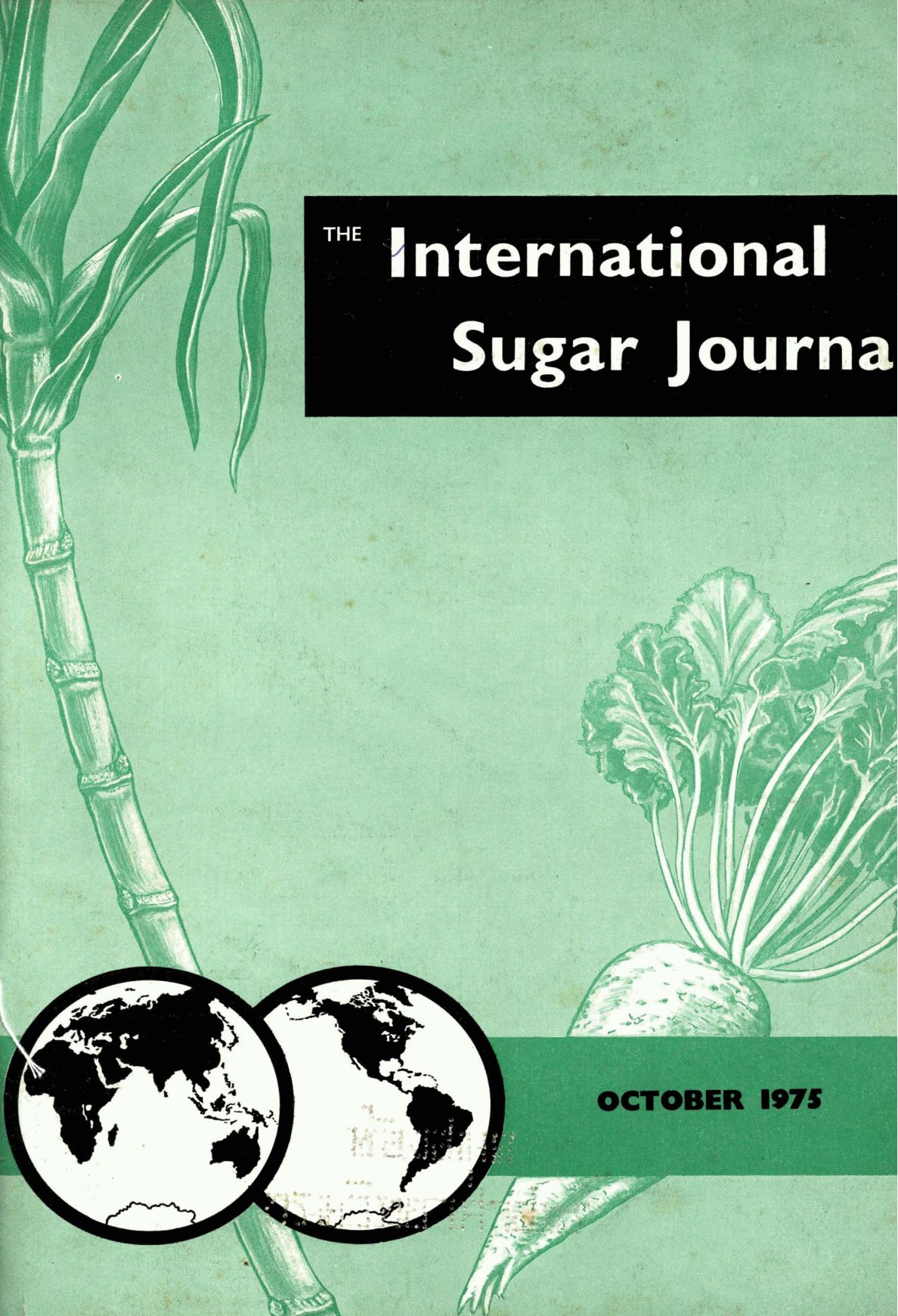

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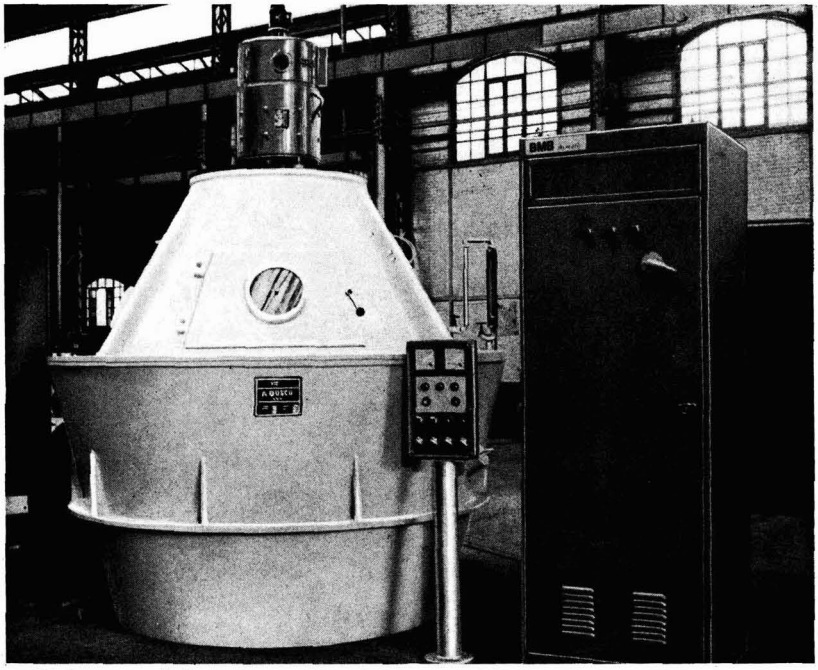

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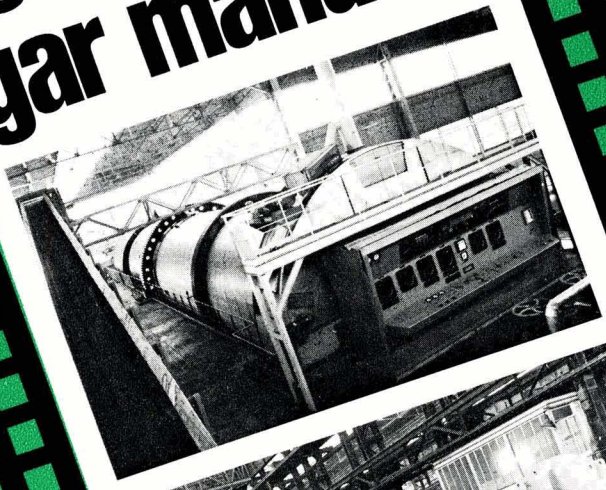

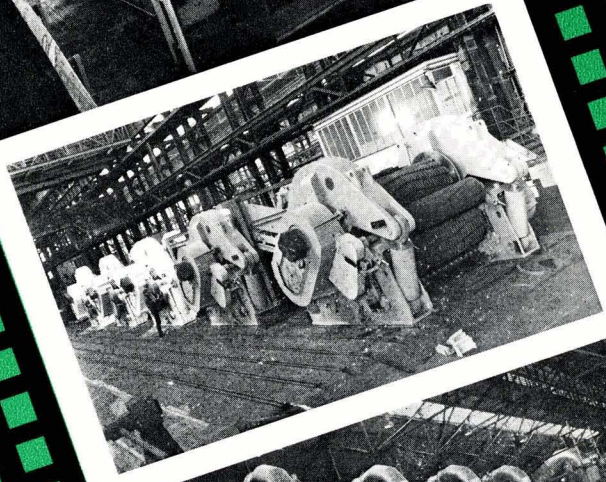

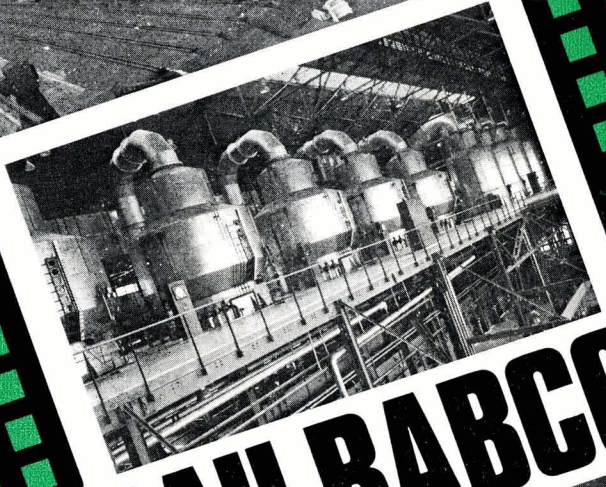

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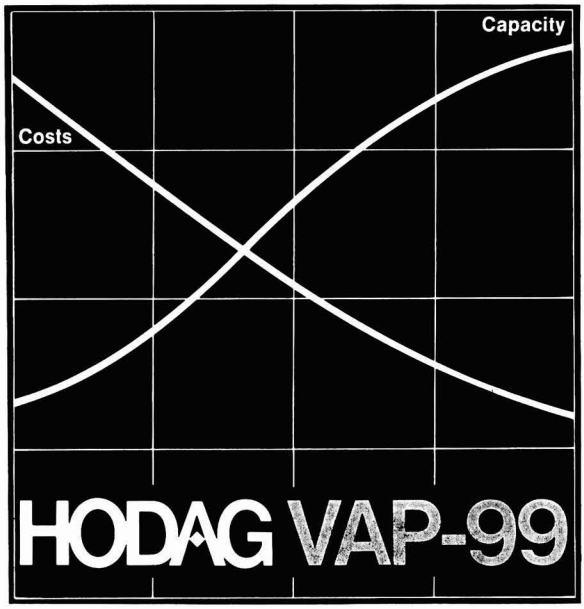

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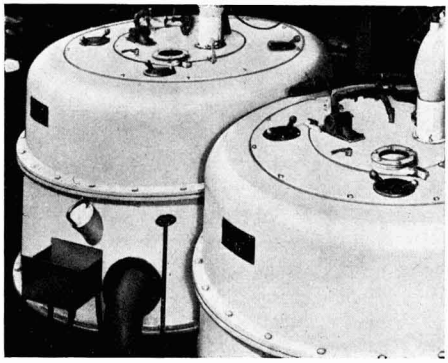

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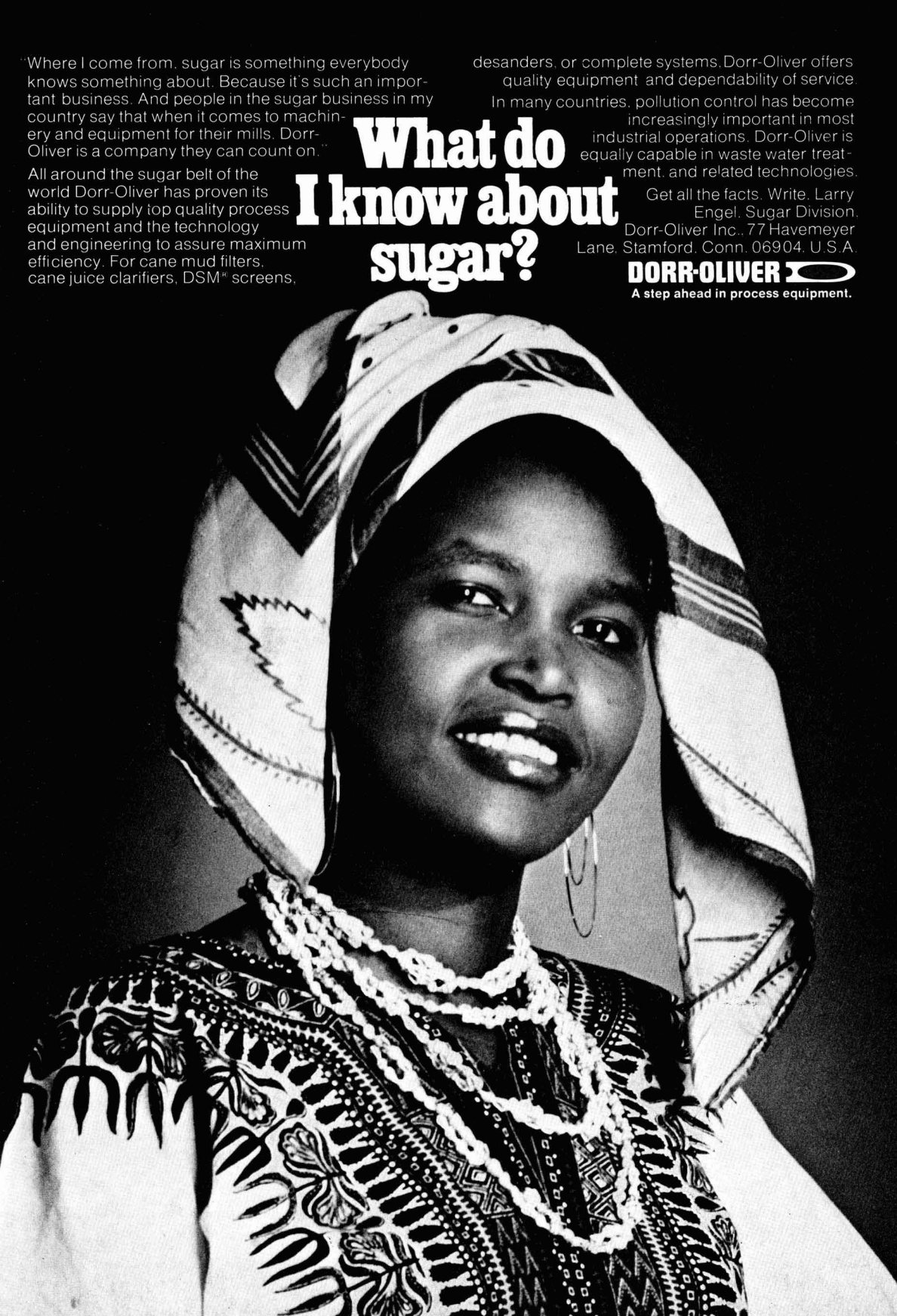
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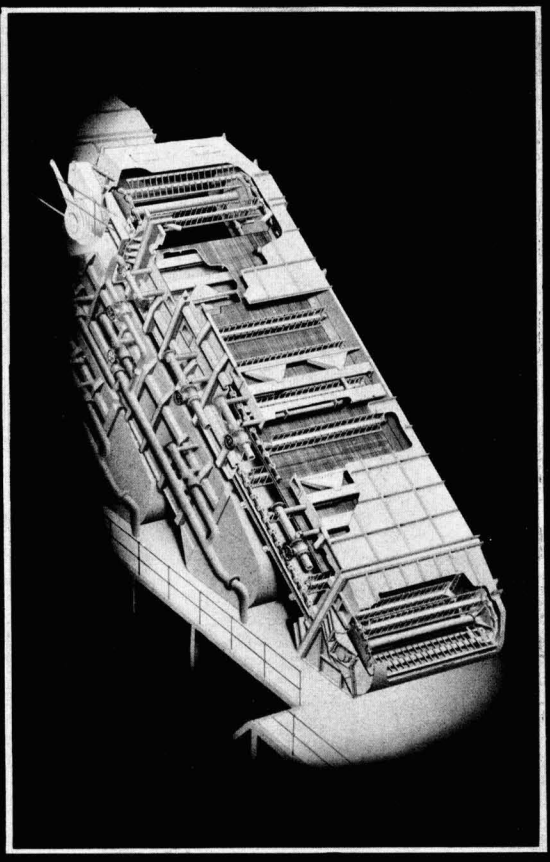

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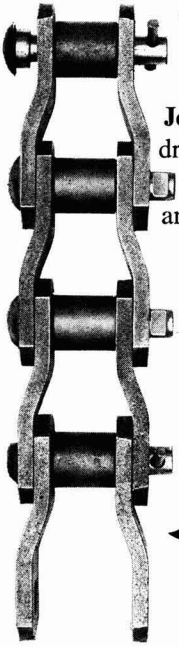

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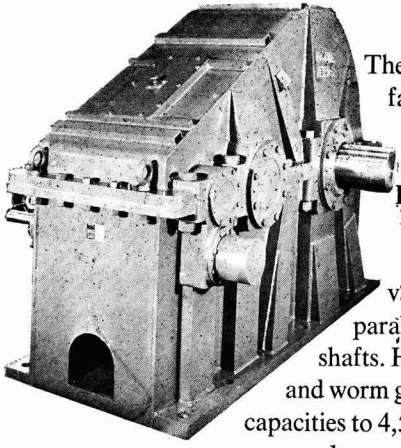

