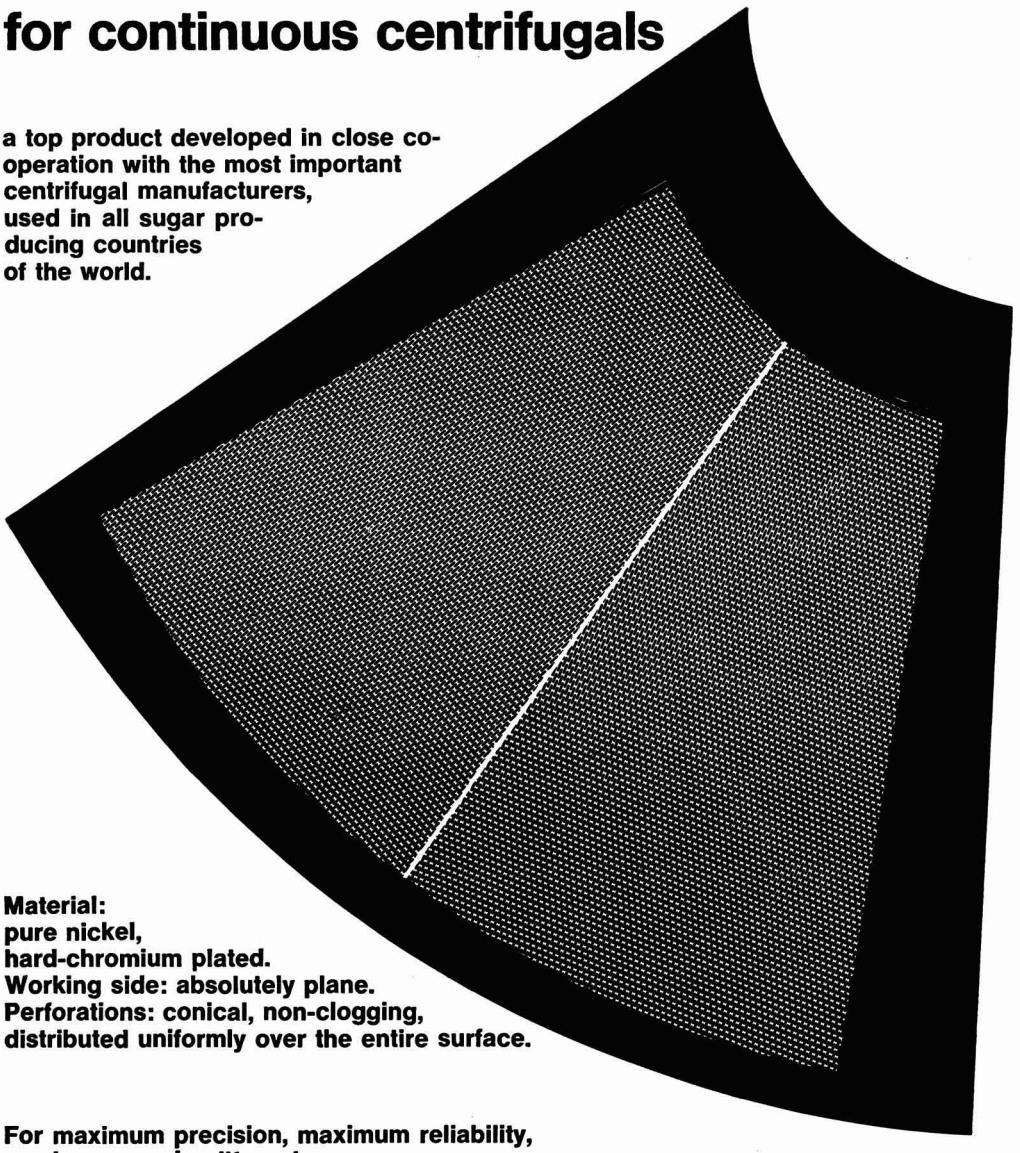

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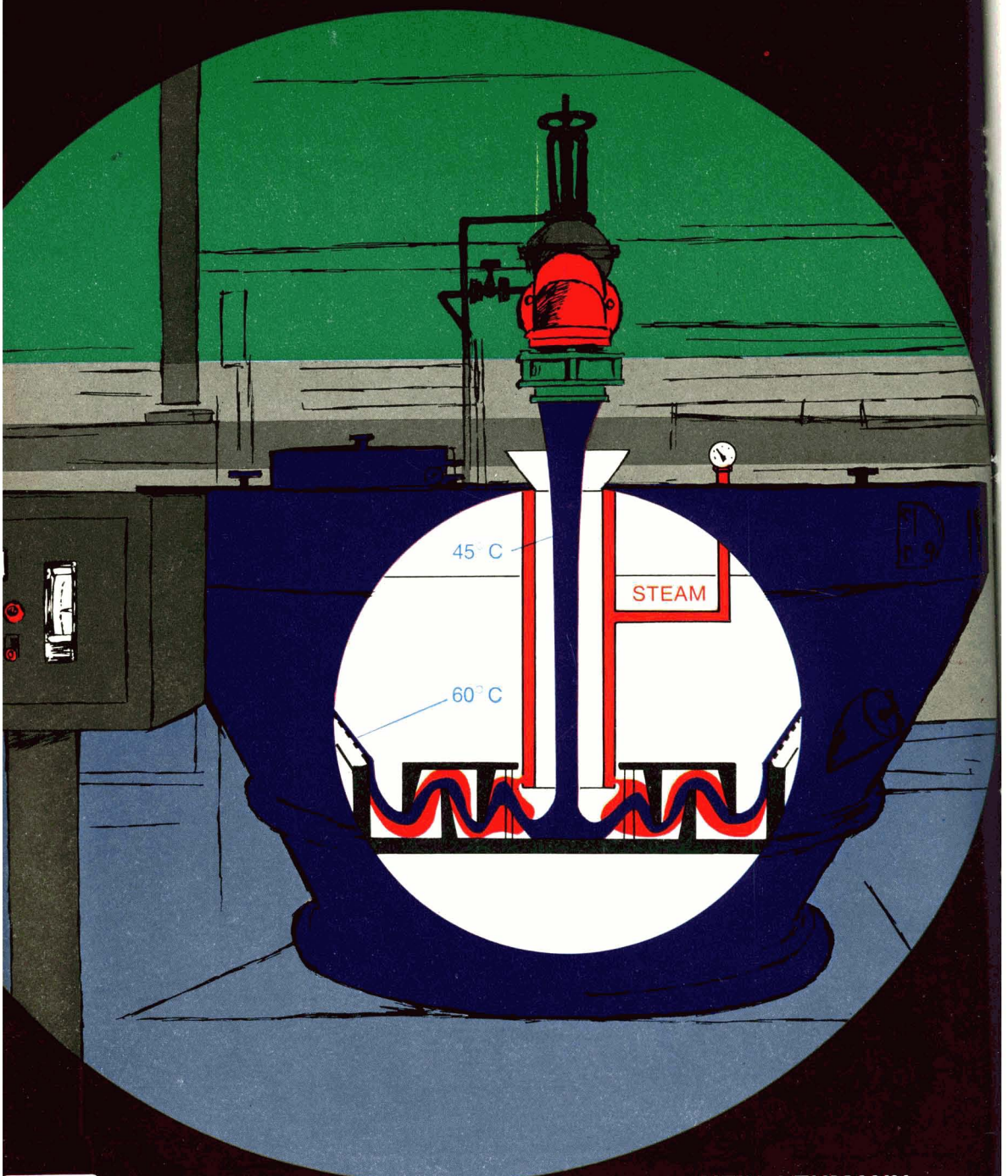

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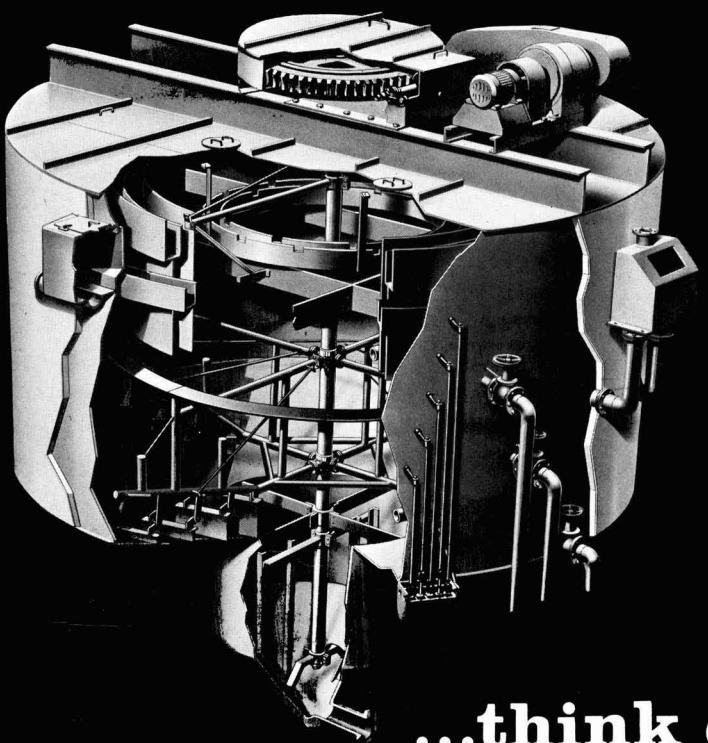

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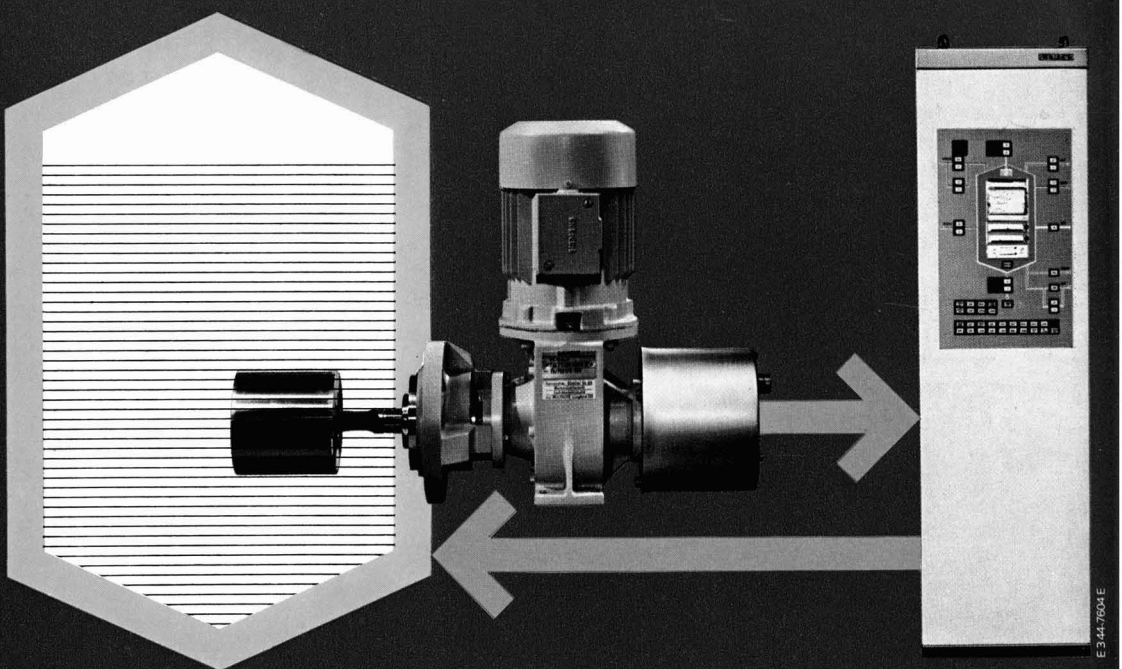

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International Sugar Journal

September 1976

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Inhibition de brunissement enzymatique pendant l'élaboration du sucre de canne. N. H. SMITH. *p.* 259–263

L'auteur présente des informations sur ses études des effets du chauffage par vapeur de canne avant de broyage sur le couleur et son développement pendant l'élaboration. Il a conclu que le chauffage empêche le brunissement enzymatique et ainsi cause des changements des propriétés du couleur du sucre brut, par exemple, réduction du niveau (en particulier, du couleur dérivé des colorants de haut poids moléculaire), diminution de la proportion des colorants inclus au cristal, et augmentation du sensibilité du couleur aux variations de pH. Les conclusions sont basées sur les resultats du fractionnement sur "Sephadex G-25".

* * *

Le décantateur "Enviro-Clear Rapid" en Europe. L. ROSENBERG, R. J. M. GOOS et A. H. K. F. RAAB. *p.* 263–266

On discute les avantages et inconvenients du décantateur "Enviro-Clear Rapid", en comparaison avec le filtre-épaississeur, et décrit l'utilisation d'un décantateur d'échelle de laboratoire, qui peut être transporté facilement en deux valises, pour démontrer les capacités du décantateur E-C aux clients potentiels en leurs sucreries. On donne détails du décantateur installé au sucrerie de Lehrte, en Allemagne Occidentale, par Stork-Werkspoor Sugar B.V. Une installation pour préparer du floculant est décrit aussi.

* * *

Développement et structure de l'industrie sucrière de Thaïlande. 1ère partie. P. ABDULBHAN et K. SUKSUPHA. *p.* 266–269

Se présente un examen de l'industrie sucrière de la Thaïlande, avec des renseignements sur la production de canne et de sucre pendant la période 1961–1975, surface plantée à canne, rendement de canne, consommation de sucre, et capacités nominales des 41 plus grandes sucreries.

Inhibierung der enzymatischen Bräunung bei der Verarbeitung von Zuckerrohr. N. H. SMITH. *S.* 259–263

Es wird über Untersuchungen über den Einfluss der Dampfbehandlung des Zuckerrohrs vor dem Mahlen auf die Farbe und die Farbbildung während der Verarbeitung in der Fabrik berichtet. Bei diesen Untersuchungen wurde festgestellt, dass die Dampfbehandlung die enzymatische Bräunung hemmt und daher Änderungen in den Eigenschaften der Rohzuckerfarbe hervorruft. Dazu gehört eine Reduzierung der Farbtiefe (insbesondere der Farbe, die von Farbstoffen mit hohem Molekulargewicht herrührt), ein Rückgang im Anteil der im Kristall eingeschlossenen Farbstoffe sowie die erhöhte Empfindlichkeit der Farbe gegenüber pH-Änderungen. Die Feststellungen sind aus den Ergebnissen von Fraktionierungsversuchen mit "Sephadex G-25" abgeleitet.

* * *

Der Enviro-Clear-Schnelldekanteur in Europa. L. ROSENBERG, R. J. M. GOOS und A. H. K. F. RAAB. *S.* 263–266

Die Verfasser diskutieren die Vorteile des Enviro-Clear-Schnelldekanteurs gegenüber den Filtereindickern. Sie beschreiben ferner die Verwendung einer Laboratoriumsausführung des Dekanteurs, die mit Zubehör leicht in zwei Koffern transportiert werden kann, um die Eignung des Enviro-Clear-Schnelldekanteurs für mögliche Kunden in der Zuckerindustrie zu demonstrieren. Weiter werden Details über den in der Zuckerfabrik Lehrte in Westdeutschland von der Firma Stork-Werkspoor Sugar B.V. installierten Enviro-Clear-Schnelldekanteur angegeben. Schliesslich wird noch ein Flockungsmittel-Präparat beschrieben.

* * *

Ausbau und Struktur der Zuckerindustrie in Thailand. Teil I. P. ABDULBHAN und K. SUKSUPHA. *S.* 266–269

Es wird ein Überblick über die thailändische Zuckerindustrie gegeben. Der Bericht enthält Angaben über die Rohr- und Zuckerproduktion in der Zeit von 1961 bis 1975, die Rohrausbeute, den Zuckerverbrauch sowie die Nominalkapazität der 41 grössten Zuckerfabriken.

Inhibición de formación enzimática de materia de color pardo en la fabricación de azúcar. N. H. SMITH. *Pág.* 259–263

Se hace un informe acerca de estudios sobre los efectos del calentamiento de caña antes de molienda sobre color y su desarrollo en el proceso de fabricación. Se estableció que calentamiento inhibió formación enzimática de material de color pardo y, por esto, causó cambios en las propriedades del color de azúcar crudo, inclusivo de reducción de su nivel (especialmente de color derivado de materias colorantes de alto peso molecular), disminución en la proporción de materias colorantes incluido en el cristal, y aumento en la sensibilidad del color a cambios en pH. Los discubrimientos se basaron sobre las resultas de fraccionación en "Sephadex G-25".

* * *

El clarificador "Enviro-Clear Rapid" en Europa. L. ROSENBERG, R. J. M. GOOS y A. H. K. F. RAAB. *Pág.* 263–266

Se discuten los ventajes y desventajes del clarificador "Enviro-Clear Rapid" en comparación con filtro-espesadores, y se presenta una descripción del uso de un clarificador de escala de laboratorio, que puede transportarse facilmente (con su equipo auxiliar) en dos maletas, para demostrar a clientes potenciales en centrales azucareras, las capacidades del clarificador E-C. Se presentan detalles del clarificador E-C instalado en la fabrica de Lehrte, en Alemania Occidental, por Stork-Werkspoor Sugar B.V. Una planta para disolver el floculante se describe también.

* * *

Desarrollo y estructura de la industria azucarera de Tailandia. Parte I. P. ABDULBHAN y K. SUKSUPHA. *Pág.* 266–269

Se presenta un examen de la industria azucarera de Tailandia, con información acerda de producción de caña y de azúcar en el período 1961–75, el área sembrado de caña, rendimiento de caña, consumo de azúcar, y capacidades do los 41 centrales mayores.

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVIII SEPTEMBER 1976 No. 933

Notes & Comments

High fructose corn syrup and sugar production in the EEC[1]

Concern was expressed during the recent 26th Congress of European sugar beet growers (C.I.B.E.) over the effect of increased production of high fructose corn syrup on the sugar industry in Europe. It was pointed out that the establishment of a restitution in favour of ECC maize and potato starch producers created an imbalance in favour of the glucose industry and to the detriment of sucrose producers. This had not been so important before since glucose syrups were not as sweet as sugar and had other characteristics such that they did not serve to replace sugar.

With the advent of HFCS, however, the picture was altered since these are virtually the same as syrups produced by inverting sucrose and they have the benefit of the restitution, from 1st July equivalent to 24·15 units of account per metric ton of dry glucose/fructose. At the same time, the internal market within the EEC for sugar is strictly limited by the system of quotas with a production levy on sugar over the basic quota; no restrictions apply at present to HFCS production. Further, in several EEC countries sugar from beet or cane is subjected to excise duty which is not charged on isomerized glucose syrups. Replacement of any part of the EEC market for sucrose means that more has to be exported, the Community being a net exporter.

It was estimated at the end of March 1976 that production of HFCS in Europe amounted to 100,000 tons a year (70,000 tons sugar equivalent), including 15,000 tons in Holland, 20,000 tons in Belgium, 35,000 tons in Spain and 30,000 tons in West Germany. A new facility is being built in Belgium with an annual production capacity of 100,000 tons while another in the UK will have a similar capacity. A further plant to produce 100,000 tons/year is to be built in the UK in 1977 and later another of the same capacity in Ireland. Plans also exist for factories in France and southern Italy each to produce more than 100,000 tons/year. Taking all known plans into consideration, it is estimated that more than 500,000 tons/year of HFCS will be produced within the next three years and, according to some recent American publications, it is planned and intended to double this potential within a relatively short time.

The threat posed to the sugar industry is obvious and it was demanded at the congress that the restitution for glucose should be limited to non-food uses of starch or removed by its reimbursement or levying a community tax equivalent to the restitution. Statistics on production and outlets for the glucose sweeteners should be required as with sugar, and the HFCS should be introduced into the common customs tariff and into the common organization of the sugar market so that it can be treated as the sweetener it is rather than as a cereal derivative.

* * *

UK sugar refining rationalization

When the negotiations for UK membership of the EEC were being concluded it became obvious that the amount of raw cane sugar to be imported by the UK for refining was going to be reduced, in face of easier access for white beet sugar from the Continent and higher domestic production. The two refining companies, Tate & Lyle Ltd. and Manbré & Garton Ltd., have applied themselves jointly to the problems arising and have submitted an analysis of prospects for the industry and its possible rationalization in face of the new conditions. The two companies disagreed on the measures necessary to cut capacity from its present 1,970,000 tons/year to the approx. 1,500,000 tons now needed. Manbré recommended that the Tate & Lyle Liverpool refinery be closed, while Tate & Lyle recommended closure of the two Manbré refineries in London and Lancashire, reduction of shift working at its own London refinery and closure of a small Scottish plant.

Closure of some facilities is inevitable but a number of factors, in addition to commercial ones, will govern the decisions to be made, since the plants are mainly located in areas of high unemployment. Discussion is still going on with the Government, and it is unlikely that any decisions will be taken involving closures before March 1977. The Government has promised aid to create employment for workers made redundant at closed refineries.

On 9th July, Tate & Lyle proposed merger discussions with Manbré and Garton, but the latter were not prepared to take part, stating that they had a duty to protect the interests of their employees.

On the 28th July, therefore, Tate & Lyle made a public bid for the company at a price valuing it at £44 million. Although the move had not been opposed by the Government or the Office of Fair Trading, the Manbré Board's rejection of it was supported by the three members of the Food and Drink Industries Council who have fears going beyond the concentration of refined cane sugar production in the hands of a single company. Manbré and Garton have a large interest in corn milling and glucose production, a field into which Tate & Lyle have recently moved,

[1] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (18), 1–7.

and a merger would mean that Tate & Lyle would not only have a monopoly of refined cane sugar production in the UK but also would control a substantial part of glucose and starch supplies to the food trade. The Council consequently appealed for the bid to be referred to the Monopolies Commission, whose decision was expected in the second half of August.

* * *

World sugar prices

From a level of £178 per ton at the beginning of July, the London Daily Price for raw sugar climbed to £197 by the 7th July and then slid during the remainder of the month, falling to £154 in the first few days of August. The corresponding white sugar values were £205, £216 and £188 per ton. The continuing drought in Europe and reports of dire distress for beet farmers, particularly in France, were the early strengthening factors, as was the report of a reduced sugar crop in India. However, rain fell during July in parts of northern Europe, albeit in insufficient amounts to enable the crop to make up for its lost growth, and virus yellows infection became evident in many areas. But reports of excellent crops in Brazil, Argentina, Australia, South Africa and Mauritius all helped to reduce prices. Towards the end of the month, the announcement by the USSR that it was intended to produce 8·89 million metric tons of sugar from a beet crop of 88 million tons (as against 7·4 million tons of sugar from 66·2 million tons of beet last year), plus the unexpectedly good results of beet tests in France and other European countries which indicated less damage to the crop than had been expected, caused a steeper fall in sugar prices at the end of the month.

* * *

Latin American sugar exporters group meeting[1]

After their 5-day meeting in Panama City in July, the GEPLACEA group of exporters issued a communiqué in which they claimed that a world-wide fall in sugar consumption has been caused by the international economic situation and not by high sugar prices. Production and consumption had remained balanced over the past year and delegates did not believe there was any great reason for a fall in prices. The objectives of the meeting had been to unify the policies of members and to fix "reasonable price limits" for sugar exports; however, the group did not establish common goals nor did it set a minimum price for sugar. Though no delegate mentioned a price limit, the Mexican delegate said that "Any price below 20 cents a pound is lower than the production costs of many of the GEPLACEA countries". He added that the Group did not favour production cuts. Delegates from 22 countries attended, with observers from the Philippines.

* * *

EEC/ACP discussions on sugar prices

Discussions have been taking place between representatives of the EEC and the ACP countries in order to clarify the terms under which sugar is supplied from the developing countries under the Lomé Agreement. The ACP countries have accepted that the recently negotiated price will apply for the 1976/77 period but wish to have a clearer definition of the price to be agreed, in time for future negotiations. They have pledged that they will meet their commitments to the EEC, following rumours that they might withhold supplies to obtain higher prices[2], a move which might have been effective, in view of fears of drought effects on the EEC beet sugar crop.

* * *

Pakistan sugar production[3]

Annual production of sugar cane in Pakistan varies between 20 and 25 million tons, but only some 25 to 30% of this is crushed by the sugar mills, the balance being utilized for the production of gur and khandsari. Currently there are 25 sugar mills in Pakistan, but it is the government's intention to encourage the growth of the domestic industry and there are plans to establish 15 new factories during the next ten years. The 1975/76 crop has been estimated at 614,000 tons but the expansion programme would take output to around the one million tons mark. Even so, this would not make Pakistan self-supporting, demand in 1979/80 being officially forecast at 960,000 tons and in 1985/86 at 1,500,000 tons.

Pakistan's sugar and cane production statistics covering the past several years are given below. It should be noted that there is also a small indigenous beet sugar industry in Pakistan.

Season	*Area (millions of acres)*	*Cane production (millions of tons)*	*Cane crushed by mills (millions of tons)*	*Sugar production (tons)*
1969/70	1·532	25·952	7·013	585,483
1970/71	1·420	23·870	6·438	505,753
1971/72	1·365	19·648	3·728	321,962
1972/73	1·318	19·632	4·597	410,208
1973/74	1·530	22·708	6·761	542,342
1974/75	1·662	20·906	5·158	452,782
1975/76	1·672	25·716	7·000	614,000

* * *

Spanish self-sufficiency in sugar[4]

For several years the area devoted to sugar beet in Spain was in the region of 200,000 hectares. In 1974, however, it was reduced to less than 130,000 hectares and production of sugar naturally fell proportionately. Imports had to be increased substantially and amounted to more than 500,000 metric tons, raw value. Of this quantity some 310,000 tons originated in Cuba.

In 1975 the beet area recovered to 190,000 hectares, while this year it has been expanded, according to latest assessments, to some 275,000 hectares. The increase in production expected from the 1976/77 crop is well in excess of anticipated domestic requirements and Spain has therefore found it necessary to negotiate reduced deliveries from Cuba. At meetings held in Havana recently it was agreed that shipments of raw sugar would amount to 120,000 tons in 1976, 130,000 tons in 1977 and 90,000 tons in 1978, compared with the original arrangements under which it had been agreed that 220/270,000 tons would be supplied in 1976 and in 1977.

In addition to the beet crop, Spain also produces sugar from cane, but output amounts only to some 25/30,000 tons a year.

Spain now faces a sizeable sugar surplus but for the time being exports are not envisaged.

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[1] *The Times*, 14th July 1976.
[2] *Public Ledger*, 17th July 1976.
[3] C. Czarnikow Ltd., *Sugar Review*, 1976, (1287), 94–95.
[4] *ibid.*, (1290), 105–106.

Inhibition of enzymatic browning in cane sugar processing

By Dr. NORMAN H. SMITH
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Introduction

CANE sugar colour is typically attributed to amino acid-sugar reactions (melanoidin formation via the Maillard reaction), thermal degradation and condensation reactions of sugars (caramel), alkaline degradation and condensation reactions of sugars, and oxidative reactions of polyphenolic compounds[1]. Of these, the first three are "non-enzymatic browning" reactions. Model systems composed of melanoidins and alkaline degradation products have been considered by some workers[2,3] to represent adequately the colorants present in cane sugar.

The identification of various polyphenols, which may contribute to the fourth source of sugar colour, has been the subject of recent publications[4,5]. The role of enzymes as catalysts in the oxidative reactions of these polyphenols has also received attention recently[6,7].

Enzymatic browning may proceed in two or three stages[8]. An enzyme, *o*-diphenoloxidase (*o*-DPO), can function as a catalyst in the oxidation of *o*-diphenolic substrates to *o*-quinones. If *o*-hydroxylating enzymes are also present, monophenolic substrates may take part. Finally, the reactive quinones can undergo further reactions, incorporating available phenolics and amino acids, to produce coloured high-molecular weight condensation products.

Chemical inhibition of enzyme activity has been reported[6]. In addition, deactivation by heat is inferred from a report on the properties of juice from heated first mill bagasse[9]. Knowledge of the role of enzyme activity in colour formation is not new[10], and an old patent claimed benefits due to heating cane prior to grinding, although the part played by enzyme deactivation was not recognised[11].

This article presents the results of recent studies on the effects of steam heating of cane prior to grinding*. Laboratory-scale milling tests, with and without the heating procedure, allowed a comparison of sugar colour at each step of the factory process. In addition, the fractionation of samples on "Sephadex G-25" and colour measurements at various pH values gave additional comparisons between the nature of the colorants present in cane products produced under normal conditions and when enzymatic browning is inhibited.

Methods

A standardized method was followed for the laboratory production of raw sugar. Duplicate samples of freshly-cut cane stalks were prepared for grinding by cutting into 4 to 12-inch pieces. For the heat treatment, the pieces were packed into a stainless steel pail equipped with a perforated copper tube to supply 10–12 psig steam. A coarse screen at the bottom of the pail provided a support under which condensate collected. After 10–15 minutes, during which the heated samples reached a temperature of 80–90°C, the samples were processed through a "Jeffco" cutter-grinder. Extraction of juice from the pulverized cane was accomplished by hydraulic pressing. Water equal in weight to that of the expressed juice was mixed with the bagasse for a second pressing. Condensate from the steam treatment supplied part of the water for the second pressing of the heat-treated samples. The mixed juice was clarified by addition of lime to pH 7·2 followed by heating, with stirring, to 80°C, and a one-hour settling time. The clarified juice was concentrated in a laboratory vacuum evaporator. Raw sugar was produced from the evaporator syrup using a laboratory crystallizing apparatus. The centrifuged sugar was washed successively with refined syrup, methanol, and finally *iso*-propyl alcohol to yield "crystal-washed" raws for subsequent colour analysis.

The samples collected for analysis were stored frozen until ready for analysis. To prepare for colour measurements, a 100 cm³ aliquot was mixed with 5 grams of filter aid and vacuum-filtered. Crystal-washed raws were first dissolved to provide 33° Brix solutions. The clear filtrates were diluted with buffer by a factor varying (with colour level and desired pH) from 2 to 10. Buffer solutions were prepared by mixing 1N ammonia and 1N acetic acid to pH 4, 7 and 9. The refractometer solids were determined on the unbuffered filtrates. The standard colours are reported as $10a^*_{420}$, measured at pH 7·0. The indicator value (I.V.), taken as a measure of pH sensitivity, is calculated as the ratio of colour at pH 9 to colour at pH 4.

The unbuffered filtrates were subjected to column fractionation on "Sephadex G-25". The eluting solvent was aqueous 0·2M potassium chloride containing 0·02% sodium azide and adjusted to pH 7·0 with ammonium hydroxide. The relative retention of colorants is reported as $K_D = (V_e - V_o)/(V_{Az} - V_o)$ where V_e, V_o and V_{Az} are the solvent volumes required to elute each colorant (V_e), completely excluded high-molecular weight reference (V_o), or a non-excluded and non-adsorbed low-molecular weight reference, such as sodium azide (V_{Az}). Results given as K_D values are essentially independent of column geometry and flow rate. K_D values range from 0 for very large molecules to 1 for very small molecules, and can exceed 1 for substances retarded by adsorptive forces.

A pair of samples was also prepared for fractionation studies by aqueous extraction of cane tops plus

[1] LAI *et al.*: *J. Chinese Agric. Chem. Soc.*, 1971, (Special Issue—Dec.), 40–50.
[2] COOKSON: *Proc.* 1970 *Tech. Sess. Cane Sugar Ref. Res.*, 103–113.
[3] REINEFELD: *Paper presented at 2nd Int. Conf. Chem. Tech. Sugar*, 1973; *I.S.J.*, 1974, **76**, 186.
[4] CARPENTER *et al.*: *Proc. 15th Congr. ISSCT*, 1974, 1318–1325.
[5] WILLIAMS *et al.*: *Phytochemistry*, 1974, **13**, 1141–1149.
[6] GROSS *et al.*: *I.S.J.*, 1976, **78**, 69–73, 106–109.
[7] HATANKA *et al.*: *J. Japan. Soc. Food & Nutrition*, 1973, **26**, (7), 457–462.
[8] WALKER: *Enzyme Tech. Digest*, 1975, **4**, (3), 89–100.
[9] SMITH *et al.*: *Proc. 14th Congr. ISSCT*, 1971, 1415–1425.
[10] BROWNE *et al.*: *Louisiana Agric. Exp. Sta. Bull.*, 1907, (91).
[11] BELL: U.S. Patent 57,465 (1866).

* This work was conducted cooperatively with the Sugar Technology Department, Hawaiian Sugar Planters' Association, using the HSPA "Mini-Factory".

Table I. Effect of heat treatment on sugar colour

Sample		*Control samples, no heat treatment* Colour[2]	Change in colour	I.V.[3]	*Test samples, with heat treatment* Colour[2]	Change in colour	I.V.[3]	*Change in colour from heating*
Juice[1]		178		4·3	95		18·8	—47%
Clarified juice[1]		159		5·3	128		11·6	—20%
	Change, in clarification		—11%			+35%		
Evaporator syrup[1]		176		5·8	143		13·6	—19%
	Change, in evaporation		+11%			+12%		
Washed crystal[1]		5·4		5·7	3·0		8·0	—44%
	Ratio crystal:syrup		0·031			0·021		—32%
Extract of tops-plus-leaves		1560		3·2	751		176	—52%
Extract of millable stalk:								
Top		1160		2·8	1500		102	+29%
Middle		169		5·5	96		26	—43%
Bottom		250		6·4	184		24	—28%

[1] Average of 8 tests.
[2] $10a^{1}_{420}$ at pH 7; samples filtered with filter aid prior to measurement.
[3] Indicator value: Ratio of colour at pH 9 to colour at pH 4.

leaves, with and without a heat treatment. Heating was carried out in water at 80°C for 15 minutes. Extraction was accomplished by disintegration in a high-speed blender. The extracts were worked up by vacuum filtration as previously described.

Additional samples were prepared in like manner to examine the effect of nodal location on juice colour.

Results

The averages of the data from eight pairs of processing tests are presented in Table I. The samples tested included two major Hawaiian cane varieties, sampled at maturity. Both clean, millable cane and cane stalks including leaves and tops were tested. All but one pair represent unburnt cane. The table indicates a 47% improvement in average juice colour as a result of heat treatment. This was reduced to a 20% improvement for clarified juice because of significant colour development (35%) during the clarification of the test samples, whereas the control samples showed the colour improvement (11%) which normally accompanies clarification. About 12% additional colour development accompanied concentration to evaporator syrup, leaving the test samples still 19% lighter than the control group. However, owing to a 32% lower ratio of colour boiling into the crystal, the test syrup yielded a washed crystal 44% lighter than did the control syrup.

The I.V. of each test sample is higher than the I.V. of the corresponding control sample. Clarification increases the I.V. of the controls but decreases the I.V. of the test samples. Both groups show a small increase in I.V. in evaporation, and a decrease in crystallization, especially in the test group. The significance of these changes will be discussed later.

The colours of aqueous extracts of tops-plus-leaves are included in Table I. The 52% reduction in colour from heating the trash is accompanied by an extremely large I.V., 176, in the treated sample.

Finally, Table I lists data for a comparison of colour characteristics dependent on stalk location. The top of the millable stalk is the largest contributor of colour, with the highly pH-sensitive extract of heated cane stalk 29% darker than the relatively pH-insensitive control extract. For the middle and bottom sections, however, the test samples are 43 and 28% lighter than the controls, respectively. Further, the I.V. of the control extract increases as lower sections of the stalk are sampled, while the reverse is true for the test samples.

Discussion

The effect of enzymatic browning on cane sugar colour can be demonstrated simply†. Fractionation of an extract of unheated leafy cane trash on "Sephadex G-25" yields a pattern which indicates the presence of high-molecular weight colorants almost exclusively (Fig. 1, left solid line). If the trash is heated prior to extraction, the broken line is obtained, indicating the presence of mostly low-molecular weight colorants and the suppression of high-molecular weight colorant formation. The nature of these low-molecular weight colorants is suggested by their high K_D value (>2), since flavanoid pigments are among the substances strongly adsorbed by "Sephadex"[12]. That these pigments were not produced by the heat treatment itself can also be demonstrated. Extraction of juice in the presence of diatomaceous earth, which adsorbs the enzyme, is sufficient to circumvent browning. Juice extracted in the presence of diatomaceous earth, but without a heat treatment, and juice extracted from heated cane yield the same fractionation pattern of predominantly low-molecular weight colorants. Since the browning reaction involves an oxidation step, extraction under nitrogen provides an alternative demonstration of browning inhibition: the highly pH-sensitive flavanoids extracted in the absence of oxygen appear much lighter than the extract of relatively pH-insensitive browning products in the control sample. The visual difference is intensified by the inherently low pH.

Although the fractionation monitored at 420 nm yields results more closely related to the presence of visual colour, ultraviolet measurements provide the sensitivity often necessary where light-coloured sugar solutions are tested. In Fig. 1 the fractionation pattern for the extracts of heated and control leafy trash monitored at 420 nm, representing visual colour,

† Brief tests using sugar beets indicate a similar effect.
[12] Woof *et al.*: *J. Chromatog.*, 1976, **28**, 94–103.

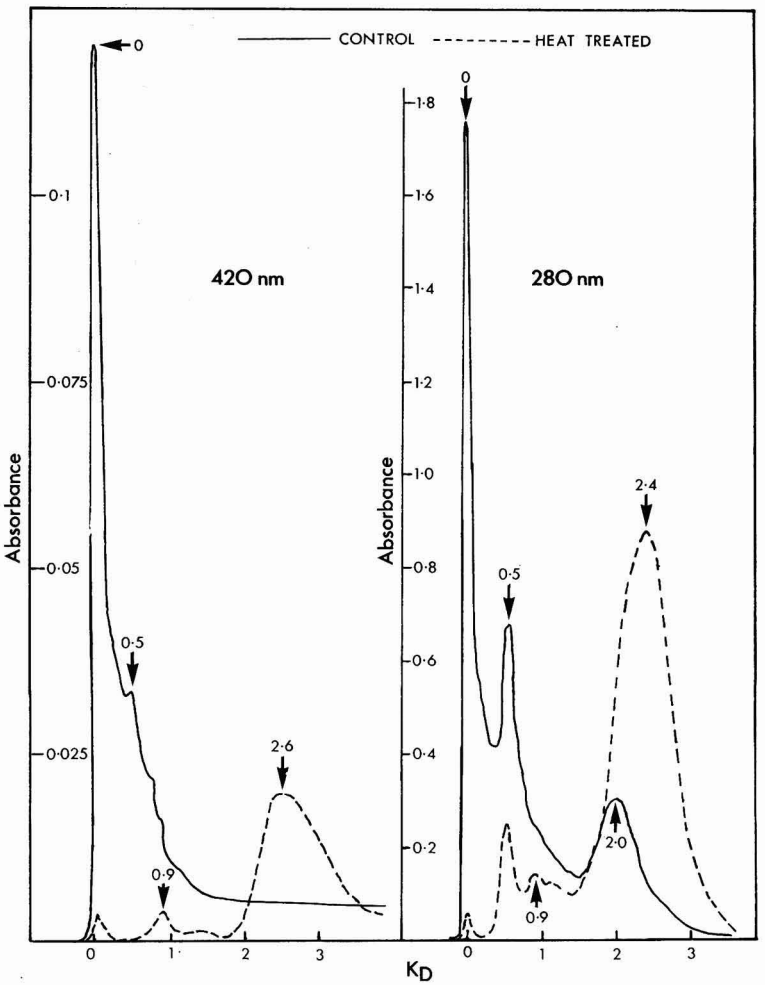

Fig. 1. "Sephadex" fractionation patterns for extracts of cane tops-plus-leaves

can be compared with replicates monitored in the ultraviolet region of the spectrum, at 280 nm. Apparently substances with high 280:420 absorbance ratios occur at $K_D = 0{\cdot}5$, and especially at $K_D = 2{\cdot}0$ (control sample). Nevertheless, the shift in composition from substances of predominantly high K_D in the extract of heated cane material to those of K_D approaching 0 in the control extract is clear.

The "Sephadex" fractionation patterns of the test and control samples, monitored at 280 nm for raw juice and crystal-washed raw sugar, are shown in Fig. 2. In each pair of curves, the characteristic difference resulting from the heat treatment is evident. In samples derived from normally processed cane, the peak at $K_D = 2{\cdot}2$ is absent, and there is a corresponding increase in absorbance caused by high-molecular weight colorants, especially at $K_D = 0$.

A detailed study of the changes in colorant composition which accompany the factory process is beyond the scope of this article. However, Fig. 2 demonstrates a build-up of colorants in the raw crystal (at $K_D = 1{\cdot}4$, $1{\cdot}8$ and $3{\cdot}4$) which were not obvious contributors to the juice colour. There also appears to be a decrease, in the crystal, in the contribution by colorants of $K_D = 0{\cdot}5$. Whether these are examples of variations in persistence of the colorants or represent colour development is not known.

The fractionation patterns for extracts of leafy trash (Fig. 1) and for cane juice (Fig. 2) differ in that the pattern for cane juice shows a major contribution in both the control and test juice samples by colorants of intermediate K_D values (0·5 to 0·9). Their absence in the extract of leaves-plus-tops may indicate differences in colorant composition between trash and stalk. An alternative explanation is that in cane juice, where the sugar:colorant ratio is high, colorants can interact with sugar to produce complexes of inter-

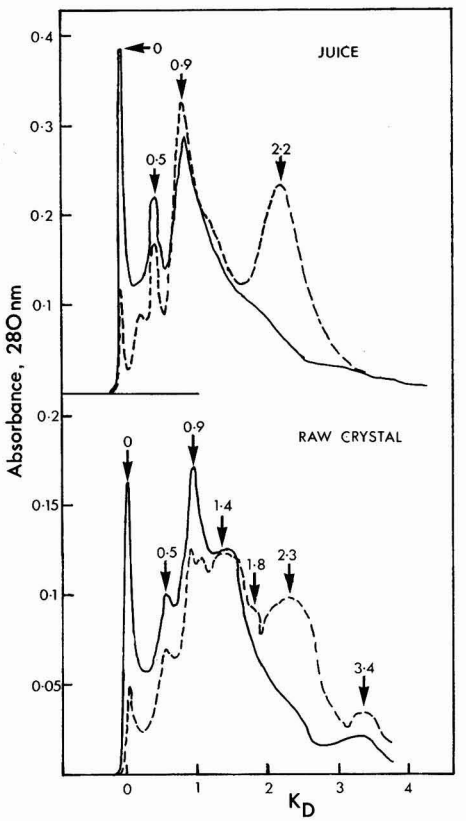

Fig. 2. "Sephadex" fractionation patterns for juice and raw sugar crystal from cane processed with and without heat treatment

———— control - - - - - heat treated

mediate K_D values. Sucrose itself has a K_D of about 0·7. Complexes between sucrose and colorants which are not retarded by adsorption effects could account for a K_D less than 0·7 (because they are larger than the sucrose molecule), while those retarded by adsorptive effects could be responsible for a K_D greater than 0·7.

In the foregoing discussion, the changes in colorant composition resulting from enzymatic browning were detected by gross changes in molecular size, as indicated by gel filtration. Another technique takes advantage of differences in chemical structure between many of the original pigments of the cane plant and most other colorants found in processed sugar. Because of their conjugated polyphenolic structure, many flavanoids possess a high sensitivity of colour to pH changes. We have defined the indicator value (I.V.) as the ratio of colour (at 420 nm) at pH 9 to that at pH 4. A high I.V. has been found to be characteristic of many naturally occurring plant pigments, while colorants produced by sugar degradation have a low I.V.[9,18]. Assigning low I.V. values to high-molecular weight colorants produced as a result of enzymatic browning reactions is consistent with results of earlier studies on the I.V. of fractions obtained by gel filtration of molasses[18]. Juice prepared under conditions where enzymatic activity was inhibited had an I.V. of about 19 (Table I). In comparison, the control sample had an average I.V. of 4·3. Table I also shows that the extract of heated leaves-plus-tops had an I.V. of 176, while the control had an I.V. of only 3·2. High values can be obtained whether inhibition of enzyme is produced thermally, chemically or by enzyme adsorption on kieselguhr.

In comparing extracts of various parts of the cane stalk, we find that the I.V. of extracts of heated cane stalk decreases, proceeding down the stalk. However, in the control samples the reverse is true; the I.V. increases toward the bottom of the stalk. In other tests it was found that enzymes producing browning are present throughout the stalk. It thus appears that the particular pigments involved in enzymatic browning do not include all of the pH-sensitive ones. As previously discussed, certain browning enzymes require a substrate having two *ortho*-hydroxyl groups, while other browning enzymes can oxidize mono- to di-phenols.

WILLIAMS *et al.*[5] identified three types of flavones in various sugar cane species. Of these three types (tricin, luteolin and apigenin), which have varying pH-sensitivity, only the luteolins possess an *ortho*-di-phenol structure. Apigenin glycosides have only one free hydroxyl group, but are oxidizable to a di-phenol. Tricin derivatives have a free hydroxyl group, but the ortho positions are not available for oxidation. (Only the B-ring hydroxyl groups are considered here, since those in the A-ring are probably not free owing to glycoside formation.) Thus there is a possible variation through the cane stalk in susceptibility of the pigments to enzymatic browning as well as in pH-sensitivity.

The increase in I.V. which accompanies colour reduction in the clarification of the control samples results from the preferential removal of high-molecular weight colorants. In the test sample, however, the juice is found to darken significantly in clarification. This increase in colour is associated with a decrease in I.V. Apparently the conditions of clarification favour the destruction of pH-sensitive colorants. The same loss of pH-sensitive colorants may accompany clarification of normally-processed juice, but is not apparent because of the relatively large amount of high-molecular weight colorant removal occurring simultaneously.

In concentrating clarified juice, both the control and test samples increase in colour (Table I). These increases are accompanied by an increase in I.V. A possible source of the colour increase is the hydrolysis of the *O*-glycosidic linkages of the flavanoids. This would increase the content of free phenolic hydroxyl groups (responsible for both pH-sensitivity of colour and reactivity), leading to additional (non-enzymatic) browning products.

In crystallization, the test samples show a large decrease in the pH-sensitivity of colour boiled into the crystal, while the controls show only a slight decrease. The decreases indicate that the colorants which boil into the raw crystal tend to be the less pH-sensitive types. Since it is the high-molecular weight

[18] SMITH: *Proc. 1966 Tech. Sess. Cane Sugar Ref. Res.*, 84–102.

colorants which have low I.V. values, we can expect the control syrups, containing higher proportions of these colorants, to yield relatively darker crystals. Indeed, we find the crystal:liquor colour ratio of the controls to average 0·031, compared with only 0·021 for the test samples.

Observations made during the processing tests and measurements of other properties of the test samples indicate that additional benefits of heat treatment may ensue. These include less foaming in clarification, less invert formation, and better filtrability of raws.

Conclusions

The colour of sugar can be considered to be derived from a mixture of pH-insensitive or acid-persistent colorants, and pH-sensitive colorants. The pH-sensitive colorants are naturally-occurring flavanoid pigments of low molecular weight. During the first stages of cane sugar manufacture, the rupture of plant cells initiates an oxidation of these pigments (especially in the upper part of the stalk). The oxidation is catalysed by enzymes present in the plant cell and results in the formation of "enzymatic browning" colorants. These are of high molecular weight, are relatively pH-insensitive and tend to be preferentially included within the raw crystal.