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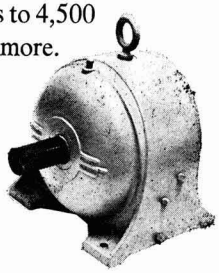

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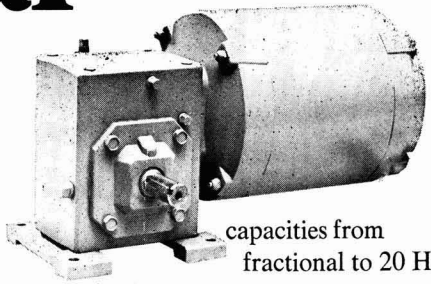

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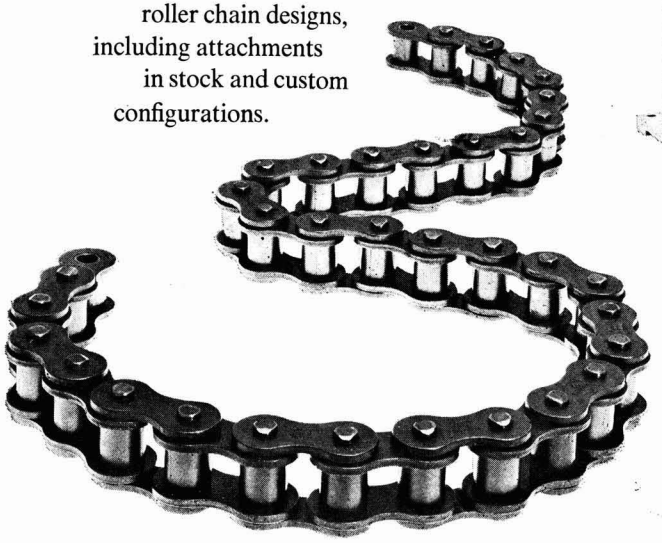

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International Sugar Journal

October 1975

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Diffusion en Afrique du Sud. 1re Partie. J. FITZGERALD et J. P. LAMUSSE. *p.* 291–293

Les recherches au sujet de diffusion de canne et l'expérience acquise en Afrique du Sud avec différents types de diffuseurs sont passées en revue. La 1re partie de l'article décrit le mécanisme de la diffusion et compare le coût et la capacité des diffuseurs et des moulins.

* * *

Récupération du sucre des mélasses de betteraves par le procédé d'exclusion P. & L. 2me Partie. H. G. SCHNEIDER et J. MIKULE. *p.* 294–298

La 2me partie de cet article traite de la régénération des résines à exclusion ionique à l'aide de NaCl ou de mélasses. On fait mention du rétrécissement des particules et de l'importance du maintien d'un faible niveau de liquide au-dessus de la surface des résines. On discute de l'évaluation et de la sélection d'une résine appropriée. L'auteur donne ensuite des détails sur une installation du procédé à exclusion où on utilise 55 m³ de résines.

* * *

Effet du virus à mosaïque sur la canne à sucre. N. RISHI, K. S. BHARGAVA et R. D. JOSHI. *p.* 298–299

On a étudié l'effet néfaste exercé par le virus à mosaïque (espèce A) sur une parcelle expérimentale de canne. On examine la réduction du poids total de canne et de canne pouvant être travaillée au moulin et on compare l'effet de ce virus avec celui causé par l'espèce F.

* * *

Etude faite en collaboration pour la détermination des éléments présents comme traces dans les pulpes à betteraves séchées et les mélasses. 1re partie. Le mercure. P. B. KOSTER, P. RAATS, D. HIBBERT, R. T. PHILLIPSON, H. SCHIWECK et G. STEINLE. *p.* 299–305

Une étude collaborative a été entreprise pour la détermination par absorption atomique sans flamme du mercure dans les pulpes séchées et dans les mélasses. Chaque laboratoire a développé sa propre méthode d'analyse pour atteindre un degré de récupération d'environ 90 à 105% avec des limites de détection de 3 à 5 ng de mercure. Les valeurs obtenues pour 22 échantillons, provenant de Holland, d'Allemagne Fédérale et de Grand-Bretagne, montrent une bonne concordance entre les méthodes. Les résultats sont comparables à ceux obtenus par analyse d'activation de neutrons. Les teneurs en mercure furent en général dans les limites prescrites par le Marché Commun pour des aliments de bétail (inférieures à 0,1 mg de Hg par kg de produit).

Die Diffusion in Südafrika. J. FITZGERALD und J. P. LAMUSSE. *S.* 291–293

Es wird ein Ueberblick über Versuche mit der Rohrdiffusion und die in Südafrika mit verschiedenen Typen von Diffusionsapparaten gewonnenen Erfahrungen gegeben. Im ersten Teil dieser Arbeit beschreiben die Verfasser den Mechanismus der Diffusion sowie die Kosten und die Leistung von Diffusionsapparaturen im Verhältnis zu denen von Rohrmühlen.

* * *

Zuckergewinnung aus Rübenmelasse nach dem Ionenausschlussverfahren der Fa. Pfeifer & Langen. Teil II. H. G. SCHNEIDER und J. MIKULE. *S.* 294–298

Im zweiten Teil dieser Arbeit wird die Regeneration des Ionenauschlussharzes mit Natriumchlorid oder Melasse behandelt. Hierbei wird auf das Schrumpfen des Harzbettes eingegangen und auf die Wichtigkeit der Einhaltung eines nur geringen Flüssigkeitsstandes über der Harzoberfläche hingewiesen. Nach einer Diskussion der Bewertung und Auswahl eines geeigneten Harzes teilen die Verfasser Einzelheiten über einen technischen Ionenausschlussprozess mit, bei dem 55 m³ Harz eingesetzt werden.

* * *

Der Einfluss des Mosaikvirus auf Zuckerrohr. N. RISHI, K. S. BHARGAVA und R. D. JOSHI. *S.* 298–299

Die nachteilige Wirkung des Mosaikvirus-Stammes A auf in einem Versuchsfeld gezogenes Zuckerrohr wurde untersucht. Die Abnahme des Rohrgesamtgewichtes und des Gewichtes an vermahlbarem Rohr wurde mit derjenigen verglichen, die durch den Mosaikvirus-Stamm F hervorgerufen wurde.

* * *

Gemeinsame Untersuchung über die Bestimmung von Spurenelementen in Zuckerrübentrockenschnitzeln und Melassen. Teil I. Quecksilber. P. B. KOSTER, P. RAATS, D. HIBBERT, R. T. PHILLIPSON, H. SCHIWECK und G. STEINLE. *S.* 299–305

Die Bestimmung von Quecksilber in Trockenschnitzeln und Melassen mit Hilfe der Atomabsorptionsspektroskopie wurde gemeinsam untersucht. Jedes Laboratorium entwickelte seine eigene Analysenmethode. Es wurden 90–105% Quecksilber wiedergefunden; die Nachweisgrenze lag bei 3–5 ng. Die an 22 Proben aus den Niederlanden, Westdeutschland und Grossbritannien erhaltenen Ergebnisse zeigen eine gute Uebereinstimmung der verschiedenen Methoden und sind mit denen vergleichbar, die bei Anwendung der Neutronenaktivierungsanalyse gefunden wurden. Der Quecksilbergehalt lag im allgemeinen unter dem EWG-Richtwert von 0,1 mg pro kg Substanz für Futtermittel.

Difusión en Sud-Africa. Parte I. J. FITZGERALD y J. P. LAMUSSE. *Pág.* 291–293

Los autores reseñan investigaciones sobre difusión de caña y le experiencia ganado en Sud-Africa. En este parte del artículo describen el mecanismo de difusión y comparan los costos y capacidad de un difusor con ellos de un tandém.

* * *

Recuperación de azúcar de melaza de remolacha por el proceso P. & L. de exclusión de iones. Parte II. H. G. SCHNEIDER y J. MIKULE *Pág.* 294–298

La segunda parte de este artículo trata de la regeneración de resina para exclusión de iones con NaCl o melaza, refierendo a la contracción de las gotas que occurre y a la importancia del mantenimiento de solamente una delgada capa de licor sobre la superficie de resina. Después de una discusión de la evaluación y selección de una resina apropriada, los autores presentan detalles de un proceso de plena escala para exclusión de iones usando 55 m³ de resina.

* * *

Efecto del virus de mosaico sobre caña de azúcar. N. RISHI, K. S. BHARGAVA y R. D. JOSHI. *Pág.* 298–299

El efecto adverso sobre caña de azúcar, cultivado en un parcela experimental, de la raza A de virus de mosaico se ha estudiado y las caídas en peso total de la caña y peso de caña molible se han comparado con ellas causado por raza F de la enfermidad.

* * *

Estudio colaborativo sobre la determinación de elementos vestigiales en pulpa seca y melaza de remolacha de azúcar. Parte I. Mercurio. P. B. KOSTER, P. RAATS, D. HIBBERT, R. T. PHILLIPSON, H. SCHIWECK y G. STEINLE. *Pág.* 299–305

Determinación de mercurio en pulpa seca de remolacha y melaza por absorción atómica sin llama se ha estudiado colaborativamente, cada laboratorio desarrollando su proprio método de análisis para proveer recuperaciones en la gama 90–105% con límites de detección de 3–5 ng de mercurio. Buena concurrencia entre los métodos se demuestra por los valores obtenido con 22 muestras originando en Holanda, la República Alemán Federal y el Reino Unido, que estan comparable con ellos obtenido por análisis por activación neutrónica. Los contenidos de mercurio fueron generalmente dentro los límites establecido por las normas de la C.E.E. para forraje animal (que no permiten de rebasar 0,1 mg mercurio por kg de material).

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVII OCTOBER 1975 No. 922

Notes & Comments

UK imports from ACP territories in 1975

Agreement has been reached between the British Government and representatives of the ACP countries concerning UK imports during the second half of this year. As reported earlier[1], an offer by the UK to take 700,000 tons—half the annual commitment—during this period, paying the special price of £260 per ton, had been rejected as inadequate by the ACP suppliers. A later offer was made to take about 1 million tons, corresponding to the full 1·4 million tons for 1975 less sugar already supplied during the first half of the year; this was accepted with an additional agreement that, in the event of a shortfall by any other supplier, Fiji and Mauritius would share the additional amount and at the price of £260 per ton. A further 300,000 tons will be allowed as the balance of the EEC quota during the first half of 1976 but this will not qualify for the special price of £260.

* * *

World raw sugar price

During the month of August the London Daily Price of raw sugar fluctuated from £185 up to £235 but ended the month at £190. There were a number of influences tending to raise prices in the first half of the month, including reports of drought and frosts in Brazil, frosts in Argentina, and poor beet test results in Europe. The recent heavier offtake by the USA slowed to a more normal level, however, rain in Europe has increased prospects for a crop recovery and there has been little buying interest for the sugar on offer, with the consequence of a weaker market.

Commenting on the situation, Sucres et Denrées write in their newsletter of the 26th August: "Is world consumption, which in 1974/75 suffered its first drop in ten years, going to reach its former level and threaten the fragile supply/demand balance that was attained this year at the expense of consumers? The present evolution of demand does not allow us to say so. In developed countries there is a progressive return of demand to the 1973/74 level; this is not the case in developing countries where consumption is still very much below that of preceding years. Of course, prices are twice as high and import charges for sugar add to the costs of many raw and manufactured products.

"The market is undecided between, on the one hand, a bullish tendency resulting from a decrease in the hope of an excellent crop in 1975/76, and on the other hand, a bearish tendency justified by a possible increase in production. This uncertainty will persist as long as the situation in the USSR is not clear, and as long as the Americans, so far alone to face the exporting countries, do not prove to be aggressive buyers on the market.

"In the US, the recovery of internal demand is confirmed. From July 1st to mid-August, deliveries to the local market reached about 1,750,000 tons against 1,650,000 tons during the same period of 1974 and 1973. It is true that refiners did not fully benefit from the said recovery because of the aggressive sales policy of the producers of beet sugar who have considerably enlarged their sales. The improvement in consumption caused an immediate reaction of refiners whose stocks were very low. The purchases of recent weeks have played a substantial role in the bullish trend. For the past few days demand has noticeably slowed down. One can, however, foresee a new wave of purchases for September shipment.

"Encouraged by the rise, exporting countries have sold relatively large quantities of sugar and gained high prices compared to the terminal market. . . The policy of long term contracts at price fixing, which enjoyed a great success, is now showing its weaknesses. Since all countries are in general covered until the end of the year, the international market is exclusively influenced by one buyer (USA) and by news of the new European and American crop.

"So a cargo purchased by an unknown refiner, rain over Paris or over the City, could cause a rise or a drop of the market and those quotations constitute the selling and buying price of several million tons of sugar at price fixing contracts".

* * *

Record Australian sugar crop[2]

The season just concluded was one of great contrasts. It commenced with cyclones, flooding and generally water-logged fields and concluded with quite satisfactory harvesting conditions.

With 1·6 million metric tons of cane stood over from the disastrous 1973 harvest, growers faced a major unknown factor in its quality when the harvest got under way in late May and early June in the northern divisions of the State. The c.c.s. of this material was generally not as disappointing as many had feared it might be, although its milling quality left no doubt as to the undesirability of standing-over cane as a general proposition in the areas north of Mackay.

[1] *I.S.J.*, 1975, 77, 257.
[2] *Willett & Gray*, 1975, **99**, 193.

The water-logging of fields towards the end of 1973 and early in 1974 prevented late-cut cane being satisfactorily ratooned and the crop showed great variability mainly for this reason, although shortages of solid forms of nitrogenous fertilizer at critical stages of crop growth were also influential in this regard.

Despite all these adverse influences the crop realized record tonnages of cane and sugar. And although costs are also increasing at historically record rates, the returns from sales at the currently inflated world free market sugar prices should ensure a most satisfactory income for the industry as a whole.

The 1974 season may be summarized as one in which: (1) 243,217 hectares were harvested for milling. This was 10,699 hectares (4·6%) more than the previous record of 232,518 hectares harvested in 1972, and represented 81·24% of the gross assigned area of 299,370 hectares.

(2) 19,421,560 tons of cane were milled in Queensland; this was 1,012,155 tons (5·5%) more than the former record crop of 1971. If the NSW crop of 996,808 tons is added, it is seen that Australia's 34 mills handled a record 20,418,368 tons of cane.

(3) 2,728,972 tons of 94 net titre sugar were manufactured in Queensland. This was 14,986 tons 94 N.T. (0·55%) more than 1972 season's former record 2,713,986 tons. NSW produced 121,020 tons which brings the Australian sugar total to 2,849,992 tons 94 N.T.

(4) 79·85 tons of cane and 11·22 tons 94 N.T. sugar per hectare were the Queensland productivity figures recorded, on the basis of which 7·12 tons of cane were required, on average, to produce each ton of 94 net titre sugar. This is slightly less satisfactory than the 1964/1973 average of 7·09 and reflects the injection of about 1·6 million tons of low-c.c.s. standover cane into the crop.

(5) The Queensland (weighted) average c.c.s. of 14·02 was 0·91 units or 6·9% higher than the 1973 figure of 13·11.

* * *

World sugar balance, 1974/75

F. O. Licht K.G. recently published[1] their second estimate of the world sugar balance for the crop year September 1974–August 1975, as follows:

[1] *International Sugar Rpt.*, 1975, **107**, (20), 1.

	1974/75	1973/74	1972/73
	metric tons, raw value		
Initial stocks	15,580,000	15,995,000	17,104,000
Production	79,294,000	80,343,000	77,392,000
Imports	24,501,000	24,647,000	24,386,000
	119,375,000	120,985,000	118,882,000
Exports	24,310,000	24,773,000	24,873,000
Consumption	79,177,000	80,632,000	78,014,000
Final stocks	15,888,000	15,580,000	15,995,000

There have been reductions in a number of crop forecasts since the first estimate was issued in February, while, at the same time, higher prices have reduced consumption in some countries. Thus, 1974/75 production is set 1,049,000 tons or 1·31% lower than in 1973/74 while consumption is also put lower by 1,455,000 tons or 1·80%. This contrasts sharply with the 3·81% and 4·71% increases in production for the earlier two years and consumption increases of 3·36% and 2·49%. With a small rise in final stocks and a fall in consumption, the stock figures as a proportion of consumption shows a rise from 19·32% to 20·07% which, is of course, still low by traditional standards.