The adverse effect of enzymatic browning can be significantly reduced by inhibition of enzymatic activity prior to grinding the cane. In this study, inhibition was accomplished by heating the cane stalks. When treated cane was processed to produce samples of raw sugar, comparison with unheated controls demonstrated significant improvement regarding the colour of juice and raw crystal.

Summary

Enzymatic browning has been found to be a significant factor in the development of cane sugar colour. Inhibition of enzymatic browning by heating cane prior to milling changes several of the properties of raw sugar colour. These include decreased colour level (especially that derived from high-molecular weight colorants), less tendency for colorants to be included within the crystal, and increased sensitivity of colour to pH changes.

The Enviro-Clear Rapid Clarifier in Europe

By L. ROSENBERG, R. J. M. GOOS and A. H. K. F. RAAB*

As our firm, Stork-Werkspoor Sugar B.V., has been since 1971 the licensee of Enviro-Clear Division of Amstar Corporation, New York, for the Enviro-Clear Rapid Clarifier in Europe, we wish to report about its introduction to the European sugar industry, the research work conducted on its behalf and the experience gained in operating the clarifier.

The apparatus itself is already so well described in sugar literature[1,2,3,4] that there is no need to repeat explanations about its construction and its general working principle. Its advantages, however, as compared with conventional thickeners and filter-thickeners, are so outstanding that they cannot be repeated too often.

The advantages of the E-C unit against multi-tray thickeners are its large capacity, small size and juice volume and capability of delivering, after a retention time of only about 10 minutes, a brilliantly clear overflow and a well-thickened underflow or mud. The small size demands lower investment and little space requirement, and provides versatility in locating the equipment in a factory which is either already crowded or where space is expensive. The short retention time lowers heat losses, permits a hotter feed to the mud filters and has distinct physico-chemical advantages in exposing the carbonatation juice to high alkalinity and high temperature for only 10 minutes before the next process step.

The short retention time accounts also for great reduction in the lime salts content and in colour formation. In the USA, in addition to replacing direct filtration, the E-C clarifier has been found to be economically attractive because of savings due to less molasses, which results from lower lime salts content, and because of reduced processing costs resulting from improved juice quality. The latter advantages are appreciable where thermolabile juices are encountered[5,6]. Depending on beet quality, such juices may be more common in the USA where the Dorr system of juice purification is widely met. In most European factories, working with thermostable juices, these beneficial influences are hardly measurable; still, nobody doubts that a short retention time is good for the juice.

In comparison with filter-thickeners, which have short juice retention times, there are other advantages for the E-C clarifier. Filter-thickeners are expensive, their regulating mechanisms complicated and liable to need extensive maintenance, and they require some degree of manual cleaning. One E-C unit can replace up to six filter-thickeners at greatly reduced investment cost; the E-C clarifier works fully automatically and is free of maintenance and cleaning during the campaign.

A moot point of the filter-thickeners is their capacity. They are usually constructed for a capacity equivalent to 1000 tons daily slice, but their performance depends on the quality of the juice to a great degree and is considerably reduced if the juice quality deteriorates. In some severe cases the filter-thickeners can clog completely, whereas the E-C unit still has some options open: the flocculant addition can be increased, or the incoming feed

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[1] McGINNIS *et al.*: *I.S.J.*, 1971, **73**, 256–268, 295–297.
[2] EIS: US Patent 3,523,899; *I.S.J.*, 1972, **74**, 27.
[3] ASH: *I.S.J.*, 1973, **75**, 170–172.
[4] McGINNIS: "Beet-sugar technology" 2nd Edn. (Beet Sugar Development Foundation, Fort Collins). 1971, 254–256.
[5] *idem ibid.*: 178–179, 199–200.
[6] SCHNEIDER: *Zucker*, 1967, **17**, 454–461.

quantity reduced; but it does not clog and does not bring the factory to a stop.

To be fair, the disadvantages of the E-C clarifier have to be discussed too. Two are mentioned in the original article[1]: (*a*) the small volume involves a loss of the buffering effect which accommodates variation in juice flow due to operational upheavals and (*b*) there is a necessity to remove air or gas bubbles thoroughly from the feed.

Some operators have found that the lack of buffering is not a disadvantage; on the contrary, they have been pleased with the opportunity to observe the results of upheavals in the sight-glass of the E-C unit, where there is a sharp separation between clear and muddy juice and any upheaval due to some change in operation or juice quality can be easily observed and correcting measures taken. In case of serious upheavals the regulation equipment acts and does not allow mud to enter the clear juice zone. The disadvantage of air or gas removal is completely eliminated by our construction of a concentric trough which achieves complete degassing of the feed. Therefore, in our opinion, the only disadvantage is the necessity to use flocculants whose influence in coagulating and eliminating colloidal materials is well known[1]. This is only a disadvantage in respect that an additional ancillary processing material is required. The expense is negligible; a large European factory spends $40–50 per day for flocculants required by the E-C system. Many European factories use flocculants anyway, especially when processing very dirty beets, in order to improve sedimentation. As flocculant preparation and dosing is fully automated, the use of flocculant is, in fact, only a minor disadvantage.

At the time we started to introduce the E-C to Continental Europe, there was one already installed and working at the British Sugar Corporation's Peterborough factory in England[5]. Investigating the E-C's possibilities on the Continent, we found the competition of the filter-thickeners overwhelming. Most factories equipped with various types of small volume multi-tray thickeners were dissatisfied with their performance. The most progressive and financially well situated factories, however, had filter-thickeners already installed and even if the managers were not satisfied with every aspect of their work, they were unwilling to change their established policy.

In order to introduce the E-C, we decided to make use of the laboratory-type clarifier with a volume of about 2 litres, designed and developed by the Research Laboratory of Spreckels Sugar Division at Woodland, California. In this small clarifier, equipped with speed-regulated feed pumps, the whole process of flocculation, mud formation and clear juice overflow can be visually followed and all process conditions, including higher or lower throughput, addition of more or less flocculant, etc., can be successfully simulated. By visits to the factories with this laboratory instrument, processing results, such as suspended solids in clear juice and mud concentration, can be obtained on the spot, as the apparatus can be directly connected with the carbonatation vessel in the factory. Together with pumps and accessories, the apparatus is packed in two suitcases for easy transportation. The small apparatus is eminently convenient to conduct research into and to study the flocculation process.

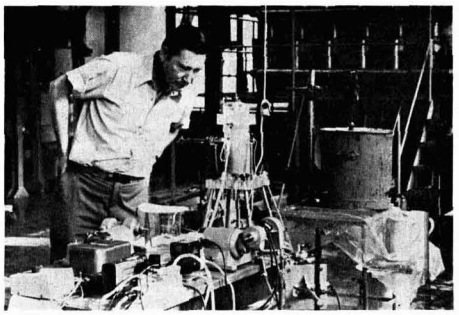


Fig. 1. Testing the laboratory-type Enviro-Clear Rapid Clarifier at the Berlin Institute for Sugar Technology

As a first step, our associates took the laboratory clarifier for a series of tests to the Berlin Institute for Sugar Technology (Fig. 1) which was at that time directed by the late Professor H. HIRSCHMÜLLER. There, in the experimental sugar factory, the apparatus was actually tested with 1st carbonatation juice with the full assistance of the Institute's associates.

Prof. HIRSCHMÜLLER especially appreciated the fact that this apparatus allowed sedimentation tests on a small scale. In Berlin, and later in various factories, our researchers determined and established mathematical formulae for retention time, clarifier load, relationship of retention time to load, thickening factor, flocculant:solids ratio, filtration time, thickening time, position of the deflector plate and relationship to the industrial-type clarifier[7]. When fully acquainted with the potentialities of the apparatus, our associates visited sugar factories in Holland, West Germany, Austria, Yugoslavia, Belgium, Finland and Sweden, demonstrating the capabilities of the E-C clarifier. The sharp separation line obtained between muddy and clear juice in experiments carried out next to their own carbonatation vessels considerably impressed the factory managers and operators.

This method proved to be a success. The breakthrough came when the sugar factory in Lehrte, near Hannover, Germany, placed an order with us in 1973 for the first E-C clarifier.

The factory wanted to increase its capacity to 5000 tons of beet per day. Their existing plant consisted of four fully-automatic, quite new filter-thickeners. They could not handle even 4000 tons under all circumstances and the management was not sure whether one or two new filter-thickeners were required for the expansion. They were further annoyed that, notwithstanding full automation, some sections of the filters had to be manually hosed down daily. Further, there was no space for more filters near the group of four. Instead of enlarging their filter-thickener plant, which they could use for other purposes, they solved their problem by ordering one E-C 315 unit with a diameter of 6400 mm and a volume of 53 m^3, for a nominal throughput of 315 $m^3.hr^{-1}$, based on 150% feed on beet, for the total extended capacity. At 5000 tons slice per day in 1975/76 at 175% feed on beet, the clarifier has worked to the full satisfaction of the factory management (Fig. 2).

[7] Goos: Unpublished data from the SWS Research Files.

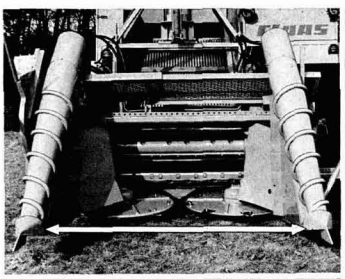
How many days work do you lose because of rainy weather in the cane harvest?

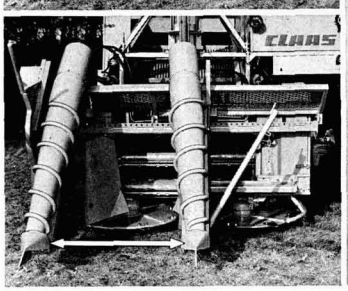
either because it has prevented a good and timely burn

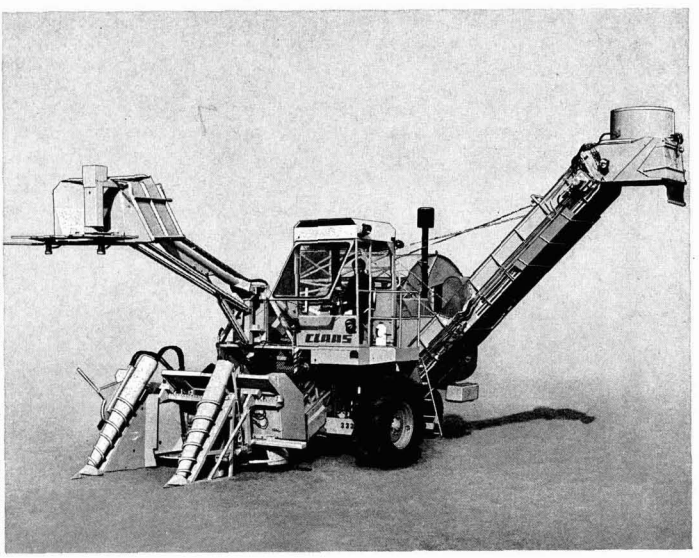
or because rains fell after you had a good burn and could not harvest?

The CLAAS LIBERTADORA 1400 Cane harvester

will solve most of such and other problems:







Because:

1. We harvest GREEN CANE, which has a slower rate of deterioration, at a rate of up to 45 tons per hour. Possible because of

   amply dimensioned rugged base cutters. ϕ each 1170 mm • high lug tires for wet and slippery soils • two choppers extending the whole width of throat, 1354 mm • no force-feed rollers, no clogging no stalling in wet crop

2. We harvest LAID CROP because of

   an intake throat with hydraulically driven dividers adjustable in steps of abt 2 inches from 30 inch to 75 inch. • side cutters preventing uprooting of the next (uncut) row

3. We harvest BURNT CROP even faster, up to 60 tons per hour

   heavy yields (200 tons/ha) or low yields (40 tons/ha) wide conveyors, a heavy blower system, and infinitely variable speed with a dependable hydraulic drive

4. We harvest even on SLOPES (where others topple)

   because of WIDE (10 FT) front drive axle

We compared our performance with that of other machines. We find advantages, so have our many clients in 20 vastly differing cane producing countries of the world. Write for reference lists and catalogues. Ask the users. We feel sure they will encourage you to approach us — or our dealers in many countries of the world.

GEBR. CLAAS MASCHINENFABRIK GMBH 4834 HARSEWINKEL West Germany
Dept. for Sugar Cane Machinery

Based on the successful operation in Lehrte, which has been witnessed and visited by many outstanding sugar technologists, in 1974 the Turengin sugar factory in Finland ordered an E-C 190 clarifier (diameter = 5000 mm, volume = 28 m³) for a capacity equivalent to 3000–3000 tons of beet per day, depending on the quantity of the feed. This unit has worked satisfactorily for the second campaign. For the 1975/76 campaign we supplied E-C190 units to two factories, Roma in Sweden and Lansi in Finland. For the same campaign the Enviro-Clear Division supplied an E-C unit to the Sinaga factory in Ponta Delgada, Azores.

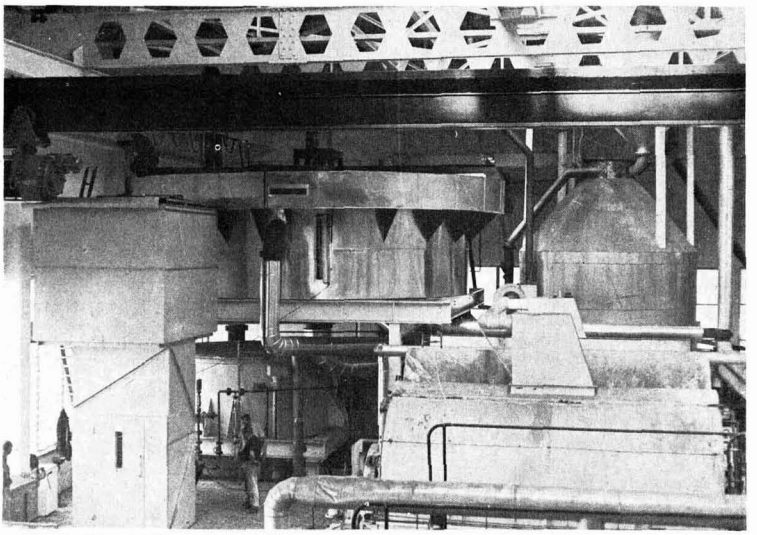


Fig. 2. The clarifier at Lehrte, West Germany, installed at a height of 22 metres. The concentrated underflow enters by gravity the rotary vacuum filters (seen in the right foreground)

We received many requests for information, held conferences with interested technologists in Yugoslavia and Ireland, and are submitting quotations to various other countries for successive orders. The plants supplied and put into operation by us serve as our best reference.

Considerable experience has been acquired with the operation of the E-C clarifiers. The clarifier at Lehrte was installed at an elevation of 22 metres for reasons of space in an already rather crowded factory. This proved to be an excellent idea, allowing the concentrated underflow (mud) to flow straight, without the intermediary of pumps, to the rotary vacuum filters (Fig. 2).

The mud, undamaged by the impellers of the pumps, filters beautifully and is easily sweetened off. Based on this experience we are advocating the installation of the E-C at such height which allows the undisturbed mud to flow to the rotary vacuum filters.

In order to improve sedimentation in thickeners for the satisfactory operation of the rotary vacuum filters, many European factories recycle either main-limed juice or 1st carbonatation mud to the prelimer, thus sometimes reaching 185% first carbonatation juice on beet. According to the experience in Turengin[9] with the E-C, the mud filtered so well that recycling, with all the negative effects associated with it, became superfluous. Without recycling, the feed to the clarifier decreased, increasing its capacity.

Much experience has been accumulated in flocculant preparation and dosage. We have developed a flocculant dissolving and dosage plant which operates fully automatically (Fig. 3). The preparation of a 0·3% flocculant solution sounds deceptively simple, but is in fact not uncomplicated. The operation is only simple if the properties of the dissolving water and the flocculant are well-known. We are not advocating the use of a specific flocculant, leaving this decision to the client. The plants set up by us were using "Tetrol 2935/74" and most of our experience has been gained with this flocculant.

The chemical composition of the water used for dissolving the flocculants influences the rheological properties of the flocculant solution, distilled water having a negative influence. But also seemingly minor influences, such as the water pressure at the vortex-pot, or the spot on the vortex-pot at which the flocculant powder enters, are important too. The concentration of the flocculant solution must be controllable; the method for its control is based on viscosity.

Much thought and research work went into the choice of the correct measuring and regulation equipment as well as into the choice of the most appropriate analytical and physical methods and determinations, e.g. thickening factor, insoluble solids, and total CaO.

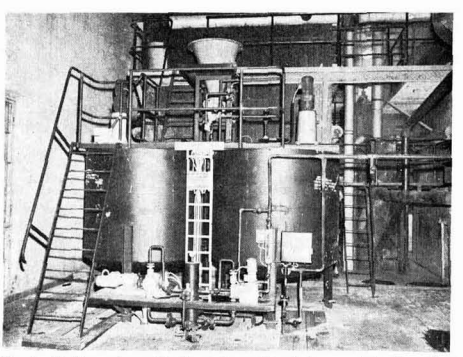


Fig. 3. Fully-automatic flocculant dissolving and dosing plant

[8] BONNEY & RAAB: *Zeitsch. Zuckerind.*, 1973, **98**, 618–619.
[9] MANSIKKAMÄKI: Private communication.

In order to establish the optimum flocculant addition, a method had to be found to measure the flocculant content of the overflow clear juice. The method is based on a standard flocculation test.

The practical performance of the E-C clarifiers installed in Europe has proved the correctness of our design parameters, of the formulae we developed, and of the analytical methods we employ. Our joint efforts with Enviro-Clear Division of Amstar Corporation have resulted in the introduction of a most useful and versatile piece of equipment to the European sugar industry.

Growth and structure of the sugar industry in Thailand

By Dr. PAKORN ABDULBHAN* and Mr. KHUBBOL SUKSUPHA†

(Industrial Engineering and Management Division,
Asian Institute of Technology, Bangkok, Thailand)

PART I

Introduction

SUGAR production from cane has been known to exist in Thailand since the fifteenth century. In those days the primitive local process produced only muscovado. Production of plantation white sugar began in 1937 when the Government bought a sugar plant from Czechoslovakia and installed it in Lampang Province in the northern part of the country. In order to meet demand at that time, another plant was set up in Uttraditr Province. The combined crushing capacity of the two plants was 1200 tons of cane per day.

After the second world war more muscovado sugar plants were set up in the East and Northeast in order to boost cane growing. However, production failed to meet demand so that the annual sugar imports were 20,000–50,000 tons. The Government then encouraged cane growing and production capacity expansion. Additional plants were built in Cholburi and Supanburi Provinces. By 1959, the sugar industry in Thailand had expanded rapidly and there were then 48 plants. Most of them, however, were substandard, using obsolete imported second-hand machinery which, combined with inefficient management, resulted in low production efficiency.

After 1960, annual production of sugar rose to 140,000 tons, creating a surplus which the Government had to help producers to export. This was a problem because product quality was below international standards, and production costs were high. The Government had to subsidize exports in order to meet world prices.

Since 1969, factors such as the importation of new sugar technology, the combination of small firms in order to exploit the economy of scale, and the post-1970 world sugar price increase have stimulated production expansion and improvements. At present there are 41 major sugar plants; their combined annual output in the 1974–75 season exceeded one million tons. Sugar export in 1974 earned 3500 million Bahts‡. The industry has become one of the major export earners of the country.

The analysis reported herein is limited to those factories producing plantation white sugar and raw sugar which have a daily grinding capacity of more than 200 tons of cane per day. Refined sugar and non-centrifugal sugar which have no economic significance will not be included.

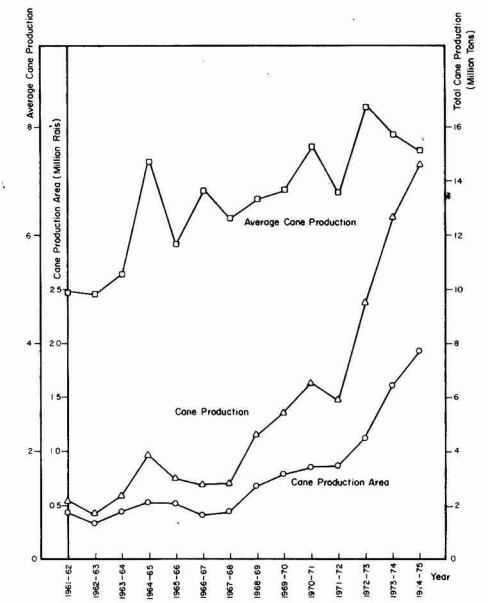


Fig. 1. Cane production and cane area, 1961–1975

Cane production

Sugar production is determined primarily by cane production which in turn depends on cane production area. Since there is no definite assignments of cultivation area for cane growers in each region, the total cane production is not co-ordinated with the needs of industry and presents a problem of practice and of economics.

The total cane production area increased to over 1 million rais (1 acre = 2·5 rais) in the 1972–73 crop season (see Table I and Fig. 1). The two major cane producing areas are the Central and Eastern regions, owing to their suitable climate and soil conditions. In recent years cane production in the Central Region, particularly in Kanchanburi, Rajburi and Supanburi Provinces which are well irrigated, has increased rapidly to 63·39% of the total area in the 1973/74 season.

* Division Chairman. † Graduate Student.
‡ 20 Bahts = US$1.

Table I. Cane and sugar production in Thailand, 1961-1975.

Year	*Total cane area (rais)*	*Total cane production (tons)*	*Average cane yield (tons/rai)*	*Cane crushed (tons)*	*Syrup production (tons)*	*Total sugar production (tons)*	*Average sugar recovery (kg/ton cane)*
1961–62	441,334	2,195,853	4·98	1,529,538	88,545	151,343	68·92
1962–63	344,982	1,694,533	4·91	1,349,698	48,490	125,031	73·78
1963–64	452,000	2,387,185	5·28	1,950,080	56,433	167,973	70·36
1964–65	532,000	3,912,788	7·36	3,435,830	70,247	319,976	81·78
1965–66	523,500	3,044,849	5·82	2,820,200	22,787	269,168	88·40
1966–67	413,537	2,834,290	6·85	2,468,605	3,909	232,412	82·00
1967–68	453,200	2,855,200	6·30	2,331,272	5,382	226,532	79·34
1968–69	699,494	4,657,360	6·66	4,383,790	2,749	388,890	83·50
1969–70	801,394	5,463,960	6·82	5,089,759	2,245	464,437	85·00
1970–71	861,806	6,585,860	7·64	6,575,661	1,835	532,429	80·84
1971–72	872,494	5,925,566	6·79	5,915,476	1,513	501,774	84·68
1972–73	1,133,439	9,512,794	8·39	9,503,392	1,583	648,437	68·14
1973–74	1,616,304	12,694,491	7·85	12,681,658	2,047	922,826	72·93
1974–75	1,935,253	14,592,300	7·54	14,592,300	—	1,015,000	69·55
Average growth rate (%)	13·7	19·5	5·0	19·1	—	18·0	—

Though the cane cultivation area has expanded rapidly in the last few years, the average cane yield (tons per rai) has increased only slightly. The average cane production lies between 6–7 tons of cane per rai. For comparative purposes, the average cane yields of other sugar-producing countries are given in Table II.

Table II. Average cane production in selected countries (tons/rai)

Country	1971–72	1972–73
Thailand	6·79	8·39
Brazil	8·00	10·00
Hawaii	34·68	37·80
South Africa.....	10·56	14·56
United States	11·24	11·92

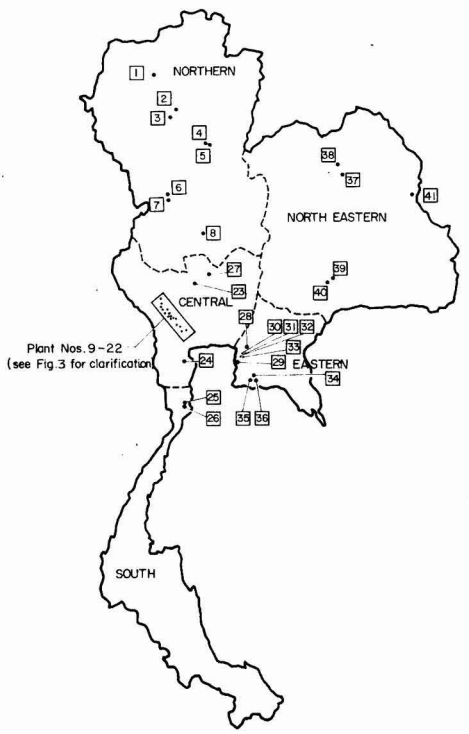


Fig. 2. Location of major sugar plants in Thailand
Note: Numbers of plants within squares correspond to those of Table III

The relatively low cane yield is probably due to the fact that large cultivable areas are available for expansion so that productivity does not seem to be important to the cane growers. Moreover, agricultural technology has not been widely known. As sugar production capacity and the demand for cane increase, the cane growers are beginning to recognise the need for improvements in productivity, and have sought technical aid from the Government.

In Thailand the majority of factories still buy cane by weight alone, the 1974 price being 300 Bahts per ton. Factories in Supanburi Province are the only group that use the c.c.s. (commercial cane sugar) system.

Sugar production

The total rated milling capacity of all major plants is 155,025 tons of cane per day (see Table III and Fig. 2). Individual milling capacities range from 225 to 14,000 tons of cane per day. Plants in the Central Region represent about 70% of the total national milling capacity. Most of the small plants of less than 1500 tons of cane crushed per day are in the Northeastern Region where cane supply is limited.

Usually the production season starts around the month of November since it is cool and dry; this kind of weather condition helps increase the sugar content in cane. The season continues to around April, when the onset of the rainy season makes it difficult to cut cane and transport it to the plant. The total operating days vary from 120 to 150. The actual milling capacities of the plants are in the range 80 to 90% of rated capacities owing to stoppages during operation caused by various factors including: (*a*) occasional lack of cane; (*b*) problems in the milling units; (*c*) boiler shutdown; and (*d*) deficiency of power supply, etc.

The average sugar recovery in the last 14 years has varied from 68·14 to 88·4 kg per ton of cane. The performance of the last ten years has shown slight progress but the amount of sugar produced per ton of cane in Thailand is quite low compared with those of other sugar producing and exporting countries (see Table IV).

Although the average sugar recovery in Thailand is low, total sugar production increased from a little over 150,000 tons in the production year 1961–62 to over one million tons in 1974–75.

Since the export market for the industry has expanded and the sugar price has increased signifi-

Table III. Rated milling capacity of major sugar plants

Plant No.	Location: Plant's name	Location: Province	Region	Rated milling capacity (tons of cane per day)
1	Chiengmai	Chiengmai	Northern	—
2	Thai Lampang	Lampang	do	800
3	Wanachai Industry	Lampang	do	1,200
4	Uttradit	Uttradit	do	750
5	Thai-ekalaksana	Uttradit	do	8,000
6	Kampangpetch	Kampangpetch	do	1,200
7	Mitr Siam	Kampangpetch	do	4,500
8	Ruam Pol Industry	Nakornsawan	do	1,500
9	Thonburi I	Rajburi	Central	3,500
10	Thonburi III	Rajburi	do	4,000
11	Mitrapol	Rajburi	do	7,000
12	Rajburi Industry	Rajburi	do	7,000
13	Thai Rungruang	Kanchanaburi	do	14,000
14	Kanchanaburi	Kanchanaburi	do	7,000
15	Krung Thai	Kanchanaburi	do	2,500
16	Ruam Kam Larp	Kanchanaburi	do	3,500
17	Thai Permpoon	Kanchanaburi	do	8,000
18	New Krung Thai	Kanchanaburi	do	5,000
19	Tamaka	Kanchanaburi	do	5,000
20	Prachuab Industry	Kanchanaburi	do	5,000
21	Mitkaset	Kanchanaburi	do	7,000
22	Thai	Kanchanaburi	do	7,000
23	Supanburi	Supanburi	do	1,800
24	Petchburi	Petchburi	do	4,000
25	Pranburi	Prachaubkirikhan	do	2,000
26	Prachaubkirikhan	Prachaubkirikhan	do	4,000
27	Mahakhun	Singburi	do	8,000
28	Thonburi II	Cholburi	Eastern	2,000
29	Sriracha	Cholburi	do	2,200
30	Angvian	Cholburi	do	3,500
31	Cholburi	Cholburi	do	3,700
32	Nong Yai	Cholburi	do	3,500
33	Sahakarn Namthan	Cholburi	do	3,000
34	Eastern	Rayong	do	4,500
35	Thai Ruam Charoen	Rayong	do	2,000
36	Ban Kai	Rayong	do	2,000
37	Kumphawapi	Udornthani	Northeastern	2,500
38	Ruem Udom	Udornthani	do	2,000
39	Saha Thai Roongruang	Burirum	do	250
40	Saha Ruang	Nakornpanom	do	225
41	Ruang Chai	Ubolrajthani	do	400
			Total	155,025

Table IV. Recovery of sugar per ton of cane in selected countries

	Sugar recovery, kg/ton cane	
	1971–72	1972–73
Thailand	84·68	68·14
Australia	100·13	100·09
Brazil	100·00	100·00
Hawaii	100·03	99·98
Philippines	95·86	100·05
South Africa.....	100·00	100·04
United States	100·12	100·05

cantly, further expansion has taken place with newly-established plants of high production capacity. The number of plants has risen from 37 in the 1973–74 crop year to 41 in 1974–75 (see Fig. 2).

Productions by region are shown in Table V. Since sugar production is directly related to cane production, the Central Region with the largest cane plantation area has increased sugar production from 55,126 tons in 1961–62 to 635,880 tons in 1974–75.

Sugar consumption

Consumption in Thailand is mainly based on plantation white sugar. Refined sugar is just beginning to be popular, but only on a small scale basis. Per caput consumption in Thailand has grown from 4 kg in 1960 to 10 kg in 1973 (see Table VI). Total consumption grew from approximately 117,000 tons in 1960 to

Table V. Production of sugar by region, 1961-1975

Year	Northern (tons)	Northern % of total	Central (tons)	Central % of total	Eastern (tons)	Eastern % of total	Northeastern (tons)	Northeastern % of total	Total (tons)
1961–62	19,976·75	13·20	55,216·47	36·48	62,439·30	41·26	13,711·20	9·06	151,343·67
1962–63	16,594·70	13·27	49,168·16	39·33	49,156·90	39·31	10,111·30	8·09	125,031·06
1963–64	11,970·57	7·13	86,596·38	51·55	56,734·70	33·78	12,671·50	7·54	167,973·15
1964–65	22,486·00	7·03	160,792·31	50·25	112,916·30	35·29	23,781·40	7·43	319,976·00
1965–66	19,665·10	7·30	144,048·83	53·52	83,205·20	30·91	22,249·10	8·27	269,168·23
1966–67	11,936·30	5·14	138,743·33	59·70	69,613·30	29·95	12,119·18	5·21	232,412·11
1967–68	13,172·10	6·98	101,784·70	53·92	59,573·20	31·56	14,247·20	7·54	226,532·20
1968–69	15,206·60	4·78	163,221·20	51·31	115,387·70	36·27	24,304·05	7·64	388,890·55
1969–70	17,763·30	4·37	233,297·00	57·37	126,631·50	31·14	28,957·80	7·12	464,437·00
1970–71	16,674·00	3·13	343,206·90	64·46	151,969·20	28·54	20,578·90	3·87	532,429·00
1971–72	19,610·30	3·91	319,940·10	63·76	139,708·90	27·84	22,515·60	4·49	501,774·90
1972–73	28,582·10	4·41	420,459·10	64·84	163,829·70	25·27	35,567·00	5·48	648,437·90
1973–74	74,207·00	8·04	579,188·30	62·76	227,569·00	24·65	41,862·30	4·53	922,826·60
1974–75	123,620·00	12·18	635,880·00	62·64	210,000·00	20·69	45,500·00	4·48	1,015,000·00
Average growth rate (%)	15·4	—	25·6	—	15·3	—	15·9	—	20·27

400,000 tons in 1973. Although consumption is still at a low level compared with some other countries, it is increasing, because of population growth, at an annual rate of 3%.

The changes in population structure and per caput income as a result of economic development have raised the income of non-agricultural people and have also stimulated sugar consumption, as has the expansion of the manufacture of processed foods such as canned fruits or sweetened condensed milk.

Table VI. Per caput income and sugar consumption in selected countries—1971

Country	*Consumption (kg)*	*Income (US$)*
Thailand	10·9	153
Australia	56·4	2,919
Indonesia	6·9	108
Japan	29·4	1,910
New Zealand	54·6	2,345
Philippines	17·5	246
Singapore	63·0	1,041

(*To be continued*)

Correspondence

The Editor,
International Sugar Journal.

Dear Sir,

MILLING-DIFFUSION OF CANE

I read with interest the contribution entitled "A comparison of cane diffusion with hybrid milling-diffusion systems" by John H. Payne published in the June issue of your Journal[1]. I agree with the conclusion of the author and the arguments he develops seem pertinent, but I think that a more fundamental reason for the relative inefficiency of bagasse diffusion *versus* cane diffusion has been overlooked.

As stated in the title, the milling diffusion process is a hybrid and like all hybrids it retains characteristics of its parents. The trouble is that milling and diffusion have opposite characteristics[2]. Milling, which is intended to remove the sugar by squeezing the juice out, leaves the bagasse with a reduced content of juice of nearly the same concentration as the original juice. Diffusion, the object of which is to remove the sugar by washing it out, leaves the bagasse with nearly the same content of juice of a much lower concentration than the original juice. The situation is obviously the same as far as the depletion of sugar is concerned *but not for water content.* In the straight milling process a moderate quantity of imbibition juice is applied between mills. In the milling-diffusion process however, the first mill bagasse is soaked in diffusion juice until the original volume of the cane is approximately restored before diffusion begins. A large quantity of sugar, which is to be later extracted again by diffusion, is thus readsorbed in the fibrous structure of the bagasse and cancels part of the efficiency of the first mill. For instance, if the pol of the diffusion juice and the first expressed juice were the same, the original sugar concentration in cane would be restored and the diffuser would have to perform the same extraction as if there were no first mill. On the other hand, if the milled bagasse were soaked in pure water, no sugar would re-enter it, a much shorter diffuser would do the job and the full effect of the first mill would be retained. The pol of the diffusion juice thus determines the useful part of the extraction provided by the first mill and, if we could choose it, the lower would be the better. Of course we cannot, and let us now see what determines the pol of the diffusion juice in a diffusion process. The pol of the diffusion juice is the quotient of the extracted sugar—which depends on the accepted loss in the bagasse—divided by the weight of juice. A high juice draft would thus be desirable but there is an economic limit on the amount of mixed juice, because the clarified juice must be subsequently evaporated. In a straight cane diffusion process all the raw juice is of course diffusion juice; in a milling-diffusion process the mill-expressed juice decreases the amount of sugar to be extracted in the diffuser but it must be simultaneously compensated by a reduction of the amount of diffusion juice to keep the mixed juice within a reasonable limit. As the volume of the first expressed juice is of course incompressible, there is an understandable trend to reduce the juice draft in the diffuser to the minimum acceptable. This makes the extraction more difficult. When a diffuser is operated at a lower juice draft the concentration of the extracting juice increases and, for a theoretical complete extraction, it tends asymptotically to the concentration of the juice contained in the feed material when the draft (expressed as the volume ratio of extracting juice to juice in the extracted material) comes nearer to unity. As said previously, the first mill squeezes juice out but does not decrease the pol of the juice left in the bagasse. This results in a comparatively high pol of the diffusion juice and the first mill does not provide much help to the diffuser. A conceivable remedy would be to add imbibition water to the bagasse before its introduction in the diffuser, but the cure would probably be worse than the evil. It is much wiser to discard the first mill and to increase somewhat the length of the diffuser. It seems that the same conclusion was reached empirically in South Africa when Huletts decided to erect a straight cane diffuser in Amatikulu in 1974 and two more were recently built by BMA in Malelane and Dalton[3].

For cane sugar extraction, milling and diffusion are equally good propositions but their combination is far from excellent and can only by justified by local investment considerations.

Faithfully yours,

G. V. GENIE
Consultant
Chaumont-Gistoux (Belgium)

* * *

Bolivian sugar exports[4].—According to the Ministry for Industry and Trade, Bolivia exported 69,800 tons of sugar in 1975 which is substantially higher than the 1974 total of about 45,000 tons. The exportable surplus from the 1966 crop is expected to reach 100,000 tons.

[1] *I.S.J.*, 1976, **78**, 170–173.
[2] GENIE: *S. African Sugar J.*, 1973, **57**, 601, 603, 605–607.
[3] DELAVIER: *Zeitsch. Zuckerind.*, 1976, **101**, 138–141.
[4] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (13), 8.

Sugar cane agriculture

Sugar cane: mineral fertilizer recommendation for the State of São Paulo. J. O. FILHO. *Brasil Açuc.*, 1975, **86**, 473–476.—The author gives quantities of N, P and K recommended for plant and ratoon cane in sandy and clay soils of São Paulo. He also recommends that for plant cane in sandy soils, one-third of the N, all of the P and two-thirds of the K should be applied at planting and the balance of the N and K given as a side-dressing 2 or 5 months later, depending on whether the cane is a 12- or 18-month crop. The ratoon fertilization should be carried out as soon as possible after the harvest with sub-surface applications on both sides of the row.

* * *

Sugar cane varieties in Pernambuco. M. M. DE MELO and J. A. C. M. DE SOUZA. *Brasil Açuc.*, 1975, **86**, 477–482.—Trials with a number of varieties in Pernambuco are reported. The standard variety, CB 45-3, which is low in fibre and has a medium ripening period, gave the best performance in the tests. CP 51-22, which is early-ripening, had a high sugar content but was also high in fibre. While B 4362 had a high sugar content, special treatment is required to produce good cane tonnages.

* * *

Influence of nitrogen, phosphorus and potassium on the industrial yield of Alagoas cane fields. M. L. MARINHO, G. A. CAVALCANTI and A. DE L. C. AMORIM. *Brasil Açuc.*, 1975, **86**, 483–493.—The results are described of field experiments carried out at Alagoas Sugar Cane Experiment Station between 1967 and 1973 to determine the effects of N, P and K on cane and sugar yields per ha, on pol % cane and on juice purity. Tests conducted with different levels of N, P and K were in two designs, one as randomized blocks to determine the effectiveness of doses of each nutrient in the presence of adequate levels of the others, and the second as factorial treatment designs. The results indicated that, in some cases, N caused negative effects in cane and sugar yield, in pol and purity even at lower levels of application (50 kg.ha^{-1}). P was the limiting factor in cane and sugar production in some soils and may give negative effects, especially with ratoons, when used at more than 100 kg.ha^{-1} P_2O_5 in soils not deficient in P. With cane grown in P-deficient soils, pol and purity were increased by P fertilization in low to medium doses (50–120 kg.ha^{-1} P_2O_5). K did not produce depressive effects on yields or juice quality, improving the latter with doses as low as 50 kg.ha^{-1} K_2O.

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Combating erosion in the Moreton area. T. LINEDALE. *Cane Growers' Quarterly Bull.*, 1976, **39**, 77–79. Problems associated with erosion in the Moreton area of Queensland, where much of the cane land is on fairly steep slopes, are discussed. Contour farming has proved inadequate and in fact has created other problems with farm operations, so that further protective measures are required as well as changes in farm design. Methods for diversion of run-off are described, followed by discussion of infield erosion control measures. Cultivation up rather than across the slope had been practised over a number of years; study of the erosion problem has permitted development of more rational farm plans as well as solving erosion and drainage problems.

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Supplementary irrigation with a limited water supply. E. PEMBROKE. *Cane Growers' Quarterly Bull.*, 1976, **39**, 80–82.—Details are given of a system for irrigating cane crops where the need is to make up for inadequate rainfall (not, it is stressed, to promote maximum cane growth). In trials in the Mackay area of Queensland, one irrigation of ratoons with 65 mm of water in September increased cane yield by 22·5 metric tons per ha, while a second irrigation in November increased the yield by a further 15 tons.ha^{-1}. Generally, one or at most two irrigations are sufficient to combat dry conditions. Costs of a typical system are set out.

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Pre-emergence weed control. A. RUDD. *Cane Growers' Quarterly Bull.*, 1976, **39**, 83.—Abnormally wet conditions or late autumn and spring rain will encourage growth of weeds which cannot be controlled by mechanical cultivation. However, 4·5 kg MCPA per ha has proved a relatively cheap but effective means of pre-emergence control, the period of which ranges from 8 to 15 weeks. The sodium salt of 2,4-D may be equally effective on sandy soils but is not recommended for soils with a high organic content, since it tends to break down rapidly. If only a 45-cm band over the row is treated, leaving the weeds between the rows to be treated later mechanically, 4·5 kg of MCPA will cover about 3 ha.

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Eye spot disease and Q 101. C. MCALEESE. *Cane Growers' Quarterly Bull.*, 1976, **39**, 84–85.—A description is given of eye spot symptoms, and mention is made of the fact that Q 101 has proved susceptible to the disease, which is usually a very minor one in Queensland. The only suitable control method is the use of resistant varieties, it is stated. Because of this, and because of the drop in c.c.s. which results from eye spot, the author recommends limiting the quantity of Q 101 cane planted where outbreaks of the disease have occurred.

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Sub-surface drainage pipes. G. KINGSTON. *Cane Growers' Quarterly Bull.*, 1976, **39**, 86–88.—Primary causes of poor drainage areas are listed and the most commonly used drainage schemes are indicated. On the question of choice of drainage pipe (between clay tile and corrugated plastic piping), the author cites

laboratory and field tests conducted in Canada in which the drainage rates of both types were found to be about the same, so that choice will be governed by purchase price and ease and cost of installation. The plastic piping is cheaper and easier to install, while its flexibility also overcomes the problem of shifts in alignment, often encountered during back-filling of clay tile drains.

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Townsville cane a threat to Burdekin. C. CHARDON. *Cane Growers' Quarterly Bull.*, 1976, **39**, 89.—Mention is made of cane grown in private gardens in Townsville. Apart from varieties introduced from a number of Queensland cane areas, cane has also been illegally introduced from the Torres Strait Islands which are close to mainland New Guinea where downy mildew and Fiji disease are common. Officials have systematically removed and destroyed all of the cane in question so as to remove a possible threat to commercial cane in the Burdekin area.

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Soil monitoring stations. A. FORD. *Cane Growers' Quarterly Bull.*, 1976, **39**, 90–91.—Information is given on soil monitoring stations of the Bureau of Sugar Experiment Stations in Queensland. These sites, 50 metres square, are located within a major cane block and provide information on physical and chemical changes in the soil and causes of such changes. By the end of 1975 there were some 60 monitoring stations in Queensland, while a further 180 were to be set up in 1976.

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Chlorotic streak disease. A. MATTHEWS. *Cane Growers' Quarterly Bull.*, 1976, **39**, 92–93.—Chlorotic streak, which is easily controlled by immersing cane in hot water at 52°C for 20 minutes, is not transmitted by knife infection but spreads from the roots. Waterlogging of roots favours multiplication of the virus, and the disease often appears in low, wet areas or in fields which are occasionally flooded or waterlogged as a result of seepage. Planting of diseased cane on well-drained soil will also promote its spread. Since the symptoms can disappear and re-appear during the life of a crop, inspection of diseased cane can fail to reveal any disorder. Planting of disease-free cane on well-drained soil is advocated.

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K. I. STEWART. *Cane Growers' Quarterly Bull.*, 1976, **39**, 94–95.—The three forms in which potassium occurs as a "straight" fertilizer are: potassium chloride, nitrate and sulphate. How to apply K, where and the rate of application are briefly discussed. It is emphasized that even soils having a high K content should still receive a dressing of potassium each year to replace that which has been removed from the soil by the crop or by leaching.

* * *

Soldier fly—a continuing problem in the Bundaberg district. D. BULL. *Cane Growers' Quarterly Bull.*, 1976, **39**, 97–99.—Increased cane damage by this pest in the latter half of 1975, with substantial areas of ratoon cane being affected, some very seriously, has been found on land which had not been treated with "Dieldrin" (earlier found to be an effective means of control) or where previous crops had been treated but the current crop had not. The most suitable means of treatment with the chemical and recommended application rates are discussed, and a list of practices to be avoided for effective soldier fly control are listed.

* * *

Care needed with planting material selection. L. G. W. TILLEY. *Cane Growers' Quarterly Bull.*, 1976, **39**, 100–101.—By means of a number of photographs, the author gives recommendations on selection and planting of cane, which should have young, soft eyes (which strike earlier and more reliably than harder, tougher ones), have short internodes (since setts with a large number of eyes improve the chances of a good strike) and be of medium thickness. Careful inspection of plant cane for signs of insect attack and disease symptoms is advocated, as is application of N fertilizer 6 weeks before cutting to improve germination and early growth.

* * *

Minor pests of the Tully district. C. R. NALDER. *Cane Growers' Quarterly Bull.*, 1976, **39**, 102–103.—Pests which normally cause only slight loss to the cane industry as a whole but which can cause considerable damage on individual farms are briefly discussed. It is pointed out that they were responsible for a loss of 1300 metric tons of cane in the Tully district in 1975. The pests mentioned are: cockatoos, coots, scrub turkeys and cassowaries, wallabies, opossums, wireworms and mole crickets. Of these, the cockatoos are the most destructive. Possible means of control are given for certain of the pests.

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Experiments with metering devices for planting short-length sugar cane. J. E. CLAYTON. *Sugar News* (Philippines), 1975, **51**, 288–290, 307.—See *I.S.J.*, 1975, **77**, 145.

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CoS 659—a new mid-late variety for east Uttar Pradesh. B. K. MATHUR and H. H. RAM. *Cane Grower's Bull.*, 1975, **2**, (4), 1–4.—Characteristics of this cane variety are described and its performance in trials during 1968–71 reported. It was released for general cultivation in 1971.

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Co 1157—a new mid-season sugar cane variety for waterlogged conditions in Uttar Pradesh. B. K. MATHUR. *Cane Grower's Bull.*, 1975, **2**, (4), 5–6. Details are given of trials with Co 1157 against BO 3 as standard (which is susceptible to red rot). Results indicated a better performance than that of BO 3, and the variety was released for general cultivation in 1970. Both Co 1157 and BO 3 are suitable for growing in waterlogged conditions.

* * *

Suitable sugar cane varieties for preparation of gur in Uttar Pradesh. D. N. GUPTA and R. SINGH. *Cane Grower's Bull.*, 1975, **2**, (4), 7–8.—Details are given of nine cane varieties which have proved suitable for gur manufacture on the basis of trials in Uttar Pradesh. The quality and estimated yield of gur produced from its juice are given for each variety, as well as the average cane yield.