* * *

European beet sugar production

F. O. Licht KG have published their first estimates of beet sugar production in Europe for the 1975/76 crop[1] which, with the figures for 1974/75 and 1973/74, appear below.

	1975/76 *Estimate*	1974/75	1973/74
	metric tons, raw value		
Belgium-Luxembourg	667,000	620,000	797,000
Denmark	472,000	424,000	376,000
France	3,500,000	3,010,000	3,240,000
Germany, West	2,900,000	2,489,933	2,509,566
Holland	917,000	794,000	850,589
Ireland	203,000	184,598	196,101
Italy	1,200,000	1,001,000	1,040,000
UK	863,000	613,864	1,068,778
Total EEC	*10,722,000*	*9,137,395*	*10,078,034*
Austria	444,000	402,660	371,096
Finland	83,000	84,231	82,789
Greece	294,000	191,114	161,927
Spain	750,000	528,000	805,126
Sweden	316,000	312,000	270,000
Switzerland	79,000	73,873	79,531
Turkey	1,097,000	852,182	752,330
Yugoslavia	510,000	571,000	468,751
Total West Europe	14,296,000	12,152,455	13,069,584
Albania	18,000	16,000	19,000
Bulgaria	218,000	200,000	240,000
Czechoslovakia	790,000	750,000	730,000
Germany, East	770,000	650,000	560,000
Hungary	420,000	345,692	326,022
Poland	1,830,000	1,588,900	1,817,114
Rumania	510,000	620,000	580,000
USSR	8,900,000	8,000,000	9,750,000
Total East Europe	13,456,000	12,170,592	14,022,136
TOTAL EUROPE	27,752,000	24,323,047	27,091,720

It had been anticipated earlier in the year that, with an 8·5% increase in the total European beet area, production of sugar might be up by more than 4 million tons, reflecting the same yield but a 15% higher beet area compared with 1973/74. Beet tests so far announced show generally lower root weights and yields which have resulted from the dry weather experienced by Western Europe this summer. The USSR is reported to have suffered from drought, and bad weather in other countries of East Europe has also contributed to the forecast of only a 3·4 million tons up on the disastrous crop of 1974/75.

Of course, it is possible for conditions to improve and raise the sugar yield per hectare before harvesting finishes; however, this yield is not likely to attain the normal level in the short time remaining. At the same time, the customary lack of information from the East European countries makes forecasting a hazardous business and considerable leeway must be given to such figures, especially of the USSR.

[1] *International Sugar Rpt.*, 1975, **107**, (25), 1–3.

Diffusion in South Africa

By J. FITZGERALD and J. P. LAMUSSE
(Sugar Milling Research Institute, University of Natal, Durban)
Paper presented to the 15th Congr. ISSCT, 1974

PART I

Introduction

AT the end of 1973 there were six diffusers in industrial operation in South Africa and a seventh very large unit on order for commissioning in 1974. Thirty per cent of South African factories are therefore dependent on diffusion for sugar extraction, handling approximately 25% of the crop harvested. The fact that, since 1966 when the first two diffusers were installed, only two new milling units have been installed, both to work in conjunction with diffusers, illustrates the trend away from conventional milling.

This preference for diffusion is due mainly to the higher capital and maintenance cost of mills required to achieve the same extraction. Various factors have limited up to now the choice of diffuser to the bagasse type but a large cane diffuser is on order and this will probably be the future trend.

Research on the diffusion process was started in South Africa well before the introduction of industrial diffusers. It was then aimed at understanding the mechanism of diffusion and more work has been done in this field in recent years. Industrial experience with diffusers has also stimulated research into the effect of this process on juice quality and boiling house work.

The purpose of this paper is to review this work and to summarize the experience gained with the operation of diffusers in South Africa.

Types of diffuser and the mechanism of diffusion

The seven diffusers operating or on order in South Africa are of the following makes:

- BMA at Union Co-op. (1966) and Empangeni (1967)
- De Smet at Entumeni (1966) and Malelane (1967)
- Saturne at Umfolozi (1971)
- FS (van Hengel System) at Pongola (1973)
- Huletts at Amatikulu (1974)

A schematic representation of the position of these units in their respective extraction plants is given in Fig. 1 and this diagram also gives an idea of the preparation and dewatering equipment used in each case.

Descriptions of most of these diffusers are available in the literature or in trade publications and this aspect will not be covered in this paper, nor will engineering details which may influence the performance of the machines but do not affect basic design or principles of operation.

The various diffusers installed can be divided into two basic types: the bed type and the submerged type, depending on the way the bagasse is conveyed through the diffuser. The only submerged type diffuser in South Africa is the Saturne at Umfolozi. The BMA De Smet and Huletts diffusers are of the bed type while the FS is a bed diffuser with systematic breaking down and reforming of the bed at regular intervals.

Research on the mechanism of diffusion has covered principles common to all diffusers as well as particularities of each type.

VAN DER POL & YOUNG[1] considered cane diffusion to be a combination of leaching (lixiviation) and dialysis (diffusion through a permeable membrane).

[1] *SMRI Comm.*, 1957, (38), 18 pp.

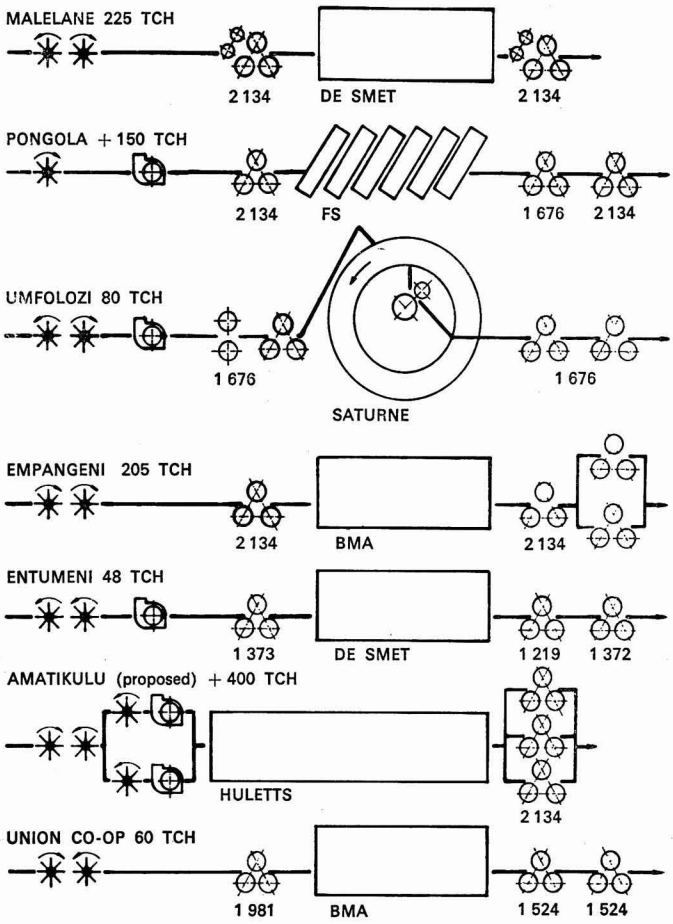

Fig. 1. Schematic representation of the South African diffuser installations

They postulated that the rate of extraction of diffusion would approach that of leaching after plasmolysis and attempted to evaluate a mass transfer coefficient based on a FICK's law analogy. They found, however, that this coefficient was not constant but varied with the contact time.

GRAHAM *et al.*[2] considered the diffusion process to be a first order process by analogy with other physical absorption phenomena. Using actual diffuser performance data, the predicted exponential relationship between the bulk liquid phase concentration and the residence time in the diffuser was obtained. By applying the same model to different molecular species, e.g. reducing sugars and inorganic ions, similar relationships were obtained. It was concluded that, as the mass transfer coefficients obtained were different for each species, the controlling mechanism must be one of diffusion rather than direct washing as this would lead to a coefficient independent of molecular size.

BUCHANAN[3] attempted to confirm the controlling influence of molecular diffusion by applying a MCCABE-THIELE graphical method to determine the number of ideal stages required. He pointed out that the extraction by diffusion involved not only transfer through the permeable cane cell walls but also molecular diffusion through the broken cells and capillary passages.

BUCHANAN & JULLIENNE[4], using laboratory batch-type percolation and submerged diffusers, investigated the rate of change of concentration in the liquid phase with the liquid phase concentration. As the extraction progressed, a distinct change in the relationship occu red for both types of diffusers. This was postulated as marking the transition between washing and the slower diffusion-controlled extraction. Investigations at various degrees of preparation led to the conclusion that unless the preparation is so fine that the complete extraction is rapidly achieved by displacement washing, the ultimate extraction is determined by a diffusion mechanism.

It was left to REIN[5,6] to develop a usable mathematical model to define the extraction of Brix by a cane sugar diffuser. The model proposes that the cane diffusion process occurs via two first-order relationships operating in parallel, representing broadly the washing and diffusion mechanisms. The validity of the model was confirmed by pilot-plant diffuser tests and REIN showed how it could be applied to full-scale diffusers of the moving-bed type.

As a result of this work, it has been generally accepted in South Africa that in a cane sugar diffuser, Brix is extracted from prepared cane or first mill bagasse by a combination of two processes:

(i) A physico-chemical transfer of Brix from within the solid phase to the surrounding extract—commonly referred to as "diffusion", and

(ii) the mechanical removal of this adhering enriched extract—washing or lixiviation.

The development of REIN's model led to the concept of "easy" and "difficult" or "tightly-held" juice fractions to represent the influence of both mechanisms and their use in attempting to evaluate the performance of a diffuser independently of the cane preparation and de-watering equipment[7,8]. The dependence of this parameter on the degree of preparation and the difficulty of obtaining representative samples has been a major stumbling block, however, in the application of this approach.

Attempts have been made by the SMRI to compare the performances of the diffusers at Union Co-op., Empangeni, Umfolozi and Malelane[8]. It has been found that, in practice, it is impossible to evaluate the diffuser in isolation from other equipment in the extraction plant and that performance depends, to a very large extent, on the physical state of the feed to the diffuser. This study did not reveal any clear-cut advantage of any particular make as far as extraction is concerned. It did show, however, that the diffuser performs a dual role in the extraction plant. In addition to extracting sugar, the diffuser makes more sugar extractable by the de-watering mills and increases the total amount of sugar extracted by these mills when compared with the last two mills of a milling tandem. The overall extraction which could be credited to a bagasse diffuser was found to be equivalent to that of three mills in a typical South African six-unit milling tandem.

It would appear therefore that the choice of a particular type of diffuser for a new extraction plant will be influenced mainly by capital and maintenance costs. In the case of an existing factory, space limitation may be an over-riding consideration and the Saturne with its relatively small floor area is then at an advantage. The modular concept of the FS is particularly attractive if gradual replacement of mills by a diffuser is programmed.

An important consideration in the choice of a diffuser is the possibility of increasing its throughput over maximum rated capacity to cope with future expansions. This is an advantage of rectangular bed diffusers and the modular FS which can be lengthened to deal with moderate increases in capacity.

Cost and capacity of diffusers

The main reason for the preference for diffusers over mills in South Africa during the past years has been their lower initial and maintenance costs.

Typical installed costs* for diffusers and mills of 250 tons of cane per hour capacity are:

	1973	1974
Bagasse diffuser	R500,000	R800,000
Cane diffuser	R570,000	R900,000
One 2145 mm mill with drive	R400,000	R600,000

Assuming a bagasse diffuser does the work of three mills, the difference in cost in favour of diffusion is of

[2] GRAHAM, MORRIS & OOSTHUIZEN: *Proc. 13th Congr. ISSCT*, 1968, 122–131.
[3] *Proc. 42nd Congr. S. African Sugar Tech. Assoc.*, 1968, 65–73.
[4] *I.S.J.*, 1970, 72, 67–70, 99–103.
[5] *Proc. 14th Congr. ISSCT*, 1971, 1254–1266.
[6] Ph.D. Thesis (University of Natal), 1972, 330 pp.
[7] FERGUSON *et al.*: *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 54–63.
[8] FITZGERALD & BUIJS: *SMRI Internal Rpt.*, 1972, (26/72), 12 pp.
* BMA Engineering, Southern Africa (Pty.) Ltd., Private Communication.

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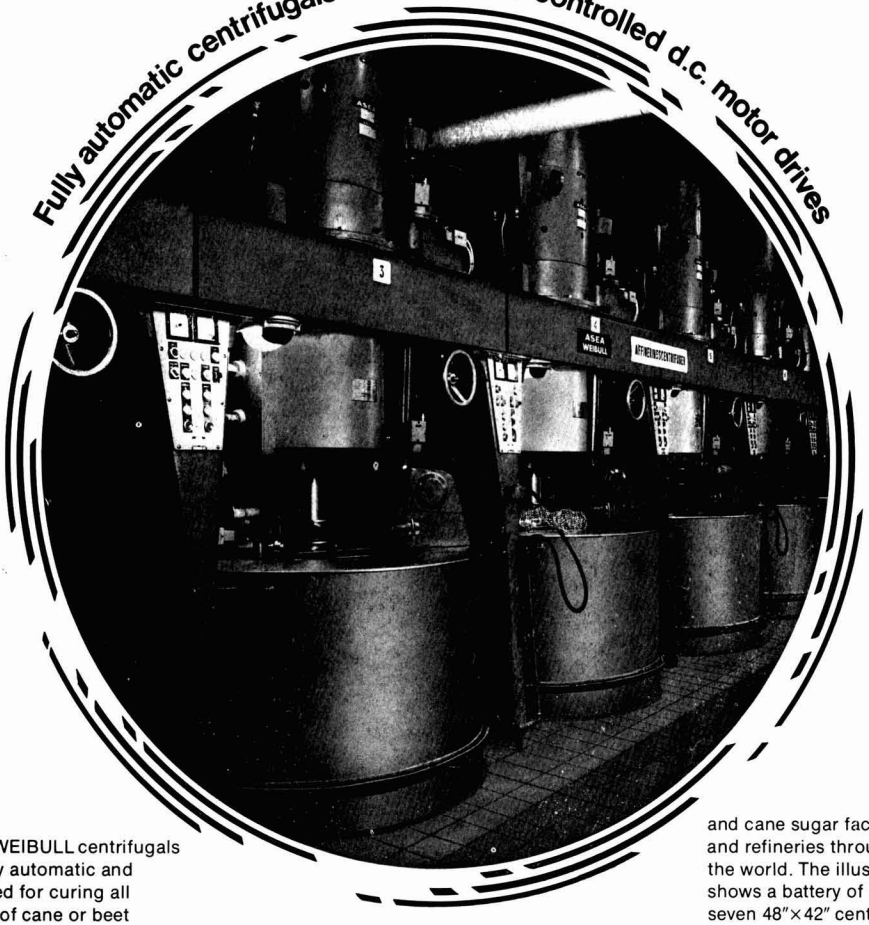

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the order of R700,000–R1,000,000. The advantage is even more apparent in the case of a cane diffuser where the cost of one mill has to be balanced against an increase of only R70,000–R100,000 in the price of the diffuser.

In spite of this, all diffusers operating in South Africa in 1973 were bagasse diffusers. Until recently, the cane payment system was based on first expressed juice sampling, thus excluding cane diffusion. The case in favour of having a first mill was further strengthened by the belief that diffusion had a harmful effect on boiling house recovery. It was felt that this effect could be minimized by extracting more than 50% of the sugar by a first mill.

An attempt was made to confirm this last theory by by-passing the first mill for two weeks at Empangeni. There was, however, no apparent effect on the boiling house although extraction did suffer as was to be expected, as no additional stages were included in the diffuser.

Experience with diffusers has led to a more favourable view of cane diffusion and the first cane diffuser in South Africa will be commissioned at Amatikulu in 1974. In this case the over-riding consideration in the choice of a cane diffuser was the very large throughput (over 400 tons of cane per hour) which it would be unpractical to handle in a single mill. At least two other factories have plans to convert their bagasse diffusers to cane diffusers in the light of possible future expansion.