* * *

Some studies on chemical control of pineapple disease of sugar cane. V. V. SULLADMATH, B. G. P. KULKARNI and R. K. HEGDE. *Cane Grower's Bull.*, 1975, **2**, (4), 9–11, 23.—*In vitro* studies of the effects of

"Benomyl" and "Agallol" on pineapple disease are reported, in which setts were dipped for varying periods in 500 ml of 0·05% "Benomyl" or 0·5% "Agallol" solution with the first node above the solution level, after which 2-mm thick disc-shaped samples cut from the inner core were placed in a Petri dish seeded with the pineapple disease pathogen, *Ceratocystis paradoxa*. Results, in the form of percentage disease inhibition obtained for each period of treatment and for four depths of fungicide penetration (as indicated by the discs), showed that "Benomyl" was superior to "Agallol" and gave a maximum inhibition of 28·5% after 5 minutes' dipping, although 1 minute dipping gave 27% inhibition compared with 22·37% after 1 minute dipping in "Agallol" (the maximum inhibition obtained with this chemical).

* * *

Red rot disease of sugar cane in Rajasthan. R. N. S. TYAGI and K. N. GOYAL. *Cane Grower's Bull.*, 1975, **2,** (4), 12–14.—Investigations in Rajasthan have revealed two types of cane infection by red rot (caused by *Colletotrichum falcatum*); one shows symptoms on leaves only, while the other affects both stem and leaves. Studies of more than 100 collections of infected cane from different areas have resulted in identification of three distinct strains. The disease has been recognized as epiphytotic in Co 312 cane for some years; screening of Co 419, Co 1007 and Co 1111 varieties against the most virulent of the three strains has shown them to be moderately resistant.

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Package of practices for sugar cane cultivation in Kerala. ANON. *Cane Grower's Bull.*, 1975, **2,** (4), 17–18.—Recommended varieties and agricultural practices for cane farmers in Kerala are described.

* * *

Protecting the soil in new cane areas. H. S. PINK. *Producers' Rev.*, 1975, **65,** (12), 19–22.—The effects and prevention of soil erosion are discussed with the aid of photographs depicting cane fields in Queensland where major soil conservation schemes are being implemented, particularly in new cane areas.

* * *

Wild pigs causing havoc. R. MCLENNAN. *Producers' Rev.*, 1975, **65,** (12), 64.—The author estimates that on the three farms alone owned by his family, wild pigs destroyed some 1500 tons of cane in 1975. Up to 70 wild pigs have been seen together late in the afternoon, and the animals can find cover in mangroves and along river banks. They may eat cane right down to the ground, and not even the harder cane varieties are safe. The increase in pig numbers is attributed to dingo baiting; effective means of control are called for.

* * *

Strain M, a new strain of sugar cane mosaic virus. H. KOIKE and A. G. GILLASPIE. *Plant Disease Reporter*, 1976, **60,** 50–54.—A new strain of mosaic, designated M, has been isolated from cane infected through transmission by an aphid vector. On *Sorghum bicolor* it produced symptoms which differed from those produced by other strains of mosaic, although its host range was found to be similar to that of strains A, B, D, H and I (it did not infect Johnson grass readily, as does strain J). Strain M is serologically related to the other strains but differs from them in its instability during purification. Details are given of the investigations.

Sugar cane flowers in Egypt. K. S. DOBBS. *Indian Sugar*, 1975, **25,** 331–333.—Reference is made to the work of RAO which resulted in flowering of cane for the first time in Egypt[1]. In 1974/75, 107 out of 176 varieties were induced to flower. It is planned to establish a sugar cane breeding station at Sabaheya near Alexandria where the work has been carried out.

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Effect of soil-applied pesticides on nitrogen nutrition and yield of sugar cane. R. S. KANWAR. *Indian Sugar*, 1975, **25,** 373–386.—See *I.S.J.*, 1972, **74,** 172.

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Boosting sugar cane quality through nitrogen application in relation to irrigation. B. K. MATHUR and K. B. TRIPATHI. *Indian Sugar*, 1975, **25,** 389–392.—A 10-day interval between irrigations proved generally superior to a 15-day interval in trials to determine the effect of this and of N application at one of five rates in the range 100–300 kg.ha^{-1}. Maximum sugar yield was obtained at 200 kg N per ha, while maximum cane yield was obtained at 300 kg.ha^{-1}. Juice quality was unaffected.

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Studies on the efficacy of micronutrient application for sugar cane in the Cuddalore tract. S. A. AHMED, K. T. NARASIMHAN, N. RAMAMOORTHY, S. SWAYAMPRAKASAM and S. D. RAJAN. *Indian Sugar*, 1975, **25,** 395–399.—Of four micronutrients (Cu, B, Mn and Zn) applied to cane in two seasons, only Zn had an overall beneficial effect on yield and quality when applied at 2 kg per acre.

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Availability of applied phosphate in the soils of the white sugar belt of north Bihar. B. P. SAHI, S. R. MUKHERJEE and M. PRASED. *Indian Sugar*, 1975, **25,** 401–403. Investigations are reported which showed that, in the three major soil types associated with cane cultivation in north Bihar, P fixation took place in two stages: the first was associated with temporary locking by minerals and bacteria, while the second (occurring after a period of release) was more marked and was attributed to the formation of less soluble phosphates. Duration of the periods of fixation depended on the type of soil. After 8 months, all of the P_2O_5 added at the rate of 85 kg.ha^{-1} had been fixed.

* * *

Intercropping of autumn-planted sugar cane with wheat. B. S. MATHUR. *Indian Sugar*, 1975, **25,** 405–413. Trials over three years at a number of sites in Uttar Pradesh indicated that intercropping of autumn-planted cane with wheat reduced the cane yield but gave a higher profit per ha for the combined crops than with autumn- or spring-planted cane on its own. It is emphasized that only those varieties of wheat should be grown which are erect and mature early, so that cane tillering is not delayed.

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Economical use of water with nitrogen fertilization and assessment of suitable indices for scheduling irrigation in sugar cane. G. SINGH, D. P. JOSHI and K. SAREEN. *Indian Sugar*, 1975, **25,** 417–426.—Experiments during two seasons are reported, in which cane was irrigated when the available soil moisture content was 20, 40 and 60% depleted, and calcium ammonium nitrate was applied at 100 or 150 kg N per ha. Increase in

[1] *I.S.J.*, 1973, **75,** 241–244.

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the moisture and N levels caused a significant increase in early cane vigour and final yield, but neither moisture nor N affected juice quality. A correlation was found between soil moisture level and leaf sheath moisture content relative to crop age, while leaf N correlated with soil N but not with cane age.

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Screening of promising sugar cane varieties for resistance to smut by *Ustilago scitaminea* Syd. in the Punjab. S. S. SANDHU, V. K. MEHAN, R. S. RAM, S. S. SAHNI and K. R. SHARMA. *Indian Sugar*, 1975, **25**, 423–426. Details are given of screening trials, in which 61 varieties proved resistant to smut, 25 were moderately resistant, 3 were susceptible and 3 highly susceptible. Three varieties under consideration for general release (CoJ 62, CoJ 64 and CoJ 67) were found to be smut-resistant.

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Effect of sodium metasilicate (foliar application) on juice quality, fibre and yield of sugar in Co 419. K. C. RAO, S. THANGAVELU and E. LALITHA. *Indian Sugar*, 1975, **25**, 427–432.—Use of sodium metasilicate as a cane ripener was investigated. Rates applied in one season's trials ranged from 0·125 to 0·50 kg.acre^{-1}, while in the subsequent season the range was 0·50–2·50 kg.acre^{-1}. Application to 10-month-old cane caused improvement in the juice quality and increase in the sugar content, while cane fibre content was not affected. The beneficial effects of the chemical lasted 10–12 weeks. In both sets of experiments, 0·50 kg per acre was the optimum rate of application. The economics are briefly considered.

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A new smut of sugar cane. K. N. GOYAL and R. N. S. TYAGI. *Indian Sugar*, 1975, **25**, 439–440.—Details are given of symptoms and morphology of an ovariicolous smut, *Sphacelotheca schweinfurthiana*, with which Co 312 cane was found to be infected at the cane research station at Borkhera, Kota, Rajasthan.

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Effect of "Agallol" and "Telodrin" on germination, tillering and yield of different varieties of sugar cane in UDIC soils of Jamuna Nagar. J. P. SINGH, U. P. SRIVASTAVA and C. N. BABU. *Indian Sugar*, 1975, **25**, 443–450.—"Agallol" and "Telodrin" at 1 kg.ha^{-1}, applied separately or together, increased cane germination percentage, number of tillers per ha and final yield. The effect of the two combined was greater than of either applied singly. Varietal differences occurred, and of three varieties tested, the most responsive to the treatment was Co 1148.

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Automatic cane planter works smoothly in Tweed district. ANON. *Australian Sugar J.*, 1975, **67**, 427–428. Information, accompanied by a number of photographs, is given on a modified automatic cane planter with curved elevators which provide smoother feeding of the cane setts than did straight elevators in the original design. For control of pineapple disease, fungicide is sprayed from high-pressure guns onto the setts as they fall from the elevator of the MF 102 chopper-harvester, used to cut the green planting material, into the infield bin. The guns are mounted on the bin, preferably one on each side to wet both ends of the setts. The method is simple and, it is hoped, will keep the billets in a better condition if rain delays planting. The planter has proved very reliable, and good strikes are being obtained from setts planted with it.

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Cane planting and harvesting time. L. G. VALLANCE. *Australian Sugar J.*, 1975, **67**, 433–436—While planting time and the length of the growth period affect final cane weight and quality, with field tonnage increasing as the period is extended, a good farm management programme provides for at least two ratoon crops to follow the plant crop, and the later the harvesting date the greater is the dependence of the ratoon crop on weather. It is stated that the "stability and financial progress of any (cane) farm depends very largely on the production of ratoon cane". Variety N:Co 310, grown widely in the southern area of the Queensland cane belt, has a relatively high sugar content early in the season, but continues to improve in quality throughout the season; because of this and its free arrowing characteristic, which prevents it losing weight as the season progresses, there is temptation to harvest the cane late. Trials started in 1970 at Bundaberg Sugar Experiment Station showed that late harvesting of the plant cane caused a reduced yield in the 1st ratoon crop of all three varieties grown. Early, mid-season and late harvesting was followed by ratoon yields of 46, 44 and 36 tons.acre^{-1}, respectively; the corresponding plant cane yields were 49·6, 51·8 and 52·3 tons.acre^{-1}, while sugar yields from the plant crop were 5·5, 7·8 and 8·1 tons.acre^{-1}, respectively. (The performances of the varieties were generally similar.) Comparison was also made between early, mid-season and late harvesting of the ratoon crop, indicating averages of 39, 43 and 44 tons.acre^{-1}, respectively. While it was to be expected that the worst ratoon crop was the one which was harvested early after a late harvest of plant cane, the extent of the difference between it and the highest yield (early cut plant cane followed by late harvested ratoon cane) was considerable at 15 tons.acre^{-1}. Similar experiments conducted at Mackay showed that plant cane sugar yield increased from early to mid-season harvesting, but further delay to late harvesting at the same time as at Bundaberg (July, September and November) yielded no further improvement. The increase in sugar yield was due to improvement in quality rather than to increase in cane yield. As at Bundaberg, the plant cane harvesting date affected the 1st ratoon sugar yield. A mid-season plant cane harvest was followed by a relatively good ratoon crop and gave the best combined sugar yield; whatever the ratoon crop harvest date, the lowest sugar yield always followed a late plant cane harvest. Some varietal differences were found in the Mackay trials.

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Problems in the diagnosis of ratoon stunting disease. C. RICAUD. *Sugar J.*, 1976, **38**, (8), 16–20.—See *I.S.J.*, 1975, **77**, 80.

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Rodent studies in Florida sugar cane. L. WALSH. *Sugar J.*, 1976, **38**, (8), 22.—An abstract is presented of an article describing studies conducted on rats and cane damage by them in Florida.

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Sugar cane: its energy relationships with fossil fuel. J. C. HUDSON. *Rev. Agric. Sucr. Maurice*, 1975, **54**, 137–142.—See *I.S.J.*, 1975, **77**, 370.

Sugar beet agriculture

High yields of beet leaves and their causes. L. SCHMIDT. *Listy Cukr.*, 1976, **92**, 1–9.—From investigation of possible causes of increase in the leaf: root ratio for beet grown in Czechoslovakia during recent years, it is suggested that changes in agricultural practices are mostly to blame, particularly late application of N in large doses as well as postponement of sowing, resulting in a later growth period. Any genetic effect was found to be small.

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Chemical weed control. ANON. *Le Betterav. Franç.*, 1976, **46**, (289), 17.—The characteristics and uses of a number of pre- and post-emergence herbicides for application in beet fields are briefly reported. Newer herbicides described (for both pre- and post-emergence applications) are "Tramat" and "Goltix", both of which can be mixed with "Betanal".

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Dosing tests with various micro-granulators under standardized conditions. W. R. SCHÄUFELE and H. SCHAFMAYER. *Zucker*, 1976, **29**, 58–63.—Tests with specific microgranulators used for pesticide, particularly nematicide, application are reported.

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The Duquenne beet self-loader. A. VIGOUREUX. *Le Betteravier*, 1976, **10**, (95), 15.—Details and illustrations are given of the Duquenne self-loader which has a capacity of 8 metric tons of beet and permits one man to carry out loading, infield transporting and piling of the beet in clamps.

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Weed control in sugar beet in 1976. J. M. BELIEN and J. F. SALEMBIER. *Le Betteravier*, 1976, **10**, (95), 16–17. Recommendations are given on pre-sowing and pre-emergence herbicide combinations, and a number of precautionary hints are listed.

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Checking the feed rate of micro-granulators is essential. R. VANSTALLEN. *Le Betteravier*, 1976, **10**, (95), 18. Advice is given on checking the feed rate of micro-granulators used to apply "Temik" or "Curater" insecticides, and ready-reckoners are given for calculating the weights and volumes of pesticide equivalent to a given number of kg per ha.

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Precision drilling of beet and plant population. S. MACHLAJEWSKI. *Gaz. Cukr.*, 1976, **84**, 17–19.—The question of final plant population in relation to seed and inter-row spacing is discussed and a method described for calculating probable emergence, taking climatic conditions into consideration.

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The behaviour of sugar beet varieties as a function of crop year and region. A. GRAF. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 45–62.—Performances of 10 varieties grown during 1970–73 at 13 sites in Austria were determined in terms of yield per ha, sugar content and Na, K and α-amino-N contents as well as molasses sugar which resulted. Tabulated data demonstrated the differences due to location and weather conditions (which differ widely in Austria) as well as variety.

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Trace element treatment of sugar beet as a function of nitrogen quantity and analytical soil factors in the Austrian sugar beet region. H. J. MÜLLER. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 62–69.—While increase in N application from 160 to 240 kg.ha^{-1} caused a fall in beet sugar, it caused the Na, K and α-amino-N contents to rise. Application of boron caused beet yield to increase with both levels of N and increased the utilization of the higher level of N where rainfall was slight but regularly distributed. Where there was no rainfall or heavy rain occurred, B had no effect on the sugar content with the higher N level, whereas it increased the sugar content with the lower N level, particularly under dry conditions. Application of a solution of Fe, Mn, Cu and Zn caused a drop in yield under dry conditions, while with adequate water supply it caused a fall in sugar content and an increase in Na, K and α-amino-N. When B was included in the solution, the latter acted as if B was absent, although the yield and sugar content reductions were not so marked. Increase in the water-soluble Zn content of the soil under very dry conditions caused the beet yield to increase and the processing quality to improve. Interaction between trace elements and N at the lower nitrogen levels caused a noticeable increase in beet K but a reduction in α-amino-N. Soil type and analysis also had a marked effect on N and the trace elements, and hence on beet yield and quality; the effect of N application on beet was particularly dependent on the soil humus and N content. The effect of trace element application was governed by the soil trace element content and by soil pH, phosphate-calcium and Na, K, Ca and Mg exchangeable cations.

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Damage to young beet by eating—birds or beetles? O. SCHREIER. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 70–73.—Investigations into the cause of leaf damage on young plants are reported. These indicated that birds, particularly pheasants and skylarks, were responsible for the damage and not insects as had been thought.

* * *

Plant biochemistry with particular respect to the sugar beet. L. LÁSZTITY. *Cukoripar*, 1976, **29**, 9–13.—The biochemical processes which take place in the growing sugar beet are discussed and bioregulation of these processes, e.g. by micro-organisms and enzyme induction and repression, is briefly explained. The effects of herbicides on respiration, photosynthesis, nucleic acid metabolism and protein biosynthesis as well as sugar accumulation are also examined.

Nematode control with "Temik 10 G" and granule distribution problems. ANON. *Die Zuckerrübe*, 1976, **25**, (2), 12–13.—An increase in the incidence of nematodes has been found where beet are grown on a mild loess or peaty soil. While the yields on such soils can be markedly reduced by the pest where a tight rotation is followed or rape or cabbage are usually grown in rotation with the beet, losses can be considerably lessened by application of "Temik 10 G". However, a warning is given of the highly toxic properties of this nematicide, which should therefore not be used as a general insecticide. Precautions to take in its application are described, and accurate determination of the application rate where a micro-granulator is used is explained. Micro-granulator adjustment for a given application rate is also indicated.

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First practical experience with "Tramat". ANON. *Die Zuckerrübe*, 1976, **25**, (2), 15.—Results achieved with "Tramat" as pre- and post-emergence herbicide are discussed and recommended application rates are indicated. The chemical has proved particularly effective against blackgrass (*Alopecurus myosuroides*), wild oats (*Avena fatua*), cockspur or barnyard grass (*Echinochloa crus-galli*), cleavers (*Galium aparine*) and chickweed (*Stellaria media*).

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Sugar beet black leg. ANON. *Die Zuckerrübe*, 1976, **25**, (2), 16–17.—Symptoms and causes of black leg are described. Since there are a number of fungi responsible for the disease, it is difficult to predict the extent of beet losses resulting from it. However, the chances of death or survival of the plant are assessed for given stages of development of the disorder and the extent of infection. Possible means of control are also described.

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"Pirimor"—a new means of controlling aphids. ANON. *Die Zuckerrübe*, 1976, **25**, (2), 17.—Information is given on "Pirimor" (from ICI Ltd.) which is particularly intended for control of aphids while not harming natural enemies such as ladybirds and hover flies.

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Successful spring planting—prerequisite for a good crop. W. C. VON KESSEL. *Die Zuckerrübe*, 1976, **25**, (2), 18–22.—Advice is given on spring work before and after beet seed drilling, including nitrogen application, seed bed preparation and pest and weed control. A table is given which indicates the damage which particular herbicides can cause to beet leaves and the long-term effects of such damage; the economics of spraying are also indicated for a number of herbicides and their combinations. Of pests to be controlled at planting, the most important are pygmy mangold beetles and springtails (controlled by "Lindane") and nematodes (against which "Temik 10 G" is effective).

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Problems concerning headlands. ANON. *Die Zuckerrübe*, 1976, **25**, (2), 23.—The headland is regarded by the author as a necessary evil. The question of whether to plant sugar beet, cereals or fodder beet on headlands is discussed. The proportion of beet field occupied by headlands of given widths is shown in a table. Associated with this is the problem for the beet sugar factory which can arise if the reported beet area does not allow for unused headland, which may occupy a considerable proportion of the total field area. Under these circumstances, factory schedules for harvesting may be incorrect, so that beet may be lifted before full maturity, while amounts of fuel and limestone, etc. for a given expected beet crop may be too great, incurring unnecessary extra costs.

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Weed control trials at Wierthe. G. EBERS, K. GORTZ and R. WÜSTEMANN. *Die Zuckerrübe*, 1976, **25**, (2), 26–29.—Small- and large-scale field trials with specified herbicides and herbicide combinations are reported and the costs per unit area calculated. Since weather conditions and soil moisture are decisive as regards performance of herbicides, no universal recommendations are given.

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Underleaf spraying in sugar beet for control of late weeds. ANON. *Die Zuckerrübe*, 1976, **25**, (2), 30–32. Information and advice is given on use of underleaf spraying equipment for the control of late-emerging weeds.

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Effect of plant density on sugar beet yield and quality in 1975. H. STRUBE. *Die Zuckerrübe*, 1976, **25**, (2), 32.—While the optimum plant density for best yield depends on variety, soil characteristics and water supply, the risk of too small a population is greater than that of too great a population, as demonstrated by tests in 1975 where a density of 50,000 plants per ha was compared with one of 80,000 per ha. Even where the plant spacing was 20–22 cm and emergence was good, the plant population was not excessive at the three locations. Argument against high densities rests on the fact that the healthy leaf growth will increase water usage compared with lower plant densities; however, the corollary of this is that higher yields would be obtained in drier locations with smaller plant populations. That this happened in 1975 was attributed merely to the very much lower rainfall than normal, so that leaf growth was poor generally and was the decisive factor in final plant density.

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Sodium supply to the sugar beet. D. MERKEL. *Die Zuckerrübe*, 1976, **25**, (2), 34.—The role played by Na as a secondary nutrient to N, P and K is discussed and recommendations are given on the optimum quantities to apply to beet as governed by the P and K rates.

* * *

Monogerm hybrids—the result of a hundred years' systematic sugar beet breeding. W. OLTMANN and T. SEDLMAYR. *Zeitsch. Zuckerind.*, 1976, **101**, 117–122. The history of sugar beet breeding during the last hundred years, starting with individual selection and progeny testing and ending with monogerm hybridization, is described. The different breeding methods are briefly mentioned and the most important breeding objectives are discussed. It is the opinion of the authors that no biological limit to further improvements in beet breeding will be reached in the near future. Hybridization is regarded as promising a considerable increase in sugar production per unit area.

Chemical weed control. ANON. *Le Betterav. Franç.*, 1976, **46,** (291), 17–18.—Advice is given on pre- and post-emergence herbicide application in beet, and results of trials with "Goltix" as pre-emergence and "Betanal" and "Tramat" as post-emergence herbicides are reported. Since "Goltix" is a systemic herbicide acting on the root system of the weed, its effectiveness depends on soil moisture and rainfall after application, and results indicated that 40 mm of rain is the minimum necessary in the 5 weeks after application to give an acceptable effect. For post-emergence treatment, "fractionation" is considered preferable whereby a second application is made shortly (say 8 days) after the first application. Advice is given on suitable combinations of "Betanal" + "Tramat" as well as on "Betanal" alone in such a scheme, which reduces the risks of phytotoxicity and permits difficult weeds to be destroyed.

* * *

Micro-granulators. ANON. *Le Betterav. Franç.*, 1976, **46,** (291), 19–20.—Details are given of the various types and makes of micro-granulators available on the French market. Tabulated data indicate results of tests with them and show how the rate of insecticide application is controlled.

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Agrotechnical criteria of precision drilling of beet. I. GUTMAŃSKI. *Gaz. Cukr.*, 1976, **84,** 11–17, 39–43. Factors governing the yield of beet resulting from precision seed drilling are discussed, including seed quality, sowing techniques, soil and weather factors, seedbed preparation, protective measures during growth and fertilization. As regards fertilizer application, a warning is given against excessive N application.

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The beet leaf miner (*Pegomya hyoscyami* Panz.)—prediction and control. M. KUBACKA-SZMIDTGAL. *Gaz. Cukr.*, 1976, **84,** 44–45.—Factors influencing incidence of the beet leaf miner are temperature and atmospheric and soil moisture. Temperature fluctuation above and below the average for the beet growth period will affect the degree of activity of parasites of the pest. Means of predicting its incidence in beet fields and the critical number at which chemical control is necessary are discussed, and suitable pesticides briefly indicated.

* * *

Let us sow early—but when and how? P. H. VERSTRAETE. *Le Betteravier*, 1976, **10,** (96), 13–16. Advice is given on pre-sowing work, including fertilization, spraying and seed bed preparation, and on sowing itself. Recommended seed spacing is given and it is emphasized that the speed of the drill should not exceed 5–6 kph.

* * *

Reflections on weeding in beet. G. PEETERS. *Le Betteravier*, 1976, **10,** (96), 26.—The modern approach to chemical weed control where beet is planted to stand is briefly discussed, wherein it is stressed that whereas previously the requirement was for a residual action of a given herbicide lasting 45 days, i.e. between sowing and manual thinning, now the residual action must last 90 days, i.e. between sowing and covering of the inter-rows. In addition, the nature of the weeds has changed, and it is important to obtain adequate control of the more noxious weeds by pre-emergence application without too much consideration to cost rather than have the problem of trying to destroy them by post-emergence application. Use of "Pyramin" in various combinations is recommended.

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Performance assessment of sugar beet varieties. C. WINNER. *Zucker*, 1976, **29,** 123–125.—The various factors which make fair assessment of beet performance difficult are discussed, including the origin of the seed, variability in root weight and quality between individual plants and local conditions (particularly climatic) under which varietal trials are held. Added to these factors are the difficulties in reconciling beet growth parameters, sugar content and processing quality, while during any one series of trials extremes of any one factor can occur and distort the results. As an example of this, the author cites data obtained in 1975, a year marked in West Germany by extremes of drought and rainfall in different regions, so that results obtained by the Institut für Zuckerrübenforschung did not receive wide publicity. Beet breeding trends in West Germany are briefly examined and mention made of a number of newer varieties which have shown promise.

* * *

Population development and performance of sugar beet drilled to a stand at various seed spacings. E. BORNSCHEUER and H. MEINECKE. *Zucker*, 1976, **29,** 126–131.—Trials in 1972–74 at three locations in West Germany showed that variation in seed spacing between 15·5, 18·5 and 21·5 cm at a constant inter-row distance of 41·7 cm (with two exceptions) resulted in smaller differences between the final plant populations than had been theoretically expected. The population differences were small but not consistent; generally, the 18·5 cm spacing was more advantageous than the other two spacings as regards sugar yield—by comparison, the sugar yield with the 15·5 cm spacing was slightly lower and the 21·1 cm spacing considerably lower. The sugar content fell with increase in spacing.

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The place of sugar beet in the rotation. J. BALDWIN. *British Sugar Beet Rev.*, 1976, **44,** 25–26.—The question of beet growing as part of a rotation is examined from two aspects: profitability of the beet crop and its ability to match in with other crops. While costs seem to have risen more steadily than have beet yields, the author considers that the long-term financial prospects of the crop are good. However, the relationship of beet crops to other crops in a rotation poses a number of problems; oil seed rape has become a serious competitor with beet on heavy soils in the UK, and the pros and cons of cereal crops with oil seed rape or beet as break crop are discussed. While direct drilling is a practical system for cereals and oil seed rape, ploughing is generally necessary before and after the beet crop, which may upset some of the benefits to soil structure which are claimed for direct drilling. The possibility of direct drilling of beet on light soil, where wind erosion is a problem, is mentioned. The advantages of beet crops on light soil are discussed, including the value of the beet residues as fertilizer and animal fodder. On poorer soils, beet and cereals are considered more suitable crops than the potato crop with its associated labour and mechanization problems.

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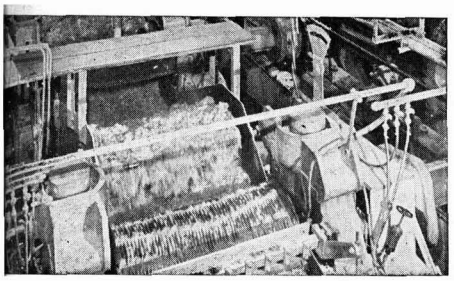

Cane sugar manufacture

Diffusion in the cane sugar industry. E. CARDET. *CubaAzúcar*, 1975, (Oct./Dec.), 47–55.—Installation and operation of diffusers in the cane sugar industry up to 1972 are discussed and data from the literature used to compare performances with milling tandems where possible. It is pointed out that, even in the Philippines where such units have achieved wide acceptance, not all the newest factories have diffusers, so that opinion is not unanimous on their selection for cane juice extraction.

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Production of centrifugal raw sugars from Mexican piloncillos. B. A. SMITH *et al.* *Sugar y Azúcar*, 1975, **70,** (13), 25–27.—Tests on manufacture of centrifugal raw sugar from Mexican non-centrifugal crude sugar known as *piloncillo* are reported, details being given of massecuite parameters and composition of molasses and raw sugars. Purities of the five syrups obtained from two *piloncillo* samples ranged from 78·4 to 89·8, and final raw sugar pol ranged from 93·5 to 97·6. No problems were encountered in massecuite boiling.

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The container ship revolution and what it means to the South African sugar industry. ANON. *S. African Sugar J.*, 1975, **59,** 639–641.—The benefits of containerization are discussed generally and specific reference made to the future use of this transport system to carry sugar from Durban to Cape Town.

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A functional layout for boiling house equipment. G. F. FUNDORA. *Sugar J.*, 1975, **38,** (7), 9–11.—A theoretical sugar factory layout is described in which the pans and evaporators are located at a height of 55 feet and most of the products are moved by gravity flow to the various stations below; limed juice, clear juice, syrup and molasses tanks are situated on the ground floor together with the centrifugals.

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Prevention of wear of the rotor of the draught fan on the boiler. Y. H. KUO. *Taiwan Sugar*, 1975, **22,** 203–208.—Modifications to boiler induced-draught fans in order to increase their durability against particle-laden gases are described. It is pointed out that it is impossible to remove all particles from flue gases and that the most serious damage is inflicted by mud and sand particles accompanying cane into the factory.

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Effects of machine harvesting on sugar manufacture. C. K. LU. *Taiwan Sugar*, 1975, **22,** 210–213.—The processing problems created by mechanical harvesting compared with manual harvesting are briefly discussed with the aid of tables, graphs and diagrams, particular attention being focused on the need for removal of greater quantities of mud and sand and equipment modifications this has necessitated.

A study of crystal content in automatic sugar boiling. C. J. LU. *Taiwan Sugar*, 1975, **22,** 216–225.—See *I.S.J.*, 1975, **77,** 119.

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Diffusion technology in the cane sugar industry—BMA cane diffusion (Egyptian system). H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1976, **101,** 138–141.—Details are given of the BMA diffusers installed in 1975 at Dalton and Malelane factories in South Africa. At Dalton, the capacity of the diffuser is 150 t.c.h., and preparation is by means of 2 knife sets and a shredder. At Malelane, the diffuser's capacity is 220 t.c.h., and preparation is by means of 3 knife sets and a shredder. During commissioning trials, extraction exceeded 97% at nominal throughput at Malelane, and at Dalton it was 96–97% at a throughput 92% of the nominal. Bagasse dewatering mills are used in both factories.

* * *

Evaluation of seeding methods. What is the most effective crystallizer for our sugar industry? E. CORONA and J. CASTAÑEDA. *ATAC*, 1975, (Sept./Oct.), 4–17. Trials were conducted on boiling of final strikes using three different seed materials, the characteristics and preparation of which are described in addition to those of pulverized refined sugar and fines from sugar dryers which were not used because of their irregularity caused by crystal damage. Results of the strikes are tabulated. It is concluded that the product "Estable I" (obtained by slow addition of a 70–75°C solution of refined sugar to ethanol in a ball mill) is more suitable, because of its micro-crystal uniformity and ready storage for long periods, so making practical its preparation at a central point for the whole Cuban sugar industry, than either fondant paste (which is not recommended because of its high proportion of crystals of $<1\mu$ which dissolve on adding to the pan) or "Crystal 600"[1] (of poor crystal uniformity).

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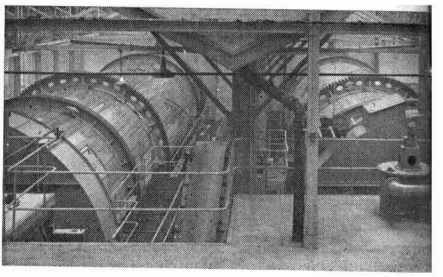
Observations and recommendations on the operations of the Asutsuare and Komenda sugar mills in Ghana. J. P. STO. DOMINGO. *Sugar News* (Philippines), 1975, **51,** 340–342, 374–379, 426–429, 472–479.—A detailed report on the operation of the two Ghana sugar factories up to 1970 is reproduced. The author, who was sent as FAO consultant to Ghana to assess the performances of the factories, points out that the report was released by FAO only shortly before publication. The results for the 1969/70 season indicate a sugar recovery of 3·5% on cane at Asutsuare and of 6·30% on cane at Komenda. Causes of the poor performances are indicated, and advice is given on ways in which improvements can be effected.

[1] DIAZ: *I.S.J.*, 1971, **73,** 180.

Beet sugar manufacture



Juice coloration during sugar manufacture. K. VUKOV. *Cukoripar*, 1976, **29**, 13–17.—The measurement and definition of juice colour are discussed and the origins and classification of beet juice colorants investigated. The properties of these colorants are examined as well as their chemical composition (with many references to the literature). For measurement of colour intensity and establishment of the "yellowness" or "greyness", the author suggests measuring the extinction coefficient at both 420 and 560 nm.

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Thin juice deliming by ion exchange with resin regeneration with thick juice. I. Laboratory tests. V. GRYLLUS. *Cukoripar*, 1976, **29**, 18–26.—See *I.S.J.*, 1976, **78**, 185.

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Tests on optimization of the boiling house at Meleuz sugar factory. V. A. PUGACHEV, A. P. TYCHININA and A. A. SLAVYANSKII. *Sakhar. Prom.*, 1975, (12), 22–25. Details are given of the measures adopted at Meleuz whereby economically optimum conditions in boiling are created by maintaining 1st and low-grade massecuite purities at target levels by adjusting feed syrup purity. Comparison shows that while a syrup purity of 92 gave a greater sugar yield and lower molasses yield than with the conventional scheme, despite a greater massecuite quantity per shift than with the optimum scheme, with a syrup purity of 86 the sugar and molasses yields were the same as with conventional processing, but the massecuite quantity per shift was 239 tons as opposed to 299 tons with the standard scheme; moreover, the higher massecuite quantity adversely affected sugar quality, particularly colour.

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Change in thermal stability of thick juices as a function of sodium sulphite dosages. L. I. RYAZANTSEVA and A. YU. GADZHIEV. *Sakhar. Prom.*, 1975, (12), 25–28. Tests are reported in which 2nd carbonatation juice was treated with various amounts of sodium sulphite and heated to simulate evaporation conditions. Results showed that addition of the sulphite helped to reduce sucrose thermal degradation and colour formation. The positive effects increased with increase in sulphite dosage from 0·001 to 0·010 mole per litre, but increase beyond this upper level had little further effect.

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Causes of a molasses sugar content which is above the permitted level and ways of reducing it. A. YA. ZAGORUL'KO, V. S. SEMENYUK, E. K. IVANISHENKO and E. A. TRIFONOVA. *Sakhar. Prom.*, 1975, (12), 37–42.—Investigation of abnormally high molasses sugar at a number of Soviet factories showed that the prime cause was an inadequate period for low-grade massecuite cooling, resulting in micro-crystals of sugar in the molasses. Advice is given on determination of the optimum cooling time, based on exhaustion of an artificial massecuite, and on determination of the presence of micro-crystals, while recommended measures for reducing the losses are listed.

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Air priming pumps for vacuum creation in vacuum pans in beet sugar factories and refineries. M. L. VAISMAN. *Sakhar. Prom.*, 1975, (12), 48–52.—Two methods of creating vacuum in pans are examined: the use of a central condenser unit and an individual priming pump. The two systems are compared and the conclusion drawn that, as regards pan operation and power consumption, the priming pump system is preferable.

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Raw juice purification on the principle of magnesium salts precipitation. J. BURIÁNEK, I. ŠAFROVÁ and Z. SCHNIDEROVÁ. *Listy Cukr.*, 1976, **92**, 10–21.—Laboratory and pilot-scale tests were conducted on raw juice treatment with magnesium carbonate and phosphoric acid added to give a molar ratio of 1:1 at a H_3PO_4 addition of 2–3 g.litre^{-1}. The mud which settled contained 2% nitrogen (on dry solids) and 30–40% organic non-sugars, while its yield was 0·5–1·0% on total raw juice. Optimum filtration took place at pH 8–8·5; in the pilot-scale tests, the cake was compact and easily removable from the plates. The method was found to be applicable also to press water treatment at pH 6–6·5. It is recommended to add the magnesium carbonate and phosphoric acid directly to the diffuser so as to prevent passage of non-sugars to the juice. Tests were also conducted on treatment of some 1st carbonatation juice by conventional means (2nd carbonatation and filtration) and treatment of the remainder with magnesium bisulphite followed by filtration and mixing together of the two filtrates.

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Present level of our knowledge on juice purification. H. SCHIWECK. *Sucr. Belge*, 1976, **95**, 3–14.—Factors affecting the purification of raw juice are listed, ranging from beet topping to raw juice pulp content. Liming flume water to give a pH greater than 10 reduces the volatile acids and anions content and hence the amount introduced into processing with the beet, which will still carry about 2–3% flume water even after washing. Diffusion water acidification and microbial activity during diffusion are also discussed. Laboratory tests have shown that removal of fine pulp (present at 0·05–0·3% on beet) from raw juice by centrifuging gives better thin and thick juices in terms of purity, colour and lime salts contents. The requirements of optimum juice purification are examined, and the advantages and disadvantages of simultaneous liming and gassing compared with those of conventional carbonatation on the basis of results obtained at factories of Süddeutsche Zucker AG.

Tabulated data show that while juice filtrability and settling velocity are higher where the simultaneous process is used than with the classic system, the latter gives juice of lower colour than does the former. The non-sugars removed during purification have been determined from mud analysis, and the values are tabulated, as is the ion balance for thin juice, showing ions removed during purification, those which are formed from glutamine and invert sugar destruction, and those introduced by diffusion water acidification and soda ash addition to maintain thick juice at a sufficiently high pH, where this is necessitated by inadequate free alkalinity. Of parameters considered important in purification, the one which the author feels to have been inadequately discussed is the juice residence time at various stages. The retention times are given for the basic system used by Südzucker factories, which includes preliming for 18 min to 1·2–1·3% CaO alkalinity with recycled mud (14% on beet) containing about 8% CaO, cold liming for 5 min with 1·2–1·4% CaO on beet, and hot liming for 20 min to an alkalinity of 2·2–2·4% CaO. The limed juice is diluted with 6 parts of 1st carbonatation juice to bring the $Ca(OH)_2$ particles suspended in the juice into solution and then subjected to 1st carbonatation for 15 min with recycling of 600% juice on beet. After filtration, the juice is subjected to further liming for 5 min to give a 2nd carbonatation juice alkalinity of 0·2–0·25% CaO and keep the residual citrate level below 40 mg per 100 g total solids and thus reduce the quantity of citrate in the final sugar. After heating to 96–98°C, the juice is subjected to 2nd carbonatation for 12 min in a CO_2 vessel, followed by 10 min in a stirred vessel where multiple recirculation takes place. Heating the thin juice to 120–125°C for 15 min before final liming is suggested as one means of saponifying the glutamine earlier than in the evaporator and thus preventing the fall in pH which results during evaporation. Whether this would adversely affect juice quality, particularly colour, has not yet been determined.

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Juice-side corrosion of steel tubes in evaporators. G. VERNOIS. *Sucr. Belge*, 1976, **95**, 15–17.—The subject is discussed briefly under the headings of: causes of corrosion, the composition of scale which forms on the juice side of the tubes, means of reducing scale formation, corrosion caused during descaling and precautions to take in retubing to prevent pitting.

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Pressure losses in thick juice pipelines. E. MANZKE and S. LIER. *Die Lebensmittelind.*, 1976, **23**, 25–27. A method for calculation of pressure loss in terms of coefficient of friction, flow rate, viscosity and pipe diameter is given for use where thick juice is transferred to and retrieved from storage tanks. A nomogram is also presented for ease of calculation.

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Storage of different varieties of sugar beet. W. TRZCIŃSKI and E. BAKOWSKA. *Prace Inst. Lab. Badaw. Przem. Spozyw.*, 1974, **24**, 511–528; through *S.I.A.*, 1976, **38**, Abs. 76-23.—Tests on nine varieties of beet in Poland, during several campaigns, are reported. Losses in storage differed markedly between the varieties. Generally, those with a higher sucrose content showed more intense respiration and thus greater losses of sucrose and weight. It is suggested that at least two varieties of beet should be delivered to each factory, one of which is processed immediately or stored for no longer than 1 month, while the other is suitable for prolonged storage.

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Effect of calcium ions in juice extraction and purification in the sugar industry. II. Mechanism of reaction of Ca ions during extract preparation. F. TESCHNER and R. KRÄMER. *Nahrung*, 1975, **19**, 267–270; through *S.I.A.*, 1976, **38**, Abs. 76-125.—The pH decrease on adding $CaCl_2$ to beet juice was smaller than that in a model solution. On adding $CaCl_2$ solution to a citric acid solution, the pH decreased from 6 to 4·3–4·4; adding NH_4Cl before, with or after the $CaCl_2$, had little effect. This indicates that the pH fall in the beet juice was not due to citric acid retained in the cossettes. It is considered that addition of $CaCl_2$ during diffusion causes, first, precipitation of any oxalate present, then formation of a calcium citrate complex and the occurrence of ion exchange reactions.

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Our sugar. G. DE ANDRE. *Ind. Sacc. Ital.*, 1975, **68**, 155–159.—The Italian sugar industry in 1967 and that in 1975 are compared and the developments in field and factory summarized. Suggestions are made on restructuring of the industry, involving rationalization of factories, enlargement and improvement of beet cultivation and unification of organizations representing beet growers so that cooperation with the sugar producers can solve problems facing the industry and achieve expansion to bring it nearer the level of the industries in other EEC countries.

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A method of automation in the sugar industry. G. WINDAL. *Sucr. Franç.*, 1976, **117**, 71–77.—Criteria of an automatic control system in a sugar factory and choice of system are discussed, and problems associated with the introduction of automation are considered. A system is outlined which is based on centralized location but decentralized control of process stages by e.g. a series of micro-processors. This system is compared with a centralized system which controls the complete process on a global basis.

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Introduction of a scheme for integrated treatment of diffusion water using aluminium sulphate at Satanov sugar factory. B. I. POGORZHEL'SKII, P. I. LENTS, V. F. BANAS, A. A. LIPETS, I. A. OLEINIK and A. I. FEL'DMAN. *Sakhar. Prom.*, 1976, (1), 30–32.—Tests are described in which press water for use in diffusion was treated with aluminium sulphate to give a pH of 4·5–5·0, at which colloid coagulation was optimum, after which the pH was adjusted to 5·8–6·2 by mixing it with condensate. The system had proved necessary because of the greater amount of press water (60% on weight of beet) produced by pressing pulp to 25% dry solids, while the normal quantity of water had been only 20–35% on beet. Comparison with the previous system showed that use of aluminium sulphate improved factory performance by raising juice purity and reducing 2nd carbonatation lime salts, pulp and molasses sugar, while increasing sugar yield, despite the processing of poor quality beet.

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Treatment of water used for the diffusion process. P. T. DUNAEV, O. V. ALEINIKOV and V. P. DRUZHLYAKOV. *Sakhar. Prom.*, 1976, (1), 32–37.—In laboratory tests, raw water was treated with aluminium sulphate or an iron compound as coagulant or limed

and gassed with CO_2. While the physico-chemical properties of the water were approximately the same for all treatments, use of the iron compound imparted a yellowish colour as a result of interaction between the Fe ions and humins and tannins to form unprecipitable colorants. Some of the mud formed by coagulation settled out, while some floated to the surface. The greatest reduction in bacterial content was achieved by treatment with aluminium sulphate, while use of the iron coagulant gave smallest reduction. At Deryugino factory, treatment of diffusion water with alumium sulphate replaced use of SO_2. Comparison of results achieved with the two methods showed that the newer one generally reduced juice colour and lime salts as well as sugar colour, while increasing syrup purity and sugar yield.

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Use of welded steel venturi tubes for measurement of the quantities of waste waters at sugar factories. A. P. PARKHOMETS, A. I. SOROKIN, A. P. FEDOROV, I. M. KATROKHA and V. I. ZABLOTSKII. *Sakhar. Prom.*, 1976, (1), 37–42.—The use of venturi tubes in pipelines to measure the quantities of various types of waste water and mud suspensions by means of differential manometer/flow meter systems or other instruments recording pressure loss is discussed and important dimensions and parameters indicated.

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Means of reducing the quantity of Class III waste waters at working sugar factories. A. N. SAKUN. *Sakhar. Prom.*, 1976, (1), 42–44.—Means of treating Class I and II waste waters in order to reduce the quantity of Class III effluent (of greatest pollution load) are suggested and advice given on best treatment of Class III waste water.

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Electrical resistance of factory syrups during thickening-up before crystal nucleation. V. I. TUZHILKIN and L. M. BOCHKO. *Sakhar. Prom.*, 1976, (1), 44–47. Investigations of the relationship between massecuite resistance and supersaturation, purity and temperature are discussed. A nomogram is reproduced which has permitted supersaturation coefficients to be found within $\pm$ 0·03 units of experimental values as a function of resistance and temperature, while equations have been obtained by computerized processing of data which permit log resistance and supersaturation coefficients to be calculated in terms of the above factors to within 3% of experimental data.

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The COD balance as an aid in waste water assessment. R. DE VLETTER and E. WIND. *Zucker*, 1976, **29**, 53–57.—See *I.S.J.*, 1976, **78**, 55.

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The development of sugar technology in the last 100 years. L. ROSENBERG. *Zeitsch. Zuckerind.*, 1976, **101**, 99-102.—The history of the development of beet sugar factory processes and equipment is briefly described.

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Heat transfer through scaled surfaces. T. BALOH. *Zeitsch. Zuckerind.*, 1976, **101**, 141–145.—Since even thin layers of scale considerably reduce heat transfer, heating and cooling surface dimensions must be based on the heat transfer coefficient for scaled and not bare metal surfaces. Experiments were conducted to test the validity of coefficient calculation procedures in the literature, and to determine the effect of increase in flow rate on heat transfer through scaled surfaces. As a model of a scaled surface, a commercial steel tube was coated on the inside with a 0·52-mm layer of enamel; steam was used as heating medium, and drinking water as heated medium. A seamless steel tube as used in sugar industry heaters served as example of bare metal tube. Results showed that, while the heat transfer coefficient relationship to flow rate conformed to well-known theory, in the case of the coated tube the effect of flow rate was very small; it was also found that between layers of a multi-layer heating surface there is an additional heat resistance, which could explain crazing or stripping of the layers under the effect of heat.

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"Treatability" of waste waters in agricultural and food industries: laboratory tests and their interpretation. J. P. RIDEAU, J. P. TOUZEL, J. SARRIS, G. CATROUX and J. N. MORFAUX. *Ind. Alim. Agric.*, 1975, **92**, 1400–1412.—Descriptions are given of continuous and batch laboratory methods and equipment for determining the degree to which factory effluents, including sugar factory waste water, can be treated to reduce the pollution load. All of the studies conducted on sugar factory effluent have made use of the activated sludge process.

* * *

Bucket wheels operating in beet yards. M. BARRE. *Sucr. Franç.*, 1976, **117**, 117–121.—The construction, operation and advantages of the bucket wheel of the type supplied by SORACEM to three French sugar factories for reclaiming of beet from the pile in the beet yard are described. The horizontal-axle wheel, which can be used to remove beet from piles as high as 4–8 m, carries a number of large buckets around its circumference; as the wheel rotates, each bucket in turn scoops beets into it and allows them to fall out as it reaches the highest point of its travel. The beets fall down a chute to a belt conveyor which feeds them to the factory. Various types of bucket wheel are available to conform to different beet yard arrangements.