The maintenance cost of diffusers is accepted as being lower than that of the mills required to reach the same level of extraction. Comparable figures are not always available as a new diffuser is, in most cases, used in conjunction with old mills in the same plant or because development work carried out on diffusers when first commissioned cannot be separated from routine maintenance costs.

Detailed maintenance costs have been obtained from Malelane for the 1972–73 season. They are listed in Table I.

Table I. Maintenance costs (Rand)

Malelane	*Diffuser*	*Mill No.* 1	*Mill No.* 2
Material	14,000	21,000	28,000
Labour†	15,000	9,000	9,000
Total	29,000	30,000	37,000

† Average cost about R5/man-hour.

The Malelane costs provide interesting comparisons as both diffuser and mills are of the same age and no modifications or development work were carried out during this season. The costs include some operational costs, e.g. welding rods for arcing the mill rollers as well as some items which do not recur every year, e.g. diffuser chain pins and bushings, a new diffuser pump, mill rollers, etc. They do not cover the cost of mill roller shafts and diffuser screens or chains which only occur at intervals of several years but which are probably more expensive for mills than for diffusers. Fifty per cent of the diffuser costs are for maintenance of pumps which would also be partially incurred in a milling tandem.

For a small factory (Union Co-op.), maintenance costs (materials only) of the diffuser were about R2000 per year as against R6500 annually for the first mill (drive excluded). In this case the diffuser costs include depreciation of a new chain over 10 years. Maintenance cost of another small diffuser (Entumeni) is reported to be about the same as that of Union Co-op. and only 27% of that of the three mills in the same extraction plant. Umfolozi reports that maintenance costs of the Saturne were one-third those of a mill in the same tandem.

It can safely be assumed that the maintenance cost of a diffuser is thus lower than that of one mill of corresponding size especially if the cost of maintenance of intermediate carriers is included with that of the mills. A further saving is in the amount of spares which have to be carried in stock.

Corrosion-erosion problems have been experienced in the older diffusers and have necessitated the replacement by stainless steel of part of the steel plates in contact with bagasse. Wear on pumps and drives is equivalent to that experienced on similar equipment in a milling train. Maintenance of chains has proved to be surprisingly low.

The capacity rating of diffusers is still uncertain. Attempts have been made to relate screen area of bed type diffusers to fibre loadings by selecting good average monthly performance at high tonnages at Malelane, Empangeni and Union Co-op. Results are listed in Table II.

Table II. Fibre loading per unit screen area

Factory	*Diffuser*	*Tons cane.hr*$^{-1}$	*Tons fibre.hr*$^{-1}$	*Tons fibre.m*$^{-2}$*.hr*$^{-1}$
Malelane	De Smet	229	28·7	0·18
Empangeni	BMA	215	35·1	0·18
Union Co-op.	BMA	63	8·6	0·18

These results indicate that a good extraction (over 96) can be obtained at a fibre loading of 0·18 tons.m^{-2}.hr^{-1}. It is probable that this loading could be increased without fall in extraction by redistribution of the screen area between different hoppers to increase stage efficiency.

More experience at near maximum capacities will be required before it is possible to estimate capacity rating of other types of diffusers (Saturne, FS).

(*to be continued*)

Costa Rica sugar factory[1].—A West German bank has provided a loan equivalent to $55,000,000 to finance the construction of a sugar factory near Guardia de Liberia and for improvement of rail and port facilities. The loan is for 20 years at an interest rate of 8½%.

* * *

Indian sugar factory re-opening[2].—The 600 t.c.d. Ahmedpur sugar mill in the district of Birbhum, which had been closed for about ten years, has recommenced crushing, after its purchase, renovation and recommissioning by the West Bengal Sugar Industries Development Corporation.

* * *

Taiwan sugar machinery for Liberia[3].—The first of four cargoes of sugar machinery has been delivered from Taiwan to Liberia where a group of 53 Taiwanese are to aid erection of the plant in a factory which will process 1000 tons of cane per day.

[1] *Amerop Noticias*, 1975, (18), 15.
[2] *Indian Sugar*, 1974, **24**, 762.
[3] *Amerop Noticias*, 1975, (18), 15.

Recovery of sugar from beet molasses by the P. & L. exclusion process

By H. G. SCHNEIDER and J. MIKULE

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PART II

Removal of the disturbing ions by counterflow ion exchange against sodium ions was also attempted. As could be expected, because of the equilibria this was only effective when the molasses was very much diluted.

For this reason it is considered better to regenerate the exclusion resin occasionally. To regenerate the resin, a solution is required with a high ionic concentration and in addition a high surplus of potassium ions in relation to calcium and magnesium ions. Molasses and the concentrated waste water of the ion exclusion process meet these demands. This is demonstrated in Tables III, IV and V, where the regenerating efficiency of different media is shown:

(1) Regeneration with 10% NaCl as reference

(2) Regeneration with mechanically purified (primary) molasses

(3) Regeneration with the concentrated low-purity fraction (fodder molasses).

Primary molasses will probably only be used when not all of it has to be processed in the plant and if it can be used afterwards and after concentration for other purposes.

From the figures given, it can be seen that 1 B.V. of 60°Brix, or 2 B.V. of 25°Brix waste water concentrate can be used for the regeneration with good success.

Ion exclusion resins are slightly crosslinked, highly swellable gel-type exchangers with sulphonic groups. In contact with solutions with high osmotic pressure, these resins contract considerable. Thus the bed of a resin of this kind shrinks, for example, by 13–15% when it is regenerated with 10% sodium chloride solution.

The marked shrinking during regeneration, together with the corresponding marked swelling occurring during subsequent elution, can lead to compaction of the resin and make further flow through the column impossible. In addition in the course of time the resin would be splintered by the continual mechanical stress if suitable steps were not taken, for example the transfer of the resin to a broad vessel for the purpose of regeneration to counteract the effects of the swelling and shrinking.

In the case of regeneration with fodder molasses the ion exclusion resin also shrinks and swells. It has been observed that the shrinking of the resin amounts only to about 9% when it is regenerated with waste water of 25–30°Brix. With lower osmotic stress the life of the resin will be longer.

Liquid level control

The principle of the level control upon the resin surface (Fig. 11) has already been mentioned above. It is extremely important for the process to keep the liquid level above the resin very small, because subsequent feed fractions might mix with each other

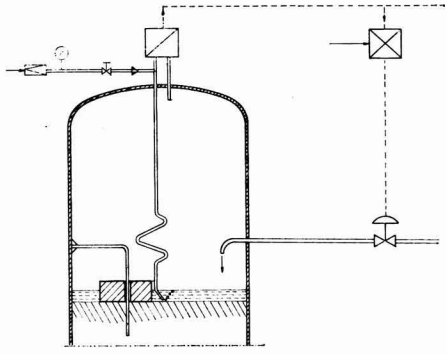

Fig. 11

Table III. Regeneration with 10% NaCl at 85°C

	K	*Na*	*Ca*	*Mg*	
Resin before regeneration	32·5	4·0	2·48	0·41	mg.cm^{-3}
Resin regenerated with 1 B.V.	6·5	26·3	2·70	0·16	,,
Resin regenerated with 2 B.V.	0·23	30·0	1·06	0·06	,,
Resin regenerated with 3 B.V.	0·05	32·5	0·32	0·06	,,

Table IV. Regeneration with molasses of 60°Brix at 85°C

	K	*Na*	*Ca*	*Mg*	
Molasses	4·40	0·80	0·13	0·06	% on D.S.
Resin before regeneration	35·0	5·00	5·60	0·29	mg.cm^{-3}
Resin regenerated with 1 B.V.	42·5	5·50	0·75	0·09	,,

Table V. Regeneration of exclusion resin with fodder molasses concentrated to 60° and 25°Brix, respectively, at 85°C

	K	*Na*	*Ca*	*Mg*	
Waste water 60°Brix	7·24	1·51	0·14	0·01	% on D.S.
Resin before regeneration	35·0	4·50	6·80	0·19	mg.cm^{-3} resin
Resin regenerated with 1 B.V.	46·0	6·80	0·42	0·08	,,
Resin regenerated with 2 B.V.	45·0	6·50	0·19	0·06	,,
Waste water 25°Brix	7·07	0·98	0·19	0·07	% on D.S.
Resin before regeneration	32·5	4·00	2·84	0·41	mg.cm^{-3} resin
Resin regenerated with 1 B.V.	35·0	5·00	1·98	0·36	,,
Resin regenerated with 2 B.V.	35·0	5·00	0·85	0·27	,,
Resin regenerated with 3 B.V.	37·5	5·00	0·77	0·23	,,

Table VI

Resin	*Lot*	*Mesh of resin delivered*	*Number of cycles*	*Bed depth, cm*	*Apparent purity*	*Ash % D.S.*	*Yield, %*
1	1	50/100	1000	60	87	3·5	74
1	2	20/50	60	60	very poor separation and yield		
1	3	50/100	250	60	As for resin 1, lot 1		
1	4	40/50	300	60	As for resin 1, lot 1		
1	5	50/100	380	180	80	4·5	71
2		30/50	140	60	87	2·9	67
3			180	60	As for resin 1, lot 1, but tending to peptization and so unusable		
4		52/100	110	60	83	5·5	60
5			370	180	88	2·5	72

Table VII. Screen analysis and flow rate measurements through filter beds of different resins

	1 1 *lot* 5 *new* %	2 1 *lot* 5 *used* %	3 1 *lot* 2 %	4 1 *resin X* %	5 *resin* 2 %	6 *resin* 5 %
On 0·5 mm	0·8	5·4	93·6	0·4	78·6	0·4
,, 0·4 ,,	7·6	74·8	3·1	93·2	11·0	93·2
,, 0·3 ,,	46·0	10·0	0·7	5·6	5·8	5·6
,, 0·25 ,,	35·2	8·4	0·3	1·4	1·3	1·4
Finer	8·2	0·8	0·2	0	0·3	0
Flow rate, $cm^3.min^{-1}$	85	94	104	115	138	172

and thus spoil the separation efficiency. Of course the resin surface should never run dry.

MOUNTFORT used a float with a conductivity electrode. This arrangement gives an electrical signal when the level is lower than 6 mm above the resin, and works discontinuously. This system has some disadvantages: (1) the instrument is influenced by foam, and (2) in the course of a cycle the column is charged with media having extremely different conductivities. As a result the electrode will, for instance, not operate precisely on water because its sensitivity is not high enough. If the electrode's sensitivity is sufficiently high that it can operate well with water, a syrup film adhering to it would have enough conductivity to indicate a contact that does not exist in reality.

The selection and evaluation of an appropriate exclusion resin

Resins are available for the production of liquid sugar by ion exchange which have optimum properties for this specific application.

The same is valid for the ion exclusion process. In the literature generally the use of a strongly acidic, 4% DVB crosslinked gel-type cation exchange resin is reported. In nearly all cases, a resin of 50/100 mesh was used. For this reason, we started our tests with this type of resin as well.

In Table VI are listed the different resins which were tried in our laboratory tests. The tests were all performed between 80 and 85°C. All columns had a diameter of 100 mm, but their lengths were different.

In the same table, the apparent purity and the ash content pertain to the product fraction quality. The yield refers to the percentage of sugar in the product fraction relative to the amount of sugar in the applied molasses.

With resin 1 lot 1 good results were achieved after a very short time. As the resin sample was only large enough to fill a small (0·60 m) column, we asked for more resin, to be able to use a column with 1·8 m bed depth.

Resin 1 lot 2 was a faulty delivery of a resin with an absolutely unsuitable size distribution. The resin could not be used for further tests.

Lot 3 and lot 4 of resin 1 corresponded in their properties to resin lot 1. There was no better performance with lot 4, having a narrower bead size distribution. So a resin was ordered that should have the quality of resin 1 lot 1, to be used in the pilot plant.

Though the resin was clearly defined, the delivery did not at all meet our demands. The resin did not exclude properly, brought bad yields and had a very high hydraulic head loss in the column.

Using the resin, it would only be possible to have a maximum resin depth in the column of 4 m, whereas we originally planned 7·5–8·5 m.

In the meantime it had been determined that resin 5 was very suitable for the exclusion process. The resin characteristic could be reproduced by the manufacturer in all respects. It worked absolutely satisfactorily in the pilot plant.

The exclusion effect is influenced above all by the "packing" of the resin bed in the column; in other words by the fact that there can be more or less interstitial water between the resin beads. In a "loose" bed this volume is greater. Thus the molasses will be more diluted. As a consequence of the broader dilution zones, the exclusion front will be more and more diffused and the separation efficiency will be lower.

If a "loose" bed is charged with molasses, for instance, it can be observed that the molasses falls a certain way through the unsettled resin.

There are resins (and No. 1 lot 5 belongs to them) which behave under water, when they are new, like a second liquid. The resin beads remain nearly suspended and need a very long time for settling. This behaviour of the resin bed in the column decreases after a number of cycles.

For some resins, complete settling requires more than 60 to 180 cycles. This property of the resins explains the difficulty in the evaluation of resins for ion exclusion.

An exclusion resin must not only exclude, but it has also to allow a good flow of the liquor through a deep resin bed.

To evaluate the resin hydraulic properties, the flow of water through a resin bed of normal depth, using a constant water pressure of 1 m level above the resin surface, can be used as a criterion which will show differences between resins. These figures are condensed in Table VII together with the screen analysis of the particular resin.

The sample "1 resin X" was composed of single fractions, screened out of resin 1 lot 5, to meet the composition of resin 5.

One would suppose that the flow through a resin bed under defined conditions should depend mainly on the size distribution of the resin beads for a certain resin type.

This is apparently not the case; with the coarse resin 1 lot 2 the flow is little, but significantly, better than with the finer resins of the same supplier, but the flow rate through this resin is greatly exceeded by that through a finer resin of another producer (compare col. 4 with resin 5 in col. 6). The flow rate through "resin X" is better than that through resin 1 lot 5 but it is by far exceeded by that through resin 5. These figures show how different can be resins, all of the "same" crosslinking and bead size distribution.

It should be mentioned that the flow rate of water through resins of different origin is differently temperature-dependent. In the pilot plant with 5 m bed depth, the following figures were measured:

Table VIII

	Resin 1 *lot* 5	*Resin* 5
20°C	45×10^4 cm³.hr^{-1}	212×10^4 cm³.hr^{-1}
80°C	95×10^4 ,,	240×10^4 ,,

The full scale ion exclusion operation

A prototype ion exclusion column, containing 55 m³ of resin was started on stream in January 1974.

Since that time, the plant has been in complete operation, apart from a two months' interruption during the main holiday season.

For the mechanical purification of the molasses, a Westfalia separator* is in use, which was formerly needed for the purification of brown syrups in our liquid sugar department.

The installation is set up in an empty part of the factory, which was arranged and completed for this purpose. The column has a diameter of 3 m and a resin bed depth of 8 m; its iron shell is plastic-clad inside. The instrumentation and installation corresponds in every detail to the principle shown in Fig. 6 for the pilot plant.

The plant is now operating fully automatically. The necessary impulses are taken from the conductivity changes of the column's effluent as shown in Fig. 7. So the personnel have only to check the setpoints of the controller.

For this installation normally two evaporating systems would be necessary: one for the product and one for the fodder molasses. Here was made a compromise, because for a single-column plant *two* quintuple-effect evaporators would have been too expensive. So only one quintuple-effect, falling-film evaporating system was installed. The fodder molasses is concentrated in the first four effects which are made of stainless steel, while the product is concentrated in the last body of the system, made of mild steel.

The total price of the whole installation was 1·5 million Deutschmarks, made up as follows:

Motors, pumps, pipelines	4%
Buildings	13%
Electric supply and light	3%
Pretreatment of molasses	8%
Exclusion column and tanks	22%
Evaporator	37%
Resin	13%
	100

During this first year of practical operation many technical problems were overcome, which had not been foreseen. Finally we will give a survey of experience in the different department of the installation.

(1) *The mechanical purification of the molasses*

Separation and filtration performed as well as could be expected from the previous tests in the pilot plant. It was established that the demand for filter-aid was significantly smaller using stored molasses than with molasses coming directly from production. On average, the demand for filter-aid was 2·5 g/kg molasses of 80°Brix.

As we wanted to separate and to filter molasses only during one shift of eight hours, it was necessary to enlarge the filtering capacity; therefore two Seitz "Orion" filters are now installed, having 20 m² filtering surface each.

(2) *The exclusion column*

There was practically no trouble with the exclusion column itself. The column operated absolutely satisfactorily and corresponded completely to the performance of the micro-laboratory column and the pilot plant.

(3) *The evaporation system*

It had to be learned by experience how to run the column so that the amount of water in the fodder molasses and in the product which had to be evaporated was so balanced that the evaporation could concentrate both effluents sufficiently.

It was found that the column could process more molasses than we expected, so that the evaporation was the bottleneck of the whole installation. During the 1974 beet campaign, the fodder molasses was concentrated in all five effects of the evaporating system and the product was added to the juice stream of the factory in the preliming tank.

Though the fifth body of the evaporation contained tubes of normal mild steel we could not observe any corrosion. So it is highly possible that in the future it will not be necessary to use stainless steel for the evaporators.

(4) *Regeneration*

According to Figs. 9 and 10, the efficiency of the ion exclusion process decreases with the accumulation of calcium and magnesium on the resin.

Processing a molasses with a calcium and magnesium content of 0·2% on dry substance (magnesium expressed as calcium), there should be a regeneration

* Type SAK 20036, having enough capacity to supply 4 columns of 50 m³ resin with molasses.

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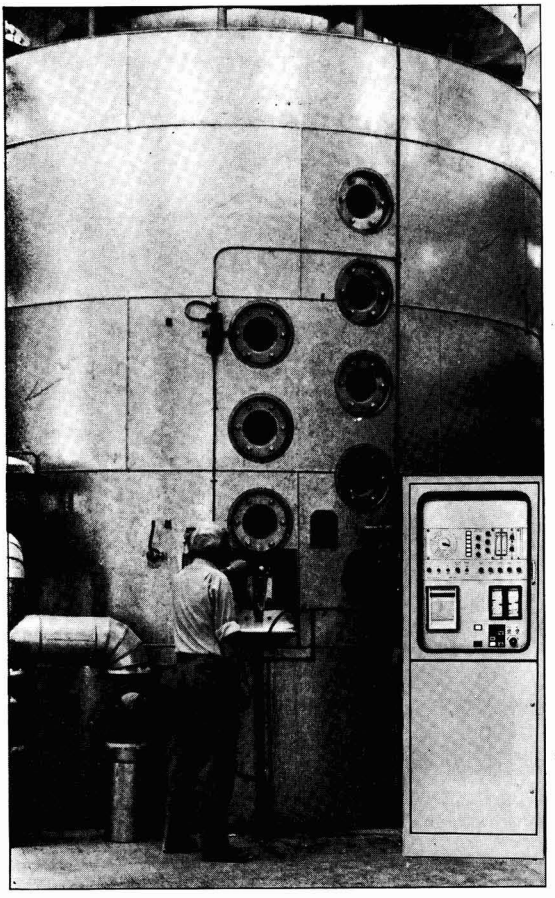
For better sugar, boil more uniform crystals, reduce conglomerates. How? Create sufficient circulation in the pan - most radically and economically through mechanical agitation.



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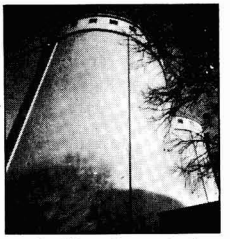

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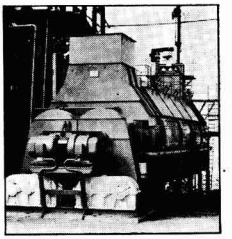

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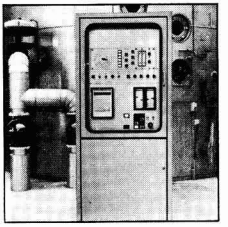

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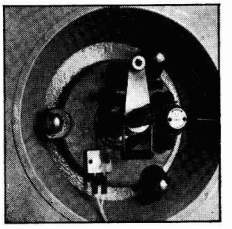

The direct view DDS Pan Microscope.

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after 150–200 cycles. Operating this way, there is a surplus of fodder molasses for the regeneration of at least 70%. During the 1974 campaign there were about 400 cycles or even more between two regenerations.

The regeneration is a tedious procedure, for the percolation of 130 m³ fodder molasses at 40°Brix through the resin bed for a complete regeneration takes about 12 hours. The spent regenerant, the fodder molasses, has to be concentrated in the evaporator to 75°Brix after passage through the column.

At the beginning there was a difficulty, because the evaporation was installed for feed concentrations of 5° and 18°Brix and not for 35–40°Brix, which is the average concentration of the fodder molasses after regeneration of the resin, and various alterations had to be made.

During this complete regeneration of a highly calcium-loaded resin sometimes precipitation of calcium salts (mainly oxalate) could be observed in the lower part of the resin bed. For this reason it proved to be necessary to backwash the resin after this kind of regeneration, to remove the mud.

For adequate backwashing two bed volumes per hour of water are necessary; this is about 120 m³ of water. By analogy with the pilot plant, there is a backwash tank also for the large plant (10 in Fig. 6). Primarily the resin is pumped into this backwash tank. The water flowing off at the top will be filtered over the "Nevaclog"-gravel filter in the exclusion column and and can be used again and again. After the backwashing has been finished, the "Nevaclog"-gravel layer will be cleaned by backwashing as well. Thus, it is possible to save considerable amounts of water.

The transport of the resin from the column to the backwash tank and back needs time and this is one of the reasons why a complete regeneration takes about 24 hours.

During the inter-campaign period it is necessary to stop the plant over the weekend for personnel reasons. Because of the sweetening-on and -off of the column, this was very uneconomical. It proved to be far better to let the resin stand over the weekend under fodder molasses, to sweeten it off at the beginning of the week and to start cycling directly. In this way less fodder molasses is needed and less calcium is left on the resin.

This kind of operation offers further advantages: As a result of regular small regenerations, the resin is in a far better condition for the exclusion process. The capacity is higher. The amount of calcium removed at each weekend is relatively small and therefore there is no precipitation of calcium in the filter bed during regeneration and backwashing is no longer necessary.

(5) *Economy*

It is difficult to make up a generally valid balance covering profit and loss, because the prices for sugar, molasses, energy and labour as well as the kind of depreciation for a plant are very different. For this reason, we will give the essential data in the following tables, so that readers may make calculations of their own using these figures.

Operating results of ion exclusion plant
Week No. 4/1975

5 Days
99 Exclusion cycles

	°Brix	tons	*Apparent purity*	*Raffinose % D.S.*
Molasses	80	209	61·5	2·0
Fodder molasses	70	118	29·1	2·0
Exclusion product	70	117	91·8	1·9
Secondary molasses	80	27	69·1	6·0
Sugar, EEC quality I		60		

Steam consumption (640 kcal/kg)

(1) *Exclusion plant*

Mechanical purification of molasses	25 tons/week
Heating of feed to column	44 ,,
Concentration of fodder molasses and product	510 ,,
Losses caused by process interruption over weekend	20 ,,
(2) *Processing of product by pan boiling*	120 ,,
Total	719 tons

Electricity

Total 17,000 kWh/week

Operating supplies

"Celite 545"	260 kg/week
Paper filter sheets	205 m²/week
Water	50 m³/week
Formalin	50 kg/week
Antifoam oil	20 kg/week

Personnel

	Men	*Shift/day*
Mechanical purification of molasses	1	1
Column and evaporation	1	3
Laboratory	1	½
Mechanical maintenance	1	1

In fact it may be possible to process the total molasses output of a sugar factory during the campaign using an exclusion plant of sufficient capacity.

As about 50% of the raffinose of the molasses will be discarded with the fodder molasses, there will, of course, be a certain accumulation of raffinose in the sugar house. This, however, will remain within tolerable limits so that normal sugar crystallization is possible. This was proved experimentally by exclusion of secondary molasses and the crystallization of another sugar crop.

In the Steffen process nearly 100% of the raffinose can be found in the calcium saccharate cake and will get into the sugar house products this way, the enrichment with raffinose being practically quantitative. For this reason it is frequently necessary to discard molasses with a high content of raffinose to keep the raffinose level within tolerable limits.

Finally we would like to mention that the exclusion plant is no longer under the control of the department for research and development. It has been handed over to our liquid sugar department, and is now considered to be a routine operation.

Acknowledgments

The authors wish to thank the Board of Directors of Pfeifer & Langen, particularly Mr. ARNOLD LANGEN, for permission to publish this paper. They also want to express their thanks to Mr. VON DÖRING and Mr. HECKEN for their helpful assistance in the realization of the projects.

Summary

Molasses of (e.g. 63 purity) is disproportioned by ion exclusion into a "product fraction" of high purity (87) and low ash and a "waste fraction" of low purity (32) and high ash.

Both fractions are concentrated separately in a multiple-effect evaporating system. Sugar is recovered from the "product fraction" by crystallization. The "secondary molasses" can be sold.

The "waste fraction" is regarded as a molasses from which sugar has been removed carefully. It is regarded as "fodder molasses" and can be added to the pulp before drying.

The behaviour of some molasses constituents in the course of the process is discussed.

The technical performance of the process is described. The mechanical purification of the molasses before exclusion by centrifugal separation and fine filtration is extremely important. The pilot plant column, containing 2·5 m^3 resin, its automation and the process conditions are discussed.

Ion exclusion is only possible when the 4% DVB crosslinked, gel-type, strongly acidic cation exchange resin is in the monovalent salt form.

As calcium and magnesium ions in the molasses are picked up by the resin, its efficiency decreases, and it must be regenerated from time to time. Regeneration is carried out using the concentrated low-purity fraction (fodder molasses). Consequently the process does not require any chemical for resin regeneration.

The properties of and experience with different exclusion resins are reported.

Finally the performance of a full-scale 50 m^3 ion exclusion column is described. The operational data after one year's experience are reported.

Effect of mosaic virus on sugar cane

By NARAYAN RISHI*, K. S. BHARGAVA and R. D. JOSHI

(Department of Botany, University of Gorakhpur, India)

Introduction

A SERIOUS reduction in tonnage of the sugar cane crop due to mosaic was reported in Jamaica[1]. This disease was considered to be one of the factors in reduction of yield of sugar cane in Louisiana also[2,3]. In India an incidence of 10% of mosaic involved a 1% reduction in cane yield and resulted in a loss of 3·3 million rupees per annum[4]. Recently, loss in yield of sugar cane due to mosaic has been reported in Argentina.

While studying mosaic virus strains A (SCMV-A) and F (SCMV-F) a marked effect on the height and thickness of sugar cane variety Co 1347 was observed in our experimental plot. It was therefore decided to work out the actual losses caused to the crop by this disease.

Material and Method

To determine the effect of mosaic on cane yield 25 stalks of healthy and diseased cane (variety Co 1347 infected with SCMV-A) were sown in alternate trenches. At maturity the crop was harvested and ten lots each of ten randomly-selected canes were cut and the mean height and weight of the entire aerial parts and millable canes were measured separately. These millable canes were used for obtaining the juice for quantitative and qualitative study. A similar study was made with cane variety BO 47 infected with SCMV-F.

To study the effect of mosaic disease on the juice, ten randomly-selected millable canes of healthy and diseased BO 47 (for strain F) and Co 1347 (for strain A) cane varieties were crushed and the juice extracted. These juices were weighed and their temperature recorded. Brix readings were recorded with a hydrometer and corrected for temperature. The juice was clarified with Horne's dry lead acetate (basic lead), filtered and pol readings made. The sucrose percentage was calculated by correlating the corrected Brix and pol reading obtained above from SCHMIDT's table[5], and the apparent purity calculated.

The invert sugar in the samples was determined by titrating the juice with Fehling's solution in the usual manner.

Results

Results of the effect of SCMV-A and SCMV-F on the height and weight of sugar cane are noted in Tables I and II. There was a marked reduction of the height of cane due to SCMV-A whereas the effect of SCMV-F was not significant. SCMV-A caused a 16·8% reduction in weight of entire plants and 31·2% of millable canes. SCMV-F caused an 8·01% reduction in weight of entire plants and 4·8% of millable canes.

Results of the effect of SCMV-A and SCMV-F on juice quality and quantity are recorded in Table III. SCMV-A caused more reduction in juice quantity than SCMV-F. Purity coefficient of sucrose also showed a similar reduction.

Table I. Effect of SCMV-A on height and weight of ten canes of variety Co 1347

	Entire aerial part				*Millable cane*			
	Mean height, cm		*Mean weight, kg*		*Mean height, cm*		*Mean weight, kg*	
Sample	*Healthy*	*Diseased*	*Healthy*	*Diseased*	*Healthy*	*Diseased*	*Healthy*	*Diseased*
1	314	254	8·72	7·58	169	106	5·10	4·21
2	316	251	8·55	7·92	169	112	5·84	4·39
3	316	258	8·79	7·85	169	114	5·97	4·36
4	315	253	8·76	7·76	168	118	5·54	4·90
5	317	262	8·95	8·20	170	125	6·05	5·10
6	318	248	9·26	7·80	170	109	6·27	4·31
7	318	245	9·64	7·67	169	113	7·03	4·42
8	318	261	9·84	7·89	169	115	7·27	4·16
9	321	251	10·14	7·21	171	105	7·51	4·20
10	327	259	10·37	7·45	175	102	7·69	4·10
Mean	318·0	254·2	9·30	7·733	169·9	111·9	6·427	4·415

Table II. Effect of SCMV-F on height and weight of ten canes of variety BO 47

	Entire aerial part				*Millable cane*			
	Mean height, cm		*Mean weight, kg*		*Mean height, cm*		*Mean weight, kg*	
Sample	*Healthy*	*Diseased*	*Healthy*	*Diseased*	*Healthy*	*Diseased*	*Healthy*	*Diseased*
1	340	325	10·28	10·13	195	190	7·92	7·25
2	345	339	11·25	9·75	200	179	8·51	8·00
3	336	325	10·21	9·30	180	176	7·71	7·31
4	338	328	10·45	9·47	187	178	7·73	7·21
5	342	327	10·76	9·51	192	181	7·86	7·48
6	337	312	10·17	9·17	191	183	8·30	7·87
7	341	341	10·20	9·82	193	185	8·53	8·21
8	336	305	9·53	8·76	189	182	7·38	7·30
9	339	317	9·80	9·00	186	178	7·58	7·25
10	335	319	9·78	9·31	180	170	7·49	7·31
Mean	338·9	333·8	10·243	9·422	189·3	180·2	7·901	7·519

Table III. Effect of SCMV-A and SCMV-F on the juice quality and quantity

Strain	*Variety*		*Weight of juices from 10 canes, kg*	*Brix*	*Sucrose, %*	*Invert sugar, %*	*Purity*
SCMV-A	Co 1347	Healthy	4·8	16·64	13·54	0·70	81·13
		Diseased	3·76	16·04	12·23	2·3	76·2
SCMV-F	BO 47	Healthy	5·6	17·54	15·22	1·60	86·7
		Diseased	5·1	16·75	14·19	1·68	84·7

Acknowledgement

This investigation was supported in part with funds provided by the USDA under a PL 480 grant.

Summary

Mosaic virus strain A caused marked reduction in the height and thickness of sugar cane in an experimental plot. In a study it was found that this strain caused a 16·8% reduction in weight of the entire plant and a 31·2% reduction of millable cane whereas strain F caused an 8·01% reduction in plant weight and 4·8% of millable cane. Strain A also caused a greater reduction in juice quantity than strain F, while the purity also showed a similar reduction.

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Collaborative study on the determination of trace elements in dried sugar beet pulp and molasses. Part I. Mercury

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

INTRODUCTION

IN recent years, increasing interest has been shown in methods for the determination, in a wide range of materials, of trace amounts of mercury. The very low detection limits obtainable with flameless atomic absorption procedures has resulted in the increased application of such techniques. In particular, numerous applications and various modifications have been published of the method first described by POLUEKTOV, VITKUN & ZELYUKOVA[1] and later refined by HATCH & OTT[2]; essentially, the mercury in the sample solution is reduced to the elemental state by means of stannous chloride and the liberated mercury vapour is carried into the absorption cell by a gas stream in either an open or a closed system[3–9].

The process of vaporizing atomic mercury from such solutions gives rise to the possibility of broad band absorption which may be caused by various substances including some organic compounds, sulphides, water vapour and oxides of sulphur and nitrogen. These may be volatilized and subsequently absorb at the same wavelength (253·7 nm) as mercury.

In applying atomic absorption techniques to the determination of mercury, one of the major problems is the development of a digestion procedure which not only assures complete extraction of mercury and quantitative conversion of organic mercury into mercuric ions but also avoids loss of the highly volatile mercury.

The present series of collaborative studies was undertaken jointly by the Dutch sugar industry, British Sugar Corporation Ltd., and Süddeutsche Zucker AG. for two reasons—first, because of the importance to the sugar industry of dried pulp and molasses as animal feeding stuffs and, second, because

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Table I. Mercury in exchange samples (mg/kg dry matter)

Sample No.	Type	Collaborator			Mean	Standard deviation	Neutron activation analysis	
		IRS	*BSC*	*SZ*			*UKAEA*	*TNO*
1	Dried pulp	0·014	0·008	0·014	0·012	0·003	0·011	0·010
2	,,	0·012	0·013	0·014	0·013	0·001	0·012	0·017
3	,,	0·012	0·006	0·015	0·011	0·005		0·006
4	,,	0·010	0·013	0·016	0·013	0·003	0·013	0·007
5	,,	0·019	0·021	0·018	0·019	0·002		
6	,,	0·010	0·017	0·011	0·013	0·004		
7	Molassed pulp	0·173	0·117	0·096	0·129	0·040		0·105
8	,,	0·010	0·016	0·008	0·011	0·004		
9	,,	0·006	0·013	0·010	0·010	0·004		0·007
10	,,	0·022	0·012	0·020	0·018	0·005		
11	Pulp nuts	0·096	0·087	0·082	0·088	0·007	0·082	0·099
12	,,	0·037	0·028	0·033	0·033	0·005	0·026	0·023
13	,,	0·031	0·029	0·027	0·029	0·002	0·013	0·030
14	,,	0·032	0·021	0·036	0·030	0·008		0·029
15	,,	0·020	0·033	0·030	0·028	0·007		
16	,,	0·011	0·012	0·017	0·013	0·003		
17	,,	0·010	0·006	0·017	0·011	0·006		
18	,,	0·018	0·012	0·017	0·016	0·003		
19	,,	0·013	0·009	0·012	0·011	0·002		
20	Molasses	0·001	0·001	0·005	0·002	0·002		<0·001
21	,,	<0·001	0·004	0·003	0·003	0·002		<0·001
22	,,	<0·001	0·004	0·007	0·004	0·004		0·004

of the special analytical difficulties imposed by these materials. These difficulties arise from the high proportion of fibrous substances and varying amounts of siliceous material found in dried pulp and from the very high soluble carbohydrate content of molasses.

Samples of dried pulp and molasses were exchanged between the laboratories participating in the present study. Although the same method of sample preparation was followed by all participants, each laboratory developed its own analytical method and used this for replicated analyses of the samples.

Neutron activation analysis, in principle more specific and sensitive than atomic absorption spectrophotometry, was used to check the results obtained on some of the samples. When the reliability of the various methods had been confirmed, a series of dried pulp samples from the 1973/74 and 1974/75 beet campaigns was investigated.

Experimental

Sample preparation (dried pulp and pulp nuts)

In order to ensure that sub-samples of dried pulp and pulp nuts used for analysis were representative of larger stock samples, a reliable sample preparation procedure was developed and subsequently used by all the participating laboratories. The importance of a well-designed sample preparation procedure is emphasized later in this paper by some data in the "Results" section.

Samples which have been stored in plastic bags are ground, in their entirety, in a cross beater mill (Retsch, type SK3 with 360° sieve surface and 1 mm diameter sieve holes). Shredded pulp is ground directly, but pulp nuts are first reduced in size (to less than 1 cm) by passage through a suitable crusher (Retsch, type BB1/A or equivalent).

A portion of the ground sample is divided into a series of eight 500 cm^3 jars by means of a sample divider (Retsch, type PTZ); further portions of the ground sample are similarly treated until the entire ground sample has been divided. The contents of one jar from each series of eight are transferred to a plastic bag, while the contents of the other seven are returned to the original sample bag.

The combined contents of one jar from each series are again divided into eight 500 cm^3 jars, after which the contents of one jar or the combined contents of two jars are divided into eight 120 cm^3 plastic tubes.

The subdivision is continued in this way to give a number of tubes each containing approximately the quantity required for a single analysis.

Sample digestion

Attention has already been drawn in the introduction to ways in which dried pulp and molasses differ rather significantly from many other materials; to overcome these difficulties, it is important that the digestion procedure should be of sufficient length and severity to ensure satisfactory analytical results. The techniques used in the participating laboratories are described in detail in the Appendix.

Determination of mercury content

Methods used for the determination of mercury in the digests are based on the technique of Poluektov *et al.*[1] (IRS) and on that of Hatch & Ott[2] (BSC & SZ).

The mercury in the digest may first be further oxidized by using potassium permanganate (SZ) and is then reduced by means of stannous chloride.

Some sodium chloride (this enhances the reducing power of stannous chloride[9]) and hydroxylamine hydrochloride are added to the digest or to the stannous chloride solution (the hydroxylamine hydrochloride is added to remove reducible components, to accelerate the reaction with stannous chloride and to reduce volatilization of mercuric ions by complexing[3,5,7]).

Using an atomic absorption spectrophotometer fitted with a hollow cathode mercury lamp, the mercury vapour is passed by means of a stream of argon through a drying column into the absorption cell (IRS) or is recirculated through a cotton wool scrubber and absorption cell (BSC) or through a drying tube and absorption cell (SZ); in the BSC and SZ procedures, recirculation is continued until the absorption signal reaches a maximum.

In the IRS procedure, the determination is repeated, using a hydrogen lamp instead of the mercury hollow cathode lamp to detect possible broad-band absorption.

The experimental procedures used in the three laboratories are described in detail in the Appendix.

Evaluation of methods

In recovery experiments, known amounts of mercury were added to blanks and samples before digestion. Recoveries ranged from 95 to 100% (IRS), 95 to 105% (BSC) and 90 to 100% (SZ).

The limits of detection of the methods are 5 ng (IRS) and 3 ng (BSC and SZ) of mercury.

Based on the results of 40 (IRS), 29 (BSC) and 16 (SZ) duplicate analyses of dried pulp, the standard error of the mean of a duplicate determination has been found to be 0·0015, 0·0012 and 0·0012 mg/kg, respectively. This implies confidence limits between duplicate tests ($P = 0{\cdot}05$) of $\pm 0{\cdot}0029$ (IRS), $\pm 0{\cdot}0024$ (BSC) and $\pm 0{\cdot}0024$ mg/kg (SZ).

In practice, broad-band absorption has been found to be negligible in most cases (0 to 5% of the absorption peak) but, in order to ensure that results are not adversely affected, at IRS it is still determined as a routine.

Results

Exchange samples

Replicate analyses were carried out by the three participating laboratories on 19 samples of dried pulp or pulp nuts and 3 samples of molasses. The pulp samples were distributed after grinding (see section on "sample preparation" above) and subdivided by the individual receiving laboratories. The samples originated from various sugar factories in the three participating countries. Some of the samples were also sent to the Central Laboratory of TNO (Netherlands Organization for Applied Scientific Research), Delft, Holland and to UKAEA, Harwell, England (United Kingdom Atomic Energy Authority) for independent determination of mercury by neutron activation analysis. The results obtained are given in Table I.

It can be seen from Table I that the results obtained with the flameless atomic absorption techniques are of the same order of magnitude as those obtained by neutron activation analysis.

None of the values presented in Table I was found to be an outlier when the Dixon test[10] was carried out on the average values at the 95% probability level.

A variance analysis and a ranking test[11] showed that the differences between the results of the three collaborators are not significant.

Except in the case of sample 7, differences between individual variances tested by the method of Cochran[12] were shown to be insignificant (i.e. individual variances are of the same statistical magnitude).

From the variance analysis and from the individual variances, it may be concluded that the best estimate of the standard error of an individual result is 0·004 mg/kg (sample No. 7 is excluded from this calculation).

Importance of sub-sampling technique

An investigation into the effect of particle size of pulp samples on mercury content emphasizes the extreme importance of adopting an adequate method of sample preparation if reliable results are to be obtained.

Some ground pulp samples were sieved using butter muslin with an aperture size of about 400 μm to give a coarse and a fine fraction. Additionally, some unground dried pulp samples were split into three fractions, using the same butter muslin to separate the fine and medium fractions and using a flour sieve with an aperture size of about 850 μm to separate the coarse and medium fractions. Only the coarse fraction was subsequently ground prior to analysis, the fine and medium ones being analysed without further treatment. The mercury content of these fractions was measured using the British Sugar Corporation Limited (BSC) method and the results are given in Table II. It is evident from the results in Table II that the mercury content of fine particles is substantially greater than that of coarse particles. This is further confirmed by tests carried out by one of the collaborating laboratories on samples of pulp dust taken from pulp drier cyclones in which mercury levels of 0·046, 0·057, 0·083, 0·051 and 0·041 mg/kg were found. This fact is not surprising since it is known that most of the heavy metals in plant material are absorbed in the parenchymatous tissue.

Table II. Mercury content of different size fractions of dried pulp

Sample	*Fraction*	*Weight (%)*	*Mercury content (mg/kg)*	*Weighted mean (mg/kg)*
		Ground samples		
1	Coarse (>400 μm)	66·7	0·058	0·087
	Fine (<400 μm)	33·3	0·144	
2	Coarse	58·8	0·056	0·099
	Fine	41·2	0·161	
3	Coarse	78·6	0·056	0·082
	Fine	21·4	0·177	
4	Coarse	61·5	0·006	0·010
	Fine	38·5	0·017	
		Unground samples		
5	Coarse (>850 μm)	90·7	0·038	0·046
	Medium	7·8	0·087	
	Fine (<400 μm)	1·5	0·311	
6	Coarse	94·9	0·030	0·033
	Medium	4·3	0·066	
	Fine	0·8	0·233	

It is thus evident that the whole quantity of the final subdivided ground pulp sample must be used for analysis; because of the rapid dehomogenization of ground pulp, the sub-sample may not be representative of the original sample if only a part is taken for analysis.

Tests on routine samples

Further investigation has been undertaken at the three laboratories of samples of dried pulp, molassed pulp, pulp nuts and molasses produced at various factories in Germany, Holland and the United Kingdom during the 1973/1974 and 1974/1975 beet campaigns.

Initial examination of some molasses samples indicated that the mercury content of this material was very low and therefore a relatively small series of molasses samples was investigated.

As far as the various types of pulp and pulp nuts are concerned, three types of sample were investigated. These were (a) composite samples representing an entire campaign's production, (b) composite samples representing a single week's production and (c) random spot samples.

The results of the analysis of these routine samples are shown as histograms in Figs. 1 to 4.

Fig. 1 shows that the mercury content of the bulk of the samples of dried pulp ranged from 0·011 to 0·040 mg/kg. Average values of 0·041 and 0·031 mg/kg were found for 18 weekly composites and 18 spot samples, respectively. The mercury content of the majority of the samples of molassed pulp and pulp

[10] Dixon: *Biometrics*, 1953, **9**, 74–89.
[11] Sachs: "Angewandte Statistik" (Springer Verlag, Berlin-Heidelberg-New York) 1973, pp. 422–424.
[12] *idem. ibid.*, 383.

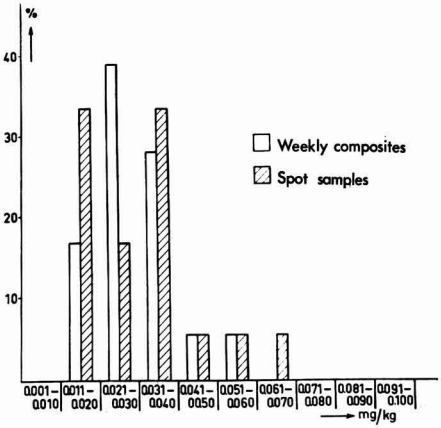

Fig. 1. Mercury in dried pulp (Routine samples)

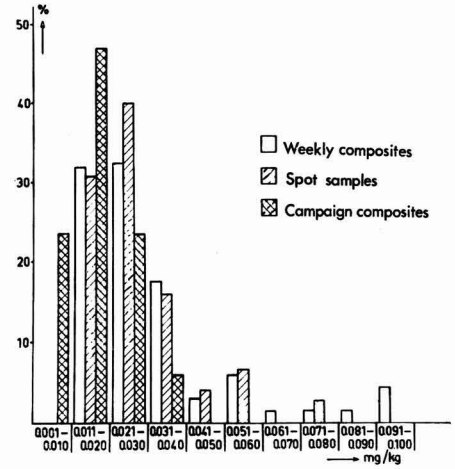

Fig. 2. Mercury in molassed pulp (Routine samples)

nuts (see Figs. 2 and 3) appeared to be somewhat lower than that of dried pulp (0·011 to 0·030 mg/kg). This may be accounted for by the fact that molassed pulp and nuts are made from dried pulp and from molasses, nearly all samples of the last having a relatively low mercury content of 0·001 to 0·020 mg/kg (see Fig. 4). Average values found for weekly composites of molassed pulp (68 samples), pulp nuts (95 samples) and molasses (24 samples) were 0·031, 0·022 and 0·008 mg/kg, respectively. Spot samples of molassed pulp (75 samples), pulp nuts (58 samples) and molasses (25 samples) revealed average values of 0·028, 0·027 and 0·011 mg/kg, respectively. Mean values of 0·016 and 0·012 mg/kg were found for 17 (molassed pulp) and 11 (pulp nuts) campaign composites, respectively.

The mercury contents of only 1 sample of dried pulp (weekly composite) and only 1 sample of pulp nuts (spot sample) of the total of 409 routine samples that were investigated were found to be higher than 0·1 mg/kg.

In conclusion, the results of this collaborative study show that the determination of mercury in dried sugar beet pulp and molasses (which, as already pointed out, require special analytical techniques) is capable of giving satisfactory results when carefully carried out using a flameless atomic absorption procedure. Satisfactory results cannot be obtained without ensuring homogeneous and representative samples.

The prospective EEC upper limit of 0·1 mg/kg for mercury in animal feeding stuffs is only very occasionally exceeded. Bearing in mind that the mercury contents reported in the present paper are in general, calculated on the basis of dry matter, the actual situation in regard to the mercury content of dried sugar beet pulp and molasses is even more satisfactory.

Summary

Methods for the determination of mercury in dried sugar beet pulp and molasses by flameless atomic absorption procedures have been studied collaboratively. Each laboratory developed its own method of analysis. Recoveries of added mercury ranged from 90 to 105%. Limits of detection of the methods range from 3 to 5 ng of mercury. Investigations into the relationship between particle size and mercury content in ground pulp samples emphasize the importance of a well-designed sample preparation procedure. Twenty-two samples were distributed and

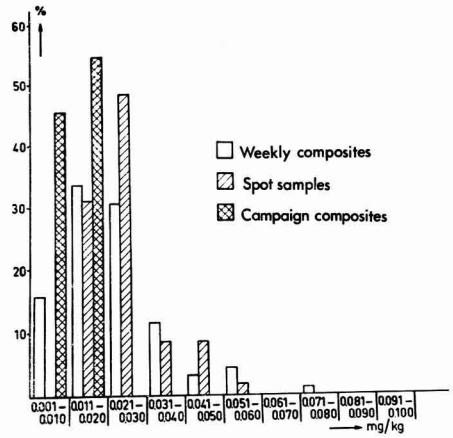

Fig. 3. Mercury in pulp nuts (Routine samples)

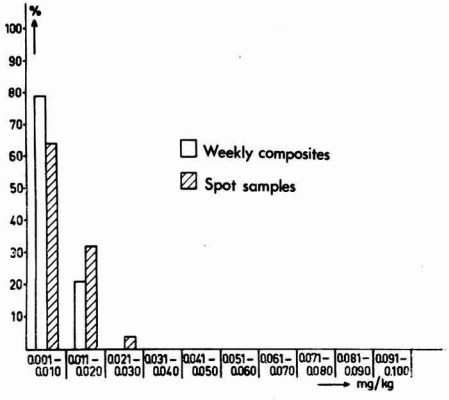

Fig. 4. Mercury in molasses (Routine samples)

subjected to replicate analyses by the collaborators. Good agreement is shown between the methods and the results obtained are comparable with those obtained by neutron activation analysis. The methods were applied to samples of pulp and molasses produced at various factories in Holland, the United Kingdom and the German Federal Republic during the 1973/1974 and 1974/75 beet campaigns. With a few exceptions, the levels of mercury found in these samples fall within the prospective EEC standard for animal feeding stuffs (not exceeding 0·1 mg Hg/kg material).

Appendix. Detailed Methods

Instituut voor Rationele Suikerproductie (IRS)

Apparatus

Atomic absorption spectrophotometer: "Varian Techtron" Model AA-5 (Varian Techtron Limited, Melbourne, Australia).

Hollow cathode mercury lamp (Varian Techtron).

Hollow cathode hydrogen lamp (Varian Techtron).

Recorder: "Varian Techtron" Model A-25.

Absorption cell: 15 cm with quartz windows (Varian Techtron).

Micropipette: "Varipet", capacity 5 to 25 μl, calibrated to 1 μl (Excalibur, Melbourne, Australia).

Mercury attachment: the apparatus, shown schematically in Fig. 5, consisting of a 100 cm³ gas washing bottle with a coarse-sintered bubbler, a 10 cm³ gas washing bottle containing magnesium perchlorate, and the absorption cell; all connexions are made with "Tygon" tubing.

Instrument settings: wavelength 253·7 nm, lamp current 3 to 3·5 mA, slit width 100 μm, coarse gain 4, damping A, recorder 5 or 2 mV, chart speed 0·5 cm.min^{-1}.

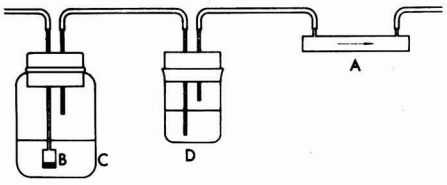

Fig. 5

A = absorption tube, 15 cm. B = coarse-sintered bubbler. C = gas-washing bottle, 100 cm³. D = gas-washing bottle, 10 cm³. ⟶ direction of flow.

Reagents

Concentrated nitric acid (BDH, AnalaR, 65%).

Reducing solution: 50 cm³ concentrated sulphuric acid (AnalaR grade, BDH, 96%) are added to distilled water (300 cm³) in a 500 cm³ volumetric flask. After cooling, 15 g sodium chloride (AnalaR grade, BDH), 15 g hydroxylamine hydrochloride (AnalaR grade, BDH) and 25 g stannous chloride (AnalaR grade, BDH) are added and dissolved, after which the solution is made up to volume with distilled water. The solution is stored in the dark in a polyethylene bottle and is stable for 3 to 4 months.

Urea solution: 2M solution (p.a. grade, Merck) in distilled water.

Blank solution: 50 cm³ nitric acid (AnalaR grade, BDH, 65%) diluted with distilled water to 100 cm³.

Octyl alcohol: octyl alcohol (chemically pure grade, Lamers & Indemans, Den Bosch, Holland) used as antifoam.

Stock mercury solution (1000 μg.cm^{-3}): 338·4 mg mercuric chloride (AnalaR grade, BDH), 20 cm³ nitric acid (AnalaR grade, BDH, 65%) and 100 cm³ distilled water are transferred to a 250 cm³ volumetric flask; after the mercuric chloride has dissolved, the solution is made up to the mark and stored in a polyethylene bottle in the refrigerator (stable for 6 months).

Working mercury solution (10 μg.cm^{-3}): 1 cm³ of the stock mercury solution (1000 μg.cm^{-3}) and 7·5 cm³ of nitric acid (AnalaR grade, BDH, 65%) are brought to volume with distilled water in a 100 cm³ volumetric flask; stored in a refrigerator, this solution is stable for 1 day.

Sample digestion

Pulp: The contents of a tube containing about 5 g of ground pulp (obtained by the method described in "Sample preparation" in the "Experimental" section) are weighed accurately into a 250 cm³ conical flask. Concentrated nitric acid (25 cm³) is added, dropwise round the neck of the flask at first, in order to rinse down any adhering pulp particles, and then in a thin stream on to the main part of the sample. The flask is closed with a glass stopper previously moistened with concentrated nitric acid and allowed to stand at room temperature for 24 hours in a fume chamber (the dry matter totally absorbs the liquid, swells, and sometimes forms a jelly). Concentrated nitric acid (25 cm³) is again added and the flask allowed to stand for a further 24 hours after which distilled water (50 cm³) is added; the flask is then allowed to stand, with occasional shaking, for a third period of 24 hours, after which the contents are filtered by suction through paper (Schleicher & Schüll, grade BF).

Molasses: The stock sample is warmed slightly and thoroughly mixed. A sample (about 25 g) is accurately weighed into a 100 cm³ conical flask and concentrated nitric acid (10 cm³) added. The flask is stoppered as described above and allowed to stand for 48 hours with frequent shaking. The contents of the flask are then diluted with 40 cm³ of distilled water, allowed to stand for 24 hours, transferred to a 100 cm³ volumetric flask, and made up to the mark.

Calibration

0, 5, 10, 20 and 25 μl (recorder setting 5 mV) or 0, 5, 10 and 15 μl (recorder setting 2 mV) aliquots of the working mercury solution (10 μg.cm^{-3}), containing respectively 0 to 0·25 μg or 0 to 0·15 μg mercury, are transferred to reaction bottles each containing 20 cm³ of blank solution. Urea solution (20 cm³)—to eliminate interference by forming complexes with oxides of nitrogen—and octyl alcohol (2 drops) are added to each bottle and the contents mixed well. Reducing solution (5 cm³) is then added and the bottle attached immediately to the mercury attachment. After shaking the bottle vigorously by hand for 1 min, a stream of argon (reduced pressure 0·5 kgf.cm^{-2}) is passed through for about 20 seconds and the absorption peak recorded. The whole procedure is then repeated, using the hydrogen lamp instead of the mercury lamp to detect possible broad-band absorption. This latter absorbance is subtracted from that obtained with the mercury lamp and corrected absorbance readings are plotted against micrograms of mercury to give a linear calibration curve. Calibration curves are prepared daily.

Procedure

The sample digest (20 cm^3) is transferred to a reaction bottle and is treated exactly as described for the zero standard solution in the "calibration" section above. From the corrected absorbance value, the mercury content of the digest (representing about 1 g of pulp or about 5 g of molasses) is calculated from the calibration curve.

British Sugar Corporation Limited (BSC)

Apparatus

Atomic absorption spectrophotometer: "Unicam" Model SP90A (Pye-Unicam Limited, Cambridge).
Mercury hollow cathode lamp (Pye-Unicam).
Recorder: "Servoscribe" Model RE 511.00 (Smiths Industries, Wembley, England).
Absorption cell: 15 cm with quartz windows (Pye-Unicam).
Mercury attachment: the apparatus is shown schematically in Fig. 6 and is sold as "mercury cold vapour analyser kit 790557" (Pye-Unicam).
Microburette: 1 cm^3 calibrated to 0·01 cm^3.
Instrument settings: wavelength 253·7 nm, lamp current 5 mA, slit 200 μm, gain to give 2× expansion on recorder, chart speed 1·0 $cm.min^{-1}$.

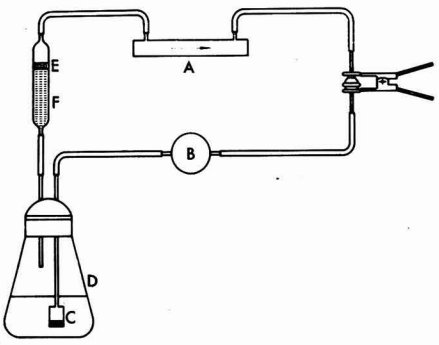

Fig. 6
A = absorption tube, 15 cm. B = pump. C = coarse-sintered bubbler. D = conical flask, 150 cm^3. E = coarse-sinter. F = cotton wool. ⟶ direction of flow.

Reagents

Concentrated sulphuric acid (BDH, AristaR, $d_4^{\circ} = 1{\cdot}84$)

Hydrogen peroxide solution (BDH, AristaR, "100-volume")

Potassium permanganate solution (BDH, AnalaR, 6 g made up to 100 cm^3 in distilled water)

Hydrochloric acid solution: 50 cm^3 hydrochloric acid (AristaR grade, BDH, $d_4^{20^{\circ}} = 1{\cdot}18$) are diluted with distilled water to 100 cm^3.

Reducing solution: 100 g of stannous chloride (AnalaR grade, BDH) and 200 cm^3 of hydrochloric acid solution are heated to boiling and stirred until solution is complete; after cooling, the solution is transferred to a 1000 cm^3 volumetric flask. A solution of 25 g hydroxylamine hydrochloride (AnalaR grade, BDH) and 30 g sodium chloride (AnalaR grade, BDH) in 200 cm^3 distilled water is then added to the same flask, the contents of which are made up to the mark, mixed, and stored in a Pyrex glass bottle (stable for 3 months).

Ceric sulphate solution: 30 cm^3 sulphuric acid (AristaR grade, BDH), 30 cm^3 distilled water and 17·2 g ceric oxide (AnalaR grade, BDH)* are heated to near boiling point in a beaker. Heating is continued for 10 minutes after fuming commences. The mixture is then cooled and diluted with 200 cm^3 distilled water. The solution is again heated to dissolve any precipitated ceric sulphate and allowed to stand overnight. The supernatant solution is decanted from any remaining ceric oxide into a 1000 cm^3 volumetric flask. A further 30 cm^3 sulphuric acid and 20 cm^3 distilled water are added to any ceric oxide remaining in the beaker and the procedure repeated from ". . . are heated to near boiling". It may be necessary to repeat the procedure a third time. After the final treatment, when all the ceric oxide has been converted to sulphate and transferred to the volumetric flask, further sulphuric acid, to bring the total amount to 100 cm^3, is added and the contents of the flask made up to the mark and mixed.

Stock mercury solution (1000 $\mu g.cm^{-3}$): Prepared as in IRS method.

Dilute mercury solution (10 $\mu g.cm^{-3}$): stock mercury solution (1 cm^3) is pipetted into a 100 cm^3 volumetric flask and made up to the mark with ceric sulphate solution; according to TKACHUK & KUZINA[13], dilute mercuric chloride solutions in a strongly oxidizing medium are stable for at least 12 months.

Working mercury solution (1 $\mu g.cm^{-3}$): dilute mercury solution (10 cm^3) is pipetted into a 100 cm^3 volumetric flask and made up to the mark with ceric sulphate solution; the solution is used immediately.

Sample digestion

Pulp and molasses: About 1 g of sample is accurately weighed into a 150 cm^3 conical flask and 5 cm^3 of concentrated sulphuric acid added. A double surface reflux condenser is attached to the flask which is then immersed for 10 min in a water bath at 70°C. Hydrogen peroxide solution (8 cm^3) is added through the condenser, dropwise at first and then more rapidly as the reaction subsides. The water bath is removed and the flask, still under reflux, is carefully heated over a bunsen burner until vigorous gas evolution ceases (about 10 min). The flask is cooled for 10 min and the walls of the condenser are then washed down with about 50 cm^3 distilled water. After removal of the condenser, aqueous potassium permanganate solution is added until the first pink colour is produced, followed by a further 2 cm^3, giving a total addition of 5 to 10 cm^3. After cooling to room temperature, the flask is washed down with a little distilled water to give a final volume of about 80 cm^3.

Procedure

Reducing solution (5 cm^3) is pipetted into the 150-cm^3 flask containing the digest; the flask is immediately connected to the mercury attachment.

The circulation pump is started and the solution aerated through the closed system. When the absorption peak has atatined a steady value, the system is opened to the atmosphere (at point A in Fig. 6) and the solution aerated until the absorption peak falls back to zero. The pump is switched off and the flask

* This procedure, using ceric oxide, has been adopted since it has proved impossible to find a commercial source of ceric sulphate with a sufficiently low mercury content.

[13] *J. Sci. Food. & Agric.*, 1972, **23**, 1183–1195.

removed from the mercury attachment. A suitable addition of working mercury solution (1 μg/cm³) is made with the microburette and the flask quickly returned to the mercury attachment. The solution is again aerated through the closed system. The absorption peak obtained from the added mercury solution should be of similar height to that obtained from the sample. The mercury content of the sample is calculated from the ratio of the two absorption peak heights. A blank determination is carried out on the reagents, using the digestion and determination procedure described, but with substitution of the sample by 1 g pure sucrose and reduction of the amount of hydrogen peroxide in the digestion to 5 cm³. The mercury content of the blank is deducted from that of the sample.

Süddeutsche Zucker AG. (SZ)

Apparatus

Atomic absorption spectrophotometer: "Perkin-Elmer" Model 300S (Bodenseewerk Perkin-Elmer & Co., Ueberlingen, German Federal Republic).

Mercury hollow cathode lamp: "Intensitron" (Perkin-Elmer).

Recorder: "Perkin Elmer" Model 56M.

Absorption cell, 10 cm, with quartz windows (Perkin-Elmer).

Mercury attachment: the apparatus is shown schematically in Fig. 7; the 300 cm³ conical flask incorporates a coarse-sintered glass bubbler, the 25 cm³ drying tube contains silica gel (Merck, No. 1925) and the scrubber contains iodized active carbon (Roth, Karlsruhe, No. 6153).

Instrument settings: wavelength 253·7 nm, lamp current 8 mA, slit width 590 μm, recorder 2 mV, chart speed 1·0 cm.min⁻¹.

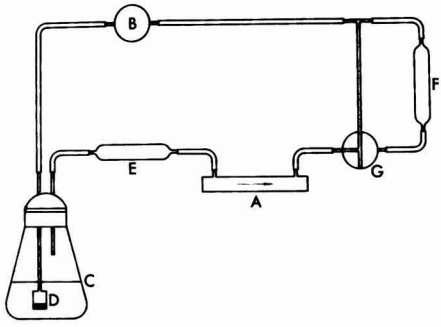

Fig. 7

A = absorption tube, 10 cm. B = pump. C = conical flask, 300 cm³. D = coarse-sintered bubbler. E = drying tube. F = scrubber. G = two-way stop cock. ⟶ direction of flow.

Reagents

Concentrated nitric acid (Merck, Suprapur, Cat. No. 441).

Potassium permanganate solution: 5 g potassium permanganate (Merck No. 5082) made up in distilled water, to 100 cm³.

Nitric acid solution: 35 cm³ nitric acid (Merck No. 731) made up to 100 cm³.

Sulphuric acid solution: 50 g sulphuric acid (Merck No. 454) made up to 100 cm³.

Hydroxylamine hydrochloride solution: 1·5 g hydroxylamine hydrochloride (Merck No. 4616) made up to 100 cm³ in distilled water.

Stannous chloride solution: 10 g stannous chloride (Merck No. 7815) made up to 100 cm³ in distilled water.

Stock mercury solution (1000 μg.cm⁻³): as in IRS method.

Working mercury solution (10 μg.cm⁻³): as in IRS method.

Sample digestion

Pulp and molasses: A sample (10 to 15 g) is accurately weighed into a 250 cm³ TPX (polymethyl pentane) conical flask* and the following additions are made at 24-hour intervals: 35 cm³ of concentrated nitric acid; 35 cm³ of concentrated nitric acid; 70 cm³ of distilled water. The digest is stood for a further 24 hours with occasional shaking. The molasses digests are then made up to 250 cm³ with distilled water. Pulp digests are filtered by suction through sintered glass (Schott & Gen., porosity G1); after washing with distilled water, filtrate and washings are made up with distilled water to 250 cm³.

Procedure

To 25 cm³ of sample in the reaction flask are added successively 45 cm³ distilled water, about 30 cm³ potassium permanganate solution (until a pink colour persists), 5 cm³ nitric acid solution (allowed to stand for 15 seconds), 5 cm³ sulphuric acid solution (allowed to stand for 45 seconds), 5 cm³ hydroxylamine hydrochloride solution and 5 cm³ stannous chloride solution. The flask is connected immediately to the mercury attachment and the solution aerated through the closed system. After the absorption peak has been recorded (as in the BSC method), the system is opened to the active carbon scrubber until the absorption falls to zero. The mercury content of the digest is measured by addition of standard mercury solution to the aerated solution (as in BSC method). A blank determination on the reagents is made by carrying out the whole analytical procedure without the sample.

Taiwan sugar expansion plans[1].—The Taiwan Sugar Corporation plans to raise its production to 900,000 metric tons a year soon, with TSC farms providing 300,000 tons and contract farmers 600,000 tons. TSC hopes to achieve the target by such measures as increasing the unit yield of sugar cane, reclamation of hitherto unused land for sugar plantations and higher subsidies to sugar cane farmers. One new sugar factory is to be built and five existing factories enlarged[2]. Sugar production reached 851,000 tons in 1974, an increase of 110,000 tons over 1973. But the 1975 production target was lowered to 800,000 tons because the price ceiling imposed on sugar by the government has discouraged sugar cane production. If international sugar prices are favourable, however, the target for 1976 will be 840,000 tons. In 1975 Taiwan expects to export 460,000 tons; the major share (200,000 tons) will go to South Korea while other major outlets will be Japan (120,000 tons), the USA (80,000 tons) and Malaysia (40,000 tons).

* TPX is used to minimize errors when the same digest is used for the determination of lead and cadmium.

[1] *Commodities Bull.*, 23rd May 1975.

[2] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (17), 7–8.

Sugar cane agriculture

Salt tolerance levels of sugar cane. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 29–32.—Tests were conducted to determine the salt tolerance of two varieties, UCW 5465 and HJ 5741. In both cases, yield fell with increase in irrigation water salinity. Differences occurred between the two varieties as regards yield at each salt level, the greatest difference being found at the highest salt concentration. The Na, Cl, Ca and Mg contents in juice from HJ 5741 cane increased, K uptake remained constant, while phosphate ion concentration fell with increase in water salinity; in the case of UCW 5465 the phosphate ions remained constant, but at a higher level than with HJ 5741, while the juice K content rose with increased salinity. Soil and leaf analyses for the above-mentioned components are also discussed.

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Varieties (in Jamaica). ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 33–64.—Details are given of varietal trials and of distribution of commercial varieties as well as parentages of canes in the BJ series.

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Mechanical harvesting (in Jamaica). ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 64–70.—Details are given of the performance of a Don Mizzi 740 harvester and of a Massey-Ferguson MF 201 harvester used as stand-by in 1973. A total of 297 acres (representing over 5000 tons of cane) was harvested by the two machines, but many problems were encountered, including a number of harvester failures for one reason or another. From the information gathered, a number of criteria are listed for mechanical harvesting in Jamaica.

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Introduction of extraneous matter by mechanical loading. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 70–74. Information on mechanical loading efficiency and costs includes mention of an experimental (non-digging) grab used to "heap-load" the cane. No details are given of the procedure used, but observations showed that less soil is introduced with the cane than with standard grabs. Push-piling heaped cane is expected to rate between standard push-piling of windrowed cane and heap-loading without push-piling.

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Harvesting organization. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 75–77.—Particular mention is made of self-loading trailers, use of which is still in the early stages in Jamaica. Costs and advantages of the system are discussed, and areas where they can be of greatest benefit are indicated. Two major problems have been encountered: the need for a special type of tractor which is more expensive than a standard one, and the need for changes in the cane cutting method. Also briefly discussed are road-side grab loading and containerization.

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Cane losses during transport. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 77–78.—Losses in the form of cane dropping from loads in transit have been found to represent 0·3%, or 12,000 tons of cane. While the monetary losses seem high, it is pointed out that measures, other than improved supervision, to prevent such losses would cost much more.

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Cultivation trials (in Jamaica). ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 78–79.—In cultivation experiments, on/off-barring resulted in a lower cane yield than did the standard no-cultivation procedure, while stubble shaving and side-cutting with a "Culticane" machine (a type of rotary hoe with stubble shaving blades instead of the normal blades) gave even poorer results. Possible reasons for the poor performances are suggested. A system of minimum tillage comprising destruction of old banks and planting in old furrows has shown promise, and an examination of the economics shows that considerable savings could be expected in land preparation costs.

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The effect of field population on yield. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 90–91.—The effects of 2-, 4- and 6-ft gaps in cane rows on yield were determined; results indicated that the yield fell progressively with size and frequency of gaps.

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The yields of "trash" rows and "clean" rows. ANON. *Ann. Rpt. Sugar Ind. Research Inst. and Sugar Research Dept.* (Jamaica), 1973, 91–92.—Comparison was made between clean rows (where the cane was burnt) and rows where trash mulching was practised. Results indicated that trash mulching was of advantage under dry conditions but had adverse effect on yield under wet conditions.

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Machines provide the muscle at Fairymead. W. P. KERR. *Producers' Rev.*, 1974, **64**, (11), 10–11.—Information is given on cane mechanization on the seven cane plantations, totalling 4812 hectares, owned by Bundaberg Sugar Co. in Queensland. Particular mention is made of activities carried on at Fairymead, with references to the harvesters, uses made of a Massey-Ferguson 1800 tractor (including application of "aqua ammonia" at the rate of three rows a time), and spray irrigation. The plantation at Fairymead has more than 29 miles of main drains.

Mauritius—sugar island. R. PRICE. *Producers' Rev.*, 1974, **64**, (11), 52–55.—A survey is presented of the Mauritian cane sugar industry.

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Consultancy and management services for the cane sugar industry. A. GOEDHART. *Zeitsch. Zuckerind.*, 1975, **100**, 17–22.—The managing director of HVA-International B.V., a Dutch firm with wide experience in tropical and sub-tropical countries of the growing and processing of various crops including sugar cane, discusses the various steps to be taken in setting up and managing a cane sugar project.

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Evaluation of some of the new insecticides for the control of *Pyrilla perpusilla* (Wlk.). M. S. DUHRA, J. S. SANDHU and S. K. SHARMA. *Sugar News* (India), 1974, **6**, (5), 13–15.—Results are given of two experiments on control of *P. perpusilla* (leaf hopper) with various insecticides. Maximum reduction in population was achieved with "Endosulfan" (94·1% decrease 72 hours after spraying), although most of the others also reduced the population by at least 90% during the period 24–72 hours after spraying in one or both experiments.

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Increasing sugar cane production through judicious manuring and irrigation. D. N. GUPTA and R. SINGH. *Sugar News* (India), 1974, **6**, (5), 22–25.—Results of experiments at Raya (Mathura), involving two levels of irrigation and three levels of nitrogen application, are reported.

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Nitrogen and sugar cane. IV. Leaf nitrogen in response to single and piecemeal application of fertilizer and its relations with growth. U. S. SINGH. *Indian Sugar*, 1974, **24**, 541–548.—Results of randomized block experiments in which ammonium sulphate was applied at the rate of 112 kg.ha^{-1} either in one single dose at planting or in two split doses, the second dose being applied usually many weeks after the first dose, showed that the single dose resulted in maximum cane leaf N and maximum cane growth rate, especially during the peak growing period. The next best results, in terms of leaf N, were obtained with application at planting in March followed by a second dose in June. In all cases, the leaf N (closely correlated with cane growth rate) was much greater than in the unfertilized control.

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Development of new sugar cane clones from somatic tissues cultured *in vitro*. J. ANTONI. *Rev. Agron. Noroeste Argentino*, 1974, **11**, (1/2), 37–46.—Short pieces of apical tissue were cultivated *in vitro* in solid medium containing macro- and micro-nutrients, vitamins and hormones. After twice transferring, independent callus tissues were obtained and further differentiation of plant organs was achieved in the same culture medium omitting 2,4-D. The general outlines of the technique used are described.

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Field mechanization. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1975, **70**, (1), 35–40.—Reference is made to the operation of a Toft harvester in Hawaii which has proved successful in handling heavy cane crops (up to 150 tons per acre). Excessive amounts of cane are left in the field, however, and the presence of large rocks in Hawaiian fields has caused problems. Moreover, it is unsuitable for use in small rocky or wet areas, and a single-line, mat-type chopper-harvester of about 1·5 tons capacity is being developed by Stubenberg Co. Ltd. for more economical harvesting. The Toft machine has been found to include some 2% of soil with the cane, which is about the same quantity remaining on wet-washed cane harvested by the pushrake-grab method; cane harvested at Laupahoehoe by the Toft machine has been fed directly to the mill without cleaning. The trash content of cane gathered by the Toft harvester is 10–12% compared with about 40% with the push-rake grab system. Information and illustrations are given of the Stubenberg cane buggy used in Hawaii[1], and mention is made of Massey-Ferguson cane harvesters and of "canetainers" as used in Australia.

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The army worm *Mocis latipes* (Guen) and its importance as a sugar cane pest. Biology, damage and control. M. A. COSTILLA, H. J. BASCO, C. W. LEVI and V. M. OSORES. *Bol. Estación Exp. Agric. Tucumán*, 1973, 7 pp.—An illustrated description is given of this nocturnal moth in its various life stages and of the damage it causes in eating cane leaves. An important factor in its control is elimination of host weeds, especially *Digitaria sanguinalis*, and the application of chemicals, of which a table is presented with required dosages.

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Elimination of weeds in cane fields. ANON. *La Ind. Azuc.*, 1975, **81**, 134.—The bad effects of weeds in cane fields in competing against cane and in providing a breeding place for pests, etc. are briefly discussed. Herbicides may be applied for their control and such chemicals are listed in pre-emergence and post-emergence groups, with a note of weed species they control.

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Heritability, genetic correlations and responses for the selection of some sugar cane characteristics. R. CESNIK and R. VENCOVSKY. *Brasil Açuc.*, 1974, **84**, 453–461. An examination of seedlings produced by crossing of a number of parental varieties and grown in two locations showed that most of the genetic variance was due to segregation and recombination. Estimates of response to selection favoured selection in the majority of characteristics. Heritabilities were generally high, indicating the possibility of rapid progress towards breeding objectives. Genetic correlations and correlated responses to selection, with some exceptions, were found to be favourable for overall genetic improvement of the material under study.

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The nematode *Pratylenchus zeae* Grahn in sugar cane. M. A. COSTILLA. *Rev. Ind. Agric.* (Tucumán), 1973, **50**, (2), 39–43.—A description is given of the morphology of this nematode as well as the type of damage it causes to cane roots. Treatment with 5% "Furadan" granular systemic nematicide at the rate of 30 g.m^{-2} killed 99·3% of the nematodes infesting the rootlets within 10 days of application.

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Varietal suitability for different periods of crushing and for different regions. A. S. ETHIRAJAN. *Cane Grower's Bull.*, 1973, **1**, (4), 3–6.—Details are given of early-, mid- and late-season cane varieties recommended for each cane-growing state in India. The author emphasizes the importance of varietal selection for increased

[1] *I.S.J.*, 1975, 77, 144.

sugar production and is of the opinion that at least one-third of the area supplying cane to a factory should be occupied by early-maturing and ratoon crops. A list is also presented of the cane breeding research programmes at Coimbatore.

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Sugar cane scale insect and its control. R. A. AGARWAL and D. K. BUTANI. *Cane Grower's Bull.*, 1973, **1**, (4), 7–9.—Information is given on the life cycle, distribution and natural enemies of *Melanaspis glomerata* as well as the nature and extent of damage caused to cane and possible control measures.

* * *

Co 6304—a new sugar cane variety for high yield and quality. G. DEVARAJ, A. K. KADIRVEL and S. D. RAJAN. *Cane Grower's Bull.*, 1973, **1**, (4), 11–12.—The characteristics of Co 6304 are described and varietal trials reported, in which it proved to be superior to Co 419, Co 449 and Co 658 in terms of a number of factors including total cane and sugar yield.

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Increasing sugar cane yield by the application of phosphatic fertilizers to the preceding legume crop. B. S. MATHUR and B. S. TEOTIA. *Cane Grower's Bull.*, 1973, **1**, (4), 13–15.—Trials indicated that application of phosphate at 30 kg P_2O_5 per ha to a pea crop not only increased yield of that crop but also increased yield of the subsequent cane crop.

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Improved practices for growing sugar cane in Gujarat State. ANON. *Cane Grower's Bull.*, 1973, **1**, (4), 17–18. Recommended cane agricultural practices for this Indian state are briefly described.

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The sugar cane scale insect. A. N. KALRA. *Indian Sugar*, 1974, **24**, 373–375.—The damage caused by *Melanaspis glomerata* to cane and the distribution of the pest are described as well as possible control measures. Studies on control by natural enemies are advocated.

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Significance of soil moisture during simulated freezing for sugar cane survival. O. SINGH and O. S. SINGH. *Indian Sugar*, 1974, **24**, 377–381.—Greenhouse experiments are reported in which 60-day-old potted plants of variety Co 975 were irrigated to maintain the soil moisture level at 6% and 12% and the plants exposed daily to a temperature of —3°C for 4 hours daily during a 6-day period. The vertical height of the mother shoot, leaf moisture content and transpiration rate were significantly lower at 6% than at 12% moisture, although the number of tillers and green leaves per plant did not differ significantly. The results for the 12% moisture level were quite close to results obtained at the lower level with freezing.

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Role of leaf mid-rib lesions in epidemiology of red rot caused by *Colletotrichum falcatum* Went in the Punjab. S. S. SANDHU, V. K. MEHAN and K. SINGH. *Indian Sugar*, 1974, **24**, 391–395.—Cane from four varieties was inoculated with isolates of *C. falcatum* from leaf mid-rib lesions as well as from the stalks of infected plants. Determination of the spread of infection showed that the isolates from the leaf mid-rib lesions were less virulent than the stalk isolates where susceptible varieties were inoculated, whereas in the case of resistant varieties the isolates had approximately the same virulence, irrespective of whether the plant sources were susceptible or resistant. (See also AGNIHOTRI & BUDHRAJA: *I.S.J.*, 1975, **77**, 175.)

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Performance of Co 6304 under different levels of nitrogen fertilization. C. RAO, S. ASOKAN and E. LALITHA. *Indian Sugar*, 1974, **24**, 397–398.—Results are reported of nitrogen fertilization trials in which the effects of 0%, 200%, 250% and 300% kg N per ha on Co 6304 and Co 419 were compared. From the cane and sugar yield standpoints Co 6304 has been found to be a good replacement for the other variety which has proved susceptible to grassy shoot disease.

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Studies on the effect of different systems of sugar cane planting on the yield and economics of intercropping sequences. K. S. RATHI and H. N. TRIPATHI. *Indian Sugar*, 1974, **24**, 399–407.—The effects of early potatoes followed by wheat as intercrops with autumn-planted cane on yields of all three crops and the economics involved were determined in 2-year field tests in which a number of variations were tried. The tabulated results indicated that two rows of potatoes followed by three rows of wheat in a 75 cm space between cane rows was the optimum, but possible alternatives are also discussed.

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Brix-pol relationships as influenced by sugar cane varieties and seasons in the Cuddalore Tract of Tamil Nadu. N. RAMAMOORTHY, K. T. NARASIMHAN, S. A. AHMED, I. MAHAMUNI and S. D. RAJAN. *Indian Sugar*, 1974, **24**, 409–416.—Trials with three Coimbatore cane varieties grown as early-, mid- and late-season cane are reported and regression equations derived for each variety with which to predict juice pol from Brix measurements.

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Incidence of spike, a virus disease of sugar cane, and its host range. A. JHA, H. C. PRASAD and B. MISHRA. *Indian Sugar*, 1974, **24**, 417–421.—The incidence of spike in India since 1955 is indicated in a table showing locations and areas affected, the varieties involved and the percentage infection. Tests over 10 years in which a number of grasses and other plants were inoculated with isolates taken from infected cane showed that only *Chenopodium amaranticolar* revealed symptoms of the disease.

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Effect of climate on sugar cane yield and sugar recovery percentage. R. VENUGOPAL, S. P. PALANIAPPAN, Y. B. MORACHAN, M. M. MURUGESAN and R. SANTHA. *Indian Sugar*, 1974, **24**, 423–431.—A study of the effect of climatic factors on cane yield and sugar recovery % in different Indian states showed that a mean annual temperature of 26–28°C with little variation in the monthly temperatures was conducive to a high cane yield, while night temperatures of 12–16°C, a relative temperature disparity factor of about 50 and comparatively low relative humidity during the cane ripening period (November–February) were optimum for sugar accumulation. The authors emphasize the need to assess the climatic conditions of a particular region before planning cane projects and establishing factories.

Sugar beet agriculture

Interdependences between individual weight and sugar beet quality factors. M. DAMBROTH. *Zeitsch. Zuckerind.*, 1975, **100**, 76–79.—Investigations have shown that while the weight