* * *

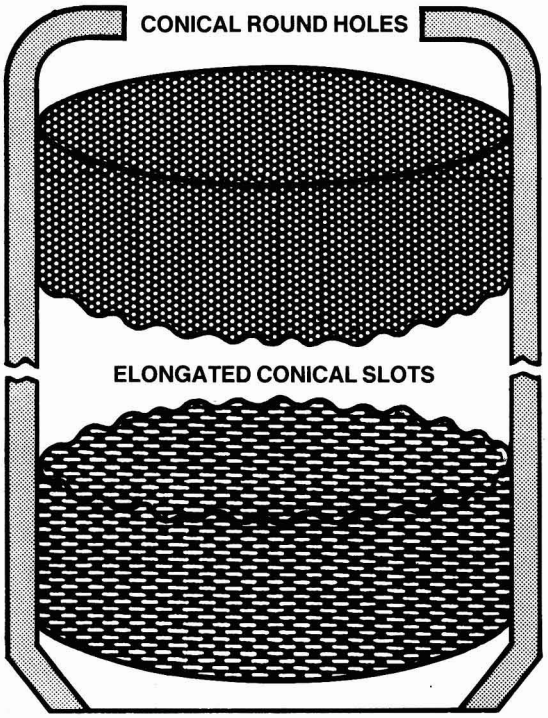
Automatic massecuite boiling. E. GIERADA and A. TOBOLA. *Gaz. Cukr.*, 1976, **84**, 26–29, 33.—Automatic boiling control is discussed, and the conductivity control technique as used in Poland is described. Tests are reported and chart sections reproduced. The relationship between conductivity, supersaturation and massecuite purity is shown graphically, and the effects of various factors on automatic boiling control are discussed.

* * *

Methods of manufacturing instant sugar. M. PIETRZAK. *Gaz. Cukr.*, 1976, **84**, 31–33.—Manufacture of quick-dissolving sugar by agglomeration or spray-drying methods is described, and properties of the final products are discussed.

* * *

Reduction of flume water impurities in settling tanks with water recycling. J. BOĆKO, H. MATUSIEWICZ and I. PYTEL. *Gaz. Cukr.*, 1976, **84**, 34–36.—Results are given of flume water treatment at Klecina sugar factory in Poland, where the waste water is treated in two settling tanks operating in series, residence times



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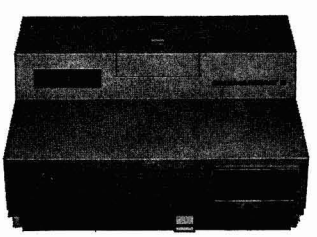

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being 16 hours in the first and 30 hours in the second tank. Graphs illustrate the fall in BOD_5, COD, mineral suspension and total suspended solids, and pressed and dried muds solids content throughout the campaign.

* * *

Thin juice deliming by ion exchange with resin regeneration with thick juice. II. Factory tests. V. GRYLLUS. *Cukoripar*, 1976, **29**, 48–56.—See *I.S.J.*, 1976, **78**, 187.

* * *

Treatment of diffuser feed water by electrocoagulation. A. YA. ROMANYUK, A. A. LIPETS and I. A. OLEINIK. *Sakhar. Prom.*, 1976, (2), 11–14.—Laboratory electrolysis tests using a special unit comprising a series of aluminium plates acting as electrodes immersed in samples of press water and condenser water showed that application of 1·5 $mA.cm^{-2}$ to the plates during 10 minutes' retention of the water in the tank at 50°C considerably reduced the dissolved solids content in the water: that of condenser water from 676–722 to 184–285 $mg.litre^{-1}$ and that of press water from 7260–9700 to 182–256 $mg.litre^{-1}$. Further investigations indicated that the treatment increased raw and carbonatation juice purity while reducing the colour and lime salts contents. The effect is brought about by dissolution of the aluminium anodes to form aluminium hydroxide which has a high adsorptive capacity[1]. A proposed factory-scale arrangement is described.

* * *

Arrangement for sweetening-off vacuum filter mud. N. G. LILA, B. I. EIBOZHENKO, P. A. SOBOL' and L. K. KOVALENOK. *Sakhar. Prom.*, 1976, (2), 25–27.—A brief description is given of an arrangement of 11 poppet valves mounted above the drum of a vacuum filter, onto which water is allowed to flow in a thin film at a regulated rate. Experience during three campaigns at Korenovskaya has shown that optimum flow per valve was 0·1 $litre.sec^{-1}$; at a cake thickness of 10 mm and a drum speed of 0·16 rpm, this permitted a water rate which was 80% of the weight of the cake and a cake loss of 0·08% sugar on weight of beet.

* * *

Determination of deep and slightly frozen beet roots. N. A. ARKHIPOVICH, I. A. OLEINIK, V. A. KNYAZEV and KH. KH. BATALOV. *Sakhar. Prom.*, 1976, (2), 30–32.—From investigations, in which the difference between the average of four measured temperatures (taken at different points in the beet root[2]) and a single reading obtained from the centre of the root was found to be within experimental error, it is concluded that the use of the single thermometer is preferable because of certain snags associated with use of the larger number. However, the method is applicable only to deep frozen beet, but not to slightly frozen or thawed beet.

* * *

Tests on a modernized evaporator of 2120 m^2 heating surface. V. N. GOROKH *et al.* *Sakhar. Prom.*, 1976, (2), 42–46.—The performance is discussed of a modern evaporator, one of a range being produced with a central downtake and horizontal tube plates and having the same diameter from top to bottom of the main vessel instead of an obsolescent model having external downtake, sloping tube plates and an upper section of greater diameter than the lower section.

Calculation of the maximum content of free calcium and magnesium oxide in lime. N. P. TABUNSHCHIKOV and L. D. SHEVTSOV. *Sakhar. Prom.*, 1976, (2), 46–49. A method for calculation of the maximum possible free Ca and Mg oxides in lime is described, and the effects of limestone composition, kiln operation and fuel ash content on the free oxide content are examined. A nomogram is reproduced for ease of calculation in terms of the three factors mentioned.

* * *

Influence of the mechanical handling of sugar beets on sugar yield in the factory. R. DE VLETTER and W. VAN GILS. *Sugar J.*, 1976, **38**, (8), 8–13.—Investigations of beet sugar loss were carried out in which beets were cut with a sharp knife into two or more parts and dropped into a measured quantity of water; the sugar content of the water was determined colorimetrically after 15 minutes' stirring, found sufficient to wash most of the sugar from the opened cells. The effects of a number of factors on sugar loss from damaged beet were then examined. A gradual increase in loss between September and December (reaching an ultimate figure which was 60% greater than at the start of the campaign) was established. Water pH, salt and sugar concentration in the tests had no measurable effect, as was also the case with direction of cut (horizontal, vertical or radial). Damaged beets were found to lose sugar in proportion to the number of ruptured cells. No direct relationship was found between the estimated fracture surface (after beets had been deliberately damaged by collision) and sugar loss. Collision with harder surfaces caused greater losses than did impact with softer surfaces, while losses were also increased by hitting prefractured beet surfaces. Piling of cut beet was followed by rapid loss of sugar, fermentation starting within a few hours of piling. Considerable temperature rise in some beet piles was attributed to heat generation from damaged, fermenting beets. Calculation of losses due to beet respiration gave values in close agreement with actual values. The monetary equivalent of losses between harvesting and processing is briefly explained.

* * *

Vessel for fluidized bed cooling of granulated sugar. L. A. ORLOV and N. A. BUZYKIN. *Pishch. Prom.*, 1975, **20**, 64–66.—A fluidized bed cooler for white sugar is briefly described which in tests reduced the temperature from 68° to 24°C and the moisture content from 0·25% to 0·05% at a throughput of 15 $tons.hr^{-1}$.

* * *

Particulars of heat transfer during pulsed flow of water and sugar solutions in horizontal and vertical tubes. I. M. FEDOTKIN and I. V. KOSMINSKII. *Pishch. Prom.*, 1975, **20**, 68–71.—It has been found that use of pulsed flow increases heat transfer, and experiments were conducted on this method using a test rig to establish the relationship between heat transfer and various parameters for water and sugar solutions of varying concentration. Equations are given which permit calculation of heat transfer over a wide range of Reynolds' and Prandtl's numbers.

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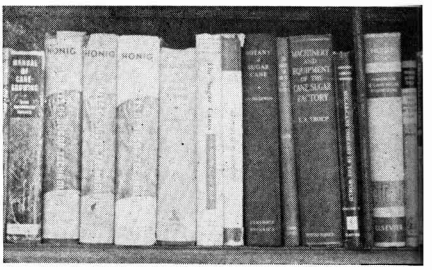
[1] *See also* KRIVCHUN *et al.*: *I.S.J.*, 1976, **78**, 89.
[2] ZAGORUL'KO *et al.*: *ibid.*, 1975, **77**, 183.

New books



An outline of expansion plans in the world sugar industry. H. AHLFELD. 77 pp; 20·5 × 29·5 cm. (F. O. Licht K.G., P.O.B. 1220, 2418 Ratzeburg, Germany.) 1975.

The expansion plans for each sugar-producing country in West Europe, East Europe, North and Central America, South America, Africa, Asia and Oceania are reported. The information has been obtained from business contacts of F. O. Licht, from West German embassies and from a large number of publications. It is admitted that the list may be incomplete and that some information may already be out-of-date; moreover, estimates for 1980 necessarily contain a great deal of personal judgement.

As it is, the work is a very interesting collection of information which helps to throw light on the future prospects in each country as well as giving a background to that country's sugar-producing role. The text is clearly printed and the subject-matter well arranged. The author is to be congratulated on such a useful job well carried out.

* * *

Planalsucar Annual Report 1974. Ed. G. M. AZZI. 68 pp; 20·5 × 28·0 cm. (Instituto do Açúcar e do Alcool, Rua Boa Morte 1367, 13400 Piracicaba, São Paulo, Brazil.) 1975.

The 1974 report of the Programa Nacional de Melhoramento da Cana de Açúcar surveys the work carried out by the experiment stations on cane breeding, diseases, pests, fertilization, use of chemical ripeners, climatology and irrigation, and extension services. Many interesting illustrations are reproduced in colour, and Portuguese and English are used side by side.

* * *

The South African sugar year book 1974-1975. ANON. 199 pp; 22 × 28 cm. (The South African Sugar Journal, Norwich Union House, Durban Club Place, Durban, P.O. Box 1209, South Africa.) 1975. Price: R5.00.

The 45th edition of the South African sugar year book contains a number of reports from various organizations concerned with sugar as well as details of refined and raw sugar-producing companies in South Africa and neighbouring countries. For those readers interested in the South African sugar industry, this will be of immense value.

* * *

Sweeteners: issues and uncertainties. ANON. 260 pp; 19 × 25 cm. (Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C., USA 20418.) 1975. Price: $8.00.

This is the proceedings of the fourth public forum of the National Academy of Sciences held on 25th–26th March 1975, at which more than fifty participants representing public interest groups, private industry, government control agencies and the scientific community aired their views on the effects of natural and artificial sweeteners on the human diet and health. (While the natural sweetener mostly mentioned is sucrose, occasional references are made to other sugars.) Although dealing with a subject not normally treated in the pages of this journal, the work may be of interest to our readers, if only to demonstrate the diversity of opinion on the merits and demerits of sweeteners.

* * *

Handbook of cane sugar technology. R. B. L. MATHUR. 498 pp; 14 × 22·5 cm. (Oxford & IBH Publishing Co., 66 Janpath, New Delhi, India 110001.) 1975. Price: Rs. 20.00.

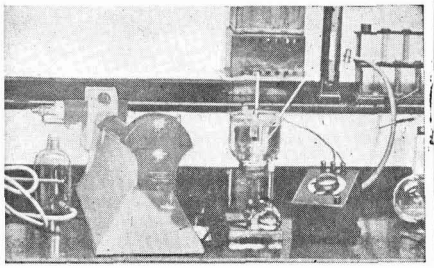
While this book cannot be compared to the more sophisticated works concerning cane sugar technology which are available, it is an inexpensive source of information on the processes and equipment used in the factory which is well set out and reasonably well printed. A subject index is included, but not an author index. It could be argued, perhaps, that separation into 57 chapters is somewhat excessive, since many are very short, and some of the subjects should have received greater treatment than they do, but for the student of sugar technology this will be a handy reference book. Certain features of the book tend to limit its scope of use to India, although students from other cane countries could glean much from it.

* * *

Food analysis: analytical and quality control methods for the food manufacturer and buyer. R. LEES. 245 pp; 15 × 23·5 cm. (Abelard-Schuman Ltd., 450 Edgware Rd., London, England W2 1EG.) 1976. Price: £8.50.

This is the 3rd edition of a book intended to provide the working analytical chemist with a compendium of methods "chosen because they give good repeatable results and are suitable for use in a factory laboratory". Section I is an index to methods for named foodstuffs, Section II gives details of the methods, and Section III is a collection of notes on general laboratory methods used in food analysis. For raw sugar (described as "crude sugar"), refined sugar and sugar syrup, methods are described for determination of ash, colour, moisture content, optical rotation, pH, reducing sugars (as invert sugar) and SO_2 as well as refined sugar bulk density and syrup sucrose and soluble solids.

Since the work is of a general nature, with only outline procedures given, it is probably of limited value to the chemist in any one industry; certainly, for the sugar chemist the book offers very little, and better value would be obtained from books specifically intended for the sugar industry.



Laboratory methods & Chemical reports

Composition of acid beverage floc. E. J. ROBERTS and F. G. CARPENTER. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 39–50.—Sucrose was dissolved in 1·85% aqueous formaldehyde to give a 54° Bx solution the pH of which was adjusted to 1·5 with phosphoric acid. After 10 days at room temperature, floc settled to the bottom of the container and was subsequently separated and treated in preparation for analysis. This showed it to be composed of silicon dioxide, polysaccharides, protein and fats + waxes + lipids, with SiO_2 as by far the major component; phosphorus and nitrogen were present in less than 1·0% quantities. Analysis of the polysaccharides after acid hydrolysis revealed arabinose, rhamnose, xylose, mannose, galactose and glucose (the last-named constituting the major sugar). The amino-acids in the hydrolysed protein were (in descending order of their content): aspartic acid, alanine, leucine, glutamic acid, serine, threonine, valine, glycine, *iso*-leucine, phenylanine, proline, arginine, lysine, tyrosine and histidine, each of the last four being present at less than 0·01% of the floc. The quantities of the amino-acids were of the same approximate order as in cane juice, with the exception of glutamic acid.

* * *

Optimum conditions for determining individual minor constituents in cane sugar by gas-liquid chromatography. M. A. GODSHALL and E. J. ROBERTS. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 51–65.—After liquid-liquid extraction of cane sugar solution with ethyl acetate, the extract (a combination of a number of sub-extracts) was dried, filtered and prepared for GLC by removal of the solvent and further drying. The minor constituents were determined with a flame ionization detector after silylation, tetraphenylethylene being used as internal standard. The effects of pH, Brix and volume of ethyl acetate used in extraction were determined, and optimum conditions established for determination of malic acid, *p*-hydroxybenzoic acid, palmitic acid, oleic acid, fumaric acid and mesaconic acid. For malic acid, a step-wise system of continuous extraction was found to be most suitable. Replacement of ethyl acetate with ethyl ether in order to reduce the amount of invert sugar extracted succeeded in this aim but the ether was not as efficient a solvent.

* * *

Cane sugar and silicon compounds. M. A. CLARKE. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 66–75.—Silicon compounds occurring naturally in cane juice or used as additives play a number of roles in sugar manufacture and refining. These are surveyed, with particular mention of sucrose degradation inhibition and the possible adverse effect of silica on filtrability. Silicon analysis is briefly discussed, and the various forms of silicate structures are examined. The part played by silicate ions in beverage floc formation is also discussed.

Chloride control in the refinery. C. R. BROWN and P. POMMEZ. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 76–92.—Use of the chloride ion-selective electrode to control affination[1] at Montreal and Toronto refineries and syrup back-boiling at Toronto is described and results presented, showing that the system is stable, reliable and practical. Application of the electrode to bone char, carbon and mud sweetening-off has shown promise, but no data are presented.

* * *

Fluorescence measurements and pH sensitivity as predictors of colour removal in process. D. F. CHARLES. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 93–105.—Refinery liquors exhibited two major fluorescence peaks, "A" having excitation and emission wavelengths of 395 and 515 nm, respectively, and "B" having corresponding wavelengths of 320 and 410 nm, respectively, while those for quinine sulphate (used as intensity standard) were 345 and 445 nm, respectively. Reduction of colour and fluorescence by clarification, adsorption on bone char and granular carbon and in boiling was investigated. Clarification removed primarily pH-insensitive colorants; bone char initially removed pH-sensitive colorants but generally removed the basic pH-insensitive colorant more efficiently; granular carbon reduced primarily the "A" fluorescence, followed by pH-sensitive colour; boiling reduced primarily the "B" fluorescence. Fluorescence did not contribute significantly to prediction of removal of colour measured at pH 7, and pH sensitivity was always a better guide. Colour measured at pH 7 in granulated sugar is best predicted from raw sugar colour measured at pH 4 plus colour measured at pH 9.

* * *

Use of differential pulse anodic stripping for trace elements in sugar products. P. POMMEZ and R. CORMIER. *Proc.* 1974 *Tech. Session Cane Sugar Refining Research*, 125–137.—In anodic stripping voltammetry (ASV), a portion of the metal ions in solution is concentrated into a stationary mercury electrode, followed by equilibration to permit a uniform distribution of the amalgam to be obtained; at the end of equilibration, a linearly increasing potential gradient is applied in the stripping stage, whereby the metals are oxidized out at their own redox potential and redissolve in the solution as ions—the amount of current generated by this reaction depends on the concentration of the material oxidized, so that a typical waveform polarogram is obtained. The differential pulse anodic stripping (DPAS) technique uses the concentration and stripping stages of ASV, but in stripping a small amplitude pulse is superimposed on the linear gradient; the first approximately two-thirds of the

[1] POMMEZ & STACHENKO: *I.S.J.*, 1973, **75**, 220.

pulse duration is used to allow the charging current to decay to a negligible value, while the last third is used to measure the Faradaic current. Current flow is measured just before application of the pulse and again during the last portion of the pulse, and the difference is displayed on the recorder, while the normal D.C. stripping waveform becomes a peak-shaped readout which is more convenient for quantification. The procedure used to determine lead, copper and cadmium simultaneously in raw sugar is explained and the resultant polarograms discussed. Most of the experiments used the hanging mercury drop electrode, although some preliminary measurements were made with a mercury film electrode on a glassy carbon electrode. The metals (possibly including zinc) are detectable down to ppb levels with the former electrode and to sub-ppb levels with the mercury film electrode.

* * *

Carbohydrate changes in invert syrups. V. S. VELASCO and J. F. DOWLING. *Proc. 1974 Tech. Session Cane Sugar Refining Research*, 138–154.—Paper and gas-liquid chromatographic analysis of medium and total invert syrups from beet and cane sugar (produced by acid or ion exchange inversion) has shown that the dextrose content was higher than the levulose content. Investigation of the inversion reaction at various pH values and temperatures showed that levulose appears to be more sensitive to low pH and high temperature than is dextrose. Under acid conditions, levulose forms higher sugars, two of which are suggested as difructose dianhydrides I and II. The levulose in sucrose inverted with invertase appeared to undergo less destruction than when acid inversion was used, so that invertase is suggested as an inverting agent in analytical methods. The higher sugars were identified by both GLC and thin-layer chromatography.

* * *

***O*-α-glucopyranosyl-(1→5)-D-arabinofuranose—a bacterio-enzymatically synthesized disaccharide.** W. MAUCH and F. EL AAMA. *Zeitsch. Zuckerind.*, 1976, **101**, 21–25.—The constitution of a new disaccharide is described which is produced by the action of *Protaminobacter ruber* on a solution containing sucrose and D-arabinose. It has reducing properties, a specific optical rotation $[\alpha]_D^{24}$ of +94·7° and a melting point of 138–142°C. Analysis has led to the finding that the disaccharide comprises a hexose and a pentose and possesses a 1,5 linkage.

* * *

Adaptation of turbidimetric method of dextran determination to beet juice. A. BORYS. *Prace Inst. Lab. Badaw. Przem. Spozyw.*, 1974, **24**, 499–510; through *S.I.A.*, 1976, **38**, Abs. 76-108.—The method of NICHOLSON & HORSLEY[1] was adapted for the determination of dextran in beet juice. The aim was to find the relationship between the adsorption at 720 nm of the colloidal dextran suspension and the dextran concentration, time allowed for turbidity formation, amount of ethanol added and the presence of sucrose. It was found necessary to increase the time for turbidity formation after addition of ethanol from 20 to 30 min. The adsorption varied linearly with dextran concentration in the range 10–120 mg per 100 ml. Results by the modified method had a coefficient of variation of 0·58%, and recovery was in the range 96–100%.

Nitrogen determination in sugar beet and factory intermediate products by the Kjeldahl method. N. KUBADINOW. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 124–128.—Comparison of the nitrogen determined as ammonia after digestion and steam distillation with the value given by the "Auto-Analyzer" method showed that the latter gave results which were consistently lower than with the former method; however, use of a solution made up of ammonium sulphate and betaine instead of pure ammonium sulphate to establish a standard curve gave satisfactory results with the automatic method. Gas-liquid chromatography was used to establish why not all of the N in the test sample (thick juice) was converted to ammonia in the automatic method. After digestion for varying periods, the solutions were passed through a polyglycol column, whereby trimethylamine was readily detected. If a sample was not completely digested before distillation and the free ammonia determined by titration with HCl, the amounts of trimethylamine and ammonia consumed were identical, i.e. optimum distillation was achieved. On the other hand, if the ammonia was determined colorimetrically, no trimethylamine could be found, so that the results were too low. Tests to obtain optimum digestion conditions are reported. Indophenol green proved suitable as indicator with the automatic method, while an aluminium Technicon "block digester" was of great advantage for digestion. It was found possible to optimize the reaction conditions so as to eliminate the error mentioned above, but addition of hydrogen peroxide proved of little value, while betaine was suitable as digestion catalyst only with protracted contact. However, values obtained with it deviated less from the theoretical value than did those given by trimethylamine, both catalysts being used with various digestion mixtures.

* * *

Tests on galactinol determination in molasses by means of inositol dehydrogenase obtained from bacteria. F. HOLLAUS. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 128–138.—Details are given of tests to determine galactinol in beet molasses using inositol dehydrogenase (IDH) isolated from *Aerobacter aerogenes*. Results indicated a number of difficulties as a result of use of an impure IDH extract; on the other hand, the method of SCHIWECK & BÜSCHING[2] for determination of galactinol from galactose by raffinose cleavage with galactose dehydrogenase is also liable to error through possible co-precipitation of raffinose with galactinol by means of lead acetate. Further tests will require the use of pure IDH.

* * *

Fully-automatic analysis of carbonatation juice, mud suspension and milk-of-lime by means of an addition titration procedure. G. POLLACH. *Jahresbericht Zuckerforschungs-Inst.* (Vienna), 1974/75, 139–146. Details are given of tests on fully-automatic titration with HCl using apparatus originally intended for microbiological determination of sugar content. The procedure described involves only partial removal of the titration mixture after the individual analyses, the residue being used for the subsequent sample. Tabulated results are reproduced.

[1] *I.S.J.*, 1960, **62**, 200.
[2] *ibid.*, 1970, **72**, 120.

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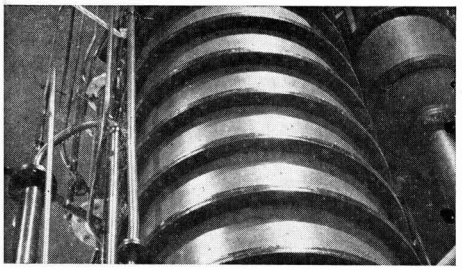


By-products

Molasses as raw material for the biotechnical production of citric acid. J. KOVATS and Z. NIESTRAWSKI. *Branntweinwirtsch.*, 1973, **113,** 373–381; through *S.I.A.*, 1976, **38,** Abs. 76–55.—The effect of processes used in sugar manufacture on beet molasses quality is outlined. The composition of a typical molasses for citric acid production is shown, and the effects of N and P compounds, trace elements, growth stimulators, colouring matter, volatile acids and pH on fermentation to citric acid are described. The effects of changes in molasses composition during the campaign and of storing the molasses are indicated. Data are given on the increase in yield which can be obtained by precipitating heavy metals with potassium ferrocyanide. Properties of good and poor molasses for citric acid fermentation are tabulated. The possibility of using cane molasses as raw material is briefly considered.

* * *

Suppression of lactic infection of molasses with lactocide. V. N. SHVETS, T. P. SLYUSARENKO and A. N. MEL'NIK. *Ferment. Spirt. Prom.*, 1974, (6), 20–22; through *S.I.A.*, 1976, **38,** Abs. 76-95.—Infection of molasses with lactic acid bacteria leads to lower alcohol yield, and increased formation of aldehydes, acids and ethers; tests showed that the addition of 0·005% of a crude preparation containing 0·5% of the antibiotic lactocide suppresses lactic acid bacteria without impairing alcohol yield or quality.

* * *

Comparative studies on treatment of beet molasses distillery waste by thermophilic and mesophilic digestion. A. K. BASU and E. LECLERC. *Water Research*, 1975, **9,** (1), 103–109; through *S.I.A.*, 1976, **38,** 76-156.—In laboratory experiments under batch, semi-continuous and high-rate conditions, thermophilic digestion at 55°C gave as good results as mesophilic digestion at 35°C; the latter method is preferred owing to the lower heating costs.

* * *

The first French distillery is in Aube. ANON. *Le Betterav. Franç.*, 1976, **46,** (289), 35.—Some information and illustrations are given of a distillery situated at Buchères in Aube *département*, erected in 1946, which now produces 52,000 hectolitres of alcohol per year from 75,000–80,000 tons of beet delivered by some 350 growers in the area.

* * *

Preparation of gel-forming beet pectin in conditions of 1·1% HCl. V. V. PARFENENKO, G. V. BUZINA and O. K. LUTSENKO. *Khlebopek. Konditer. Prom.*, 1974, (10), 20–22; through *S.I.A.*, 1976, **38,** Abs. 76-231. Dried beet pulp was hydrolysed at 15-fold dilution in 0·3–1·4% HCl at 85–75°C; tabulated results are compared with those of the conventional 20-fold dilution in 2% HCl at 70°C. The extracts contained 1% pectin rather than 0·7% by the conventional method; pectin prepared with 1·1% HCl at 75°C contained more methoxyl groups, and tended to give a stronger gel.

* * *

Some features of the technology of beet pectin manufacture. G. V. BUZINA and V. V. PARFENENKO. *Khlebopek. Konditer. Prom.*, 1974, (6), 23–24; through *S.I.A.*, 1976, **38,** Abs. 76-232.—Tests on coagulation of beet pectin with $CaCl_2$ and subsequent purification of the coagulate are reported. Pectin yield and gel strength were almost unaffected by pH and quantity of $CaCl_2$ used, though the coagulation proceeded faster when the concentration of the $CaCl_2$ solution added was greater than 20%. Low molecular weight demethoxylated pectin remained in solution; its concentration was 0·03–0·04%, and it was incapable of gelling. The coagulate was dehydrated and demineralized with HCl in alcohol—the optimum HCl dose was approx. 98% on weight of coagulate with 15% moisture, or 10·7% on alcohol volume. The properties of pectins obtained using 78–110% HCl (8·5–12 vol. %) are tabulated. The coagulate from $CaCl_2$ precipitation could be dewatered in block presses to 33% dry solids compared with 25–27% for $AlCl_3$ precipitation.

* * *

Scaling of rum columns. J. NAVARRO and J. PIÑOL. *ATAC*, 1975, (Sept./Oct.), 56–65.—Trials consequent to the rapid scaling of columns in a distillery showed that the two major factors were temperature and alcoholic concentration of the must. By maintenance of suitable temperatures in different parts of the column, and adjusting feed strength to below 6·00 G.L., scaling was reduced markedly.

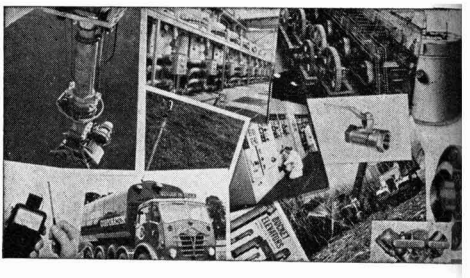
* * *

Corrosion of structural materials in first-stage mash in a molasses distillery. N. I. KRANSNOPOL'SKII and G. A. PREIS. *Pishch. Prom.*, 1975, **20,** 40–42.—Mash to which urea, orthophosphoric acid and HCl are added is held for 1·5–2 hours during sterilization with chloride-of-lime in an air stream. Hence, the materials used for vat construction are exposed to the corrosive effects of a number of elements. Tests conducted on various materials showed that certain titanium alloys are the most suitable under such conditions.

* * *

Vessel for growing fodder yeast biomass. P. S. MATVEENKO and P. A. SEMENETS. *Pishch. Prom.*, 1975, **20,** 47–49.—Details are given of a yeast tank which uses a special internal air injection system for aeration of the culture and air circulation. Because of its simplicity and ease of operation, the system is recommended for direct production of liquid fodder yeast from molasses and other beet sugar factory waste on animal farms. Tests are reported.

Trade notices



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

New rivetless chain range. Ewart Chainbelt Co. Ltd., Colombo St., Derby, England.

Ewart rivetless, heavy-duty chains are now available in a comprehensive range of sizes to meet wider needs in industry. Quality-engineered in high-grade steels, these chains have been found to offer significant advantages over chains made from drop-forged components, including: better flexing, greater pitch accuracy (assuring smoother running) and longer, trouble-free life. A locking feature in the pin prevents uncoupling or turning of the pins; the chains are easily assembled or dismantled without the need for tools, and are interchangeable with conventional forged rivetless chains. Breaking loads range from 24,000 lb (10,895 kg) up to 130,000 lb (59,000 kg). Full details are given in leaflet RC/1 which is printed in English, French, German and Spanish.

* * *

"Autopol" automatic polarimeters. Rudolph Research, Pier Lane, Fairfield, NJ, USA 07006.

Bulletin 431 gives details of the new "Autopol" series of automatic polarimeters and saccharimeters. "Power" and "Reset" are the only two controls necessary for operation of the instrument, all other functions being completely automatic. A servo-controlled analyser is used for polarimetric balance, while the angle of rotation is continuously displayed in digital form via long-life light-emitting diode read-outs, a plus or minus sign indicating dextro- or levo-rotation, respectively. The gain and light source output automatically change to compensate for sample absorbance. The halogen-tungsten filament light source normally operates at less than 80% full voltage, and is automatically boosted to rated voltage only when the instrument senses a strongly absorbent sample. A front panel indicator lights up when the lamp is operating in the "Boost" mode, and should the performance range of the instrument be exceeded (less than 0·1–0·01% transmittance) a second front panel indicator lights up to indicate "Energy limit". The "Autopol IIS" has a range of —225° to +225°S; its accuracy is 0·01°S, with a drift of 0·02°S over 8 hours.

* * *

PUBLICATIONS RECEIVED

"UPDATE". Fabcon International Inc., 1275 Columbus Ave., San Francisco, CA, USA 94133.

Fabcon announce a new bi-monthly technical publication which is to be sent to most sugar factories. It will provide information on Fabcon products, but particularly on experience in use of such products by the sugar industry, for which factories are asked to send details of case histories. The first edition of "Update" is concerned with raw cane juice sanitation by means of CMA bactericide.

TATE & LYLE "TALO" TECHNOLOGY. Tate & Lyle Enterprises Ltd., Cosmos House, Bromley Common, Bromley, Kent, England BR2 9NA.

A 27-page brochure gives details of the various processes, equipment and chemicals available under the "Talo" mark: the "Talofloc" process for simultaneous clarification and decolorization of refinery remelt liquors, the "Talo" clarifier mud sweetening-off process, the "Talodura" process for thick juice clarification, the "Talo" low-cost, short-retention time clarifier, "Talo" pumps and control systems, the "Talameter" colorimeter, "Talofloc" decolorizing agent, "Taloflote" flocculant, "Talodura" water-soluble polymer, "Talosep" flocculant, "Talocide" bactericide for cane mill sanitation, "Talo" filter aid, "Talozyme BA" bacterial alpha-amylase for starch removal from evaporator syrup, "Taluron D" substituted urea herbicide, and "Talo 2,4-D amine 72%" selective herbicide for broadleaf weed control. Separate brochures give more details of the flocculants mentioned above, the mud sweetening-off system and the "Talodura" syrup clarification process.

* * *

Bagasse furnace order.—Clarke Chapman Ltd., International Combustion Division, has been awarded a £750,000 contract for the supply of two water-tube boilers with bagasse furnaces for a sugar factory to be built at Northern Cotabato on Mindanao Island in the Philippines.

* * *

Iran order for Toft.—Toft Bros. Ltd., of Bundaberg, Queensland, Australia, have signed a contract worth $US 17,000,000 for the supply of cane harvesters and infield transporters to Iran. The contract, which is the largest ever received by the company, means that the Toft factories will be operating at full capacity for the rest of 1976 and during 1977. The full-track cane harvesters as used in New South Wales are to be slightly modified (as with machines for Iraq and Peru) whereby the base cutter will be sloped to cut into the furrow. The infield transporters will be of standard design. Technical assistance will be provided during the 1977-78 harvest in Iran.

* * *

Egyptian order for Massey-Ferguson.—Nearly £400,000 worth of MF tractors, implements and cane harvesters are being supplied to Egypt for the new 6000-acre development at Kom Ombo Aswan. The order comprises 40 MF 815, 75-hp tractors and implements, and two MF 201 cane harvesters plus cultivation equipment.

* * *

Bone char kiln for Colombia.—Sim-Chem Ltd., a Simon Engineering company, has completed the design, supply and supervision of erection of a bone char revivification kiln, worth £104,000, ordered by Tate & Lyle Engineering Ltd. for supply to the refinery of Manuelita S.A. near Calle, Colombia.

* * *

Fives-Cail Babcock sugar factories for Yugoslavia.—On the 30th April, FCB signed an important and unique contract at Novi Sad for the construction, in the autonomous region of Vojvodina, of five identical sugar factories, each to have a capacity of 4000 metric tons of beet per day. The contract is to be fulfilled in cooperation with Belgian suppliers and part of the manufacture and erection will be carried out by Yugoslavian enterprises. The factories are to go into service in September 1978. This contract is reported[1] to be worth 400 million French francs.

[1] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (15), 11.

Commission Internationale Technique de Sucrerie

16th General Assembly

It has been announced that the 16th General Assembly of the C.I.T.S. will be held in Amsterdam during the 28th May–1st June 1979. During the May 1976 meeting of the Scientific Committee of the Commission, held in Ferrara, it was decided that the priority subjects for the 16th General Assembly should be (1) Sugar losses, and (2) Environmental protection.

Dominican Republic sugar statistics[1]

	1975		1974	
	(short tons, tel quel)			
Initial stocks....		41,157		36,246
Production		1,251,833		1,316,267
		1,292,990		1,352,513
Exports:				
Algeria	4,460		15,353	
Canada	0		17,527	
Chile	0		16,976	
Egypt	0		8,818	
Finland	24,696		0	
France	12,882		37,754	
Holland	12,732		0	
Iran	24,140		10,914	
Italy	60,600		0	
Japan	0		23,198	
Morocco	31,737		103,644	
New Zealand	0		12,936	
Portugal	14,550		12,096	
Rumania	35,052		0	
Senegal	7,448		0	
Sweden	26,400		25,368	
Tunisia	7,524		13,426	
UK	30,406		36,230	
USA	751,120		794,759	
		1,043,747		1,128,999
Consumption ..		177,685		184,043
Final stocks		71,558		39,471

Fives-Cail Babcock mill for Pakistan.—Fives-Cail Babcock have signed a contract with Pakistan providing for the construction of a sugar factory at Debiora in the Tata district. The factory, to have a daily crushing capacity of 2300 tons of cane, is to be completed by the start of the 1978/79 season.

* * *

USSR beet cultivation improvement measures[2].—A decree issued by the Central Committee of the Soviet Communist Party and the Council of Ministers—and published on the front page of *Pravda* and other newspapers—calls for intensive sugar beet cultivation and a streamlining of beet deliveries to purchasing centres. The decree indicates quite specifically that the mechanization of beet lifting and the supply of synthetic fertilizers, herbicides and insecticides for sugar beet crops are not entirely satisfactory. It instructs local authorities to take urgent action this year, and more permanent measures for improvement in the period from 1977 to 1980. The sugar factories and refineries, too, come in for criticism, by implication. It seems that they are short of spare parts and therefore a number of Ministries not directly connected with sugar production have been asked to fill the gap. According to a Reuter report, the decree also recommended the development of new harvesting machinery, the use of 19,000 hectares of newly-irrigated land by 1980, and a new emphasis on sugar content rather than tonnage when State purchases are made.

Barbados sugar statistics[3]

	1975		1974	
	(metric tons, raw value)			
Initial stocks....		3,023		4,343
Production		100,517		112,680
Imports		0		194
		103,540		117,217
Consumption		14,865		17,256
Exports:				
Canada	4,863		6,886	
Tunisia	0		5,458	
UK	52,077		49,384	
USA	24,041		33,938	
Other countries	1,774		1,272	
		82,755		96,938
Final stock ..		5,920		3,023

La Carlota Sugar Central annual report 1974/75.—A record 1,681,608 tons of cane, grown on 23,732 hectares of land, were crushed during the 1974/75 season to give 2,656,406 piculs (166,025 long tons) of sugar. As a consequence of higher production and favourable sugar prices, gross sales income rose by 116% from the previous year.

* * *

VMF-Stork annual report, 1975.—Of the many companies in the VMF-Stork Group, the best known to our readers will be Stork-Werkspoor Sugar B.V. Large orders were received by this company during 1975 as a consequence of growing world demand for sugar. Major orders included the construction of the world's largest sugar factory in Iran (Karun) and the extension of a sugar factory in Indonesia (Kebon Agung). Steam boiler installations were supplied to sugar factories in Indonesia and construction of a sugar factory in Tanzania was almost completed. The firm expects substantial new orders in 1976. Wescon International, another member of the Group, is building the Kilombero II factory for S.W.S.; it is to be completed before the 1976 season and will have a capacity of 2400 t.c.d. The entire energy-generating unit for the Karun factory is also to be supplied by another Group member, Stork Boilers of Hengelo.

* * *

Belgian factory closures[4].—The Ambresin raw sugar factory in Belgium is reported to be due for closure after the 1977/78 campaign. The Wavre raw sugar factory, also part of the Raffinerie Tirlemontoise Group, is to be closed at the same time[5]. The Barry-Maulde white sugar factory closed after the 1975/76 campaign.

* * *

New Zaire sugar complex[6].—A preliminary agreement has been signed between the Governments of Zaire and China for the construction of a sugar complex in Upper Zaire with financing assured by the two countries.

* * *

Mexico sugar expansion.[7]—The Comisión Nacional de la Industria Azucarera is to invest 3000 million pesos to build six new sugar factories near the Isthmus of Tehuantepec so as to increase production in Mexico by 540,000 tons a year.

* * *

French finance for African sugar projects[8].—France is to lend the Ivory Coast 15 million francs to contribute towards studies for a sugar complex at Borotou, including cane plantations of 6000 hectares and a factory with an annual output capacity of 45,000 metric tons of raw sugar. A loan of 30 million francs is also planned for the Cameroun as a contribution to the cost of development of sugar cane plantations and building of a factory capable of producing 50,000 tons of sugar for local consumption.

[1] C. Czarnikow Ltd., *Sugar Review*, 1976, (1283), 79.
[2] *Commodities Bulletin*, 26th June 1976.
[3] *I.S.O. Stat. Bull.*, 1976, **35**, (4), 21.
[4] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (17), 7.
[5] *Zeitsch. Zuckerind.*, 1976, **101**, 489.
[6] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (15), 11.
[7] *Bank of London & S. America Review*, 1976, **10**, 349.
[8] *Reuter's Sugar Rpt.*, 14th May 1976.

Australia sugar exports[1]

	1975	1974	1973
	(metric tons, raw value)		
Canada	473,884	338,717	354,270
China	36,965	30,949	66,220
Finland	0	0	42,354
Japan	265,803	256,847	601,907
Korea, South	218,059	110,152	64,502
Malaysia	266,803	210,616	104,472
New Zealand	59,869	109,572	112,118
Oceania	9,736	9,288	8,951
Singapore	111,977	81,476	77,695
UK	16,569	383,095	360,870
USA	496,703	221,808	244,749
USSR	0	53,311	64,768
Other countries	5,591	2,118	193
Total	1,961,959	1,807,949	2,102,822

Fiji sugar statistics[6]

	1975	1974	
	(metric tons, tel quel)		
Initial stocks		10,862	9,507
Production		283,684	297,596
Imports		78	176
		294,624	307,279
Consumption		27,941	30,120
Exports:			
Canada	0	16,469	
Malaysia	19,209	11,882	
New Zealand	36,216	35,100	
Singapore	19,209	33,462	
UK	180,194	127,587	
USA	0	41,797	
		254,828	266,297
Final stocks		11,855	10,862

Bagasse furfural plant for Mexico[2].—Nacional Financiera S.A. is to participate in the setting-up of a 176·8 million peso furfural plant in Tres Valles (Veracruz), which will process bagasse from the Mexicana de Papel Periódico factory nearby. The plant will have an installed capacity of 10,000 tons a year, of which about half will be used by Petróleos Mexicanos in 1979 and the rest partially processed into derivatives for exports valued at some $3,000,000 a year.

* * *

Polish sugar factory for Iran[3].—It is reported that Poland is to deliver a further sugar factory to Iran having a daily slicing capacity of 2000 tons of beet.

* * *

Verenigde HVA-Maatschappijen N.V. 1975 report.—In Ethiopia, Wonji and Shoa sugar estates produced a total of 72,842 metric tons of sugar in the 1974/75 milling season under occasionally adverse conditions, an amount nearly 1200 tons more than in 1973/74. As in the previous season, Metahara had to face labour problems in 1974/75, yet its production of 55,798 tons of sugar exceeded that of 1973/74 by well over 6800 tons. Although less sugar was consumed domestically in 1974/75 the reduction was more than compensated by increased exports. A total of 24,000 tons went to Djibouti, the Yemen Arab Republic and Egypt, yielding the equivalent of 24,500,000 Dutch florins for Ethiopia, with some 8,500,000 florins equivalent in export duty. 18,000 tons of molasses were exported. Extension of production capacity at Metahara to some 70,000 tons of sugar per year was completed early in 1976. In Ghana, results at Asutsuare and Komenda sugar factories have not yet met expectations notwithstanding the fact that the 1974/75 milling season procedeed more favourably that the previous. It is evident that rehabilitation of the factories and improvement and expansion of the cane fields will take many more years. A study for a new sugar project in the Volta flood plains has been continued in 1975. The Kilombero I (Msolwa) sugar factory in Tanzania has continued under HVA management as has construction of the Kilombero II (Ruembe) factory due to start operations this year. Consultancy services and advice have also been given to the Mtibwa factory in Tanzania, as well as other supervision of construction contracts and studies of feasibility in Sudan, Ivory Coast, Guinea-Bissau, Nigeria, Uganda, Indonesia, El Salvador, Peru and Ecuador.

* * *

New Philippines sugar project[4].—A 4000 t.c.d. sugar factory is to be supplied by Marubeni Corporation on a turn-key basis for Cagayan Sugar Company and will be set up in Piat, Cagayan Province, in 1977. The area has unused land which will be planted to cane, and payment for the plant will be made in the form of sugar.

* * *

Western Australia pilot sugar cane project[5].—The Government of Western Australia has decided to set up a pilot sugar farm on the Ord River, with up to 64 hectares planted to cane, to establish the feasibility of such a unit as a one-man unit (the average Queensland cane farm is 40 ha). If the Ord development proceeds as a result of the study, an approach would be made to the Commonwealth and Queensland Governments for integration into the national sugar industry. The Western Australia Government aims for an industry producing 220,000 metric tons of raw sugar per year.

Puerto Rico factory to be re-erected in Costa Rica[7].—The Costa Rica Development Corporation has bought the Los Caños sugar mill from Puerto Rico at a price of $3 million and is to re-erect it, possibly in Guanacaste. It is hoped that the plant will be in production in 20 months, that is, in the 1978 season, with a capacity of 4000 tons per day. Total installed cost will be about $12 million.

* * *

US beet sugar factory closure[8].—The Great Western Sugar Company announced in May that operations of the Eaton, Colorado, sugar factory are to be discontinued and beets diverted to its other sugar factories in the area. There has been a reduction in beet sowings in North Central Colorado and the expected volume of beets can be handled by the four remaining factories at Brighton, Greeley, Longmont and Loveland, while studies had shown that the Eaton plant was the least efficient in terms of operation costs and environmental factors.

* * *

Pakistan cane yield increase[9].—Sugar cane production in Pakistan has risen by a significant 16·6% from a 1% increase in the area under the crop. The second estimate of sugar cane production for 1975/76 places the area under cane at 1,678,000 acres estimated to produce 24·3 million tons of cane, as against 1,662,000 acres and 20·9 million tons in 1974/75.

* * *

Indian sugar machinery manufacture[10].—According to Indian press reports, the cooperative sugar sector, which now includes 103 mills in production, contributing 47% of the country's sugar production, is to have its own project to meet the demands for new plant and machinery, as well as for replacements. The unit is to be located at Poona and is expected to go into production in two years. It will have a capacity to manufacture six sugar plants a year, according to the Minister of State for Industry and Civil Supplies at the end of a 2-day session of an all-India conference of cooperative sugar factories.

* * *

Argentina cane harvesting mechanization study[11].—A task group has been formed to examine measures to mechanize cane harvesting in the Argentina producing areas of Tucumán, Salta and Jujuy, and will study the possible effects of gradual mechanization on employment as well as verifying domestic capacity for the manufacture of harvesting machinery. Questions to be reviewed will include the possibility of having to import machinery and the tariffs required to protect local industry. At the moment it is estimated that around 10% of Argentine sugar cane is harvested by fully mechanized means and about 25% partly mechanized.

[1] *I.S.O. Stat. Bull.*, 1976, **35**, (4), 20.
[2] *Bank of London & S. America Review*, 1976, **10**, 348.
[3] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (3), 10.
[4] *Sugar News* (Philippines), 1976, **52**, 84–85.
[5] *Australian Sugar J.*, 1976, **67**, 629.
[6] *I.S.O. Stat. Bull.*, 1976, **35**, (4), 44.
[7] *Amerop Noticias*, 1976, (31).
[8] *Lamborn*, 1976, **54**, 77.
[9] *Standard Chartered Review*, June 1976, 23.
[10] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (17), 15.
[11] *Public Ledger*, 19th June 1976.

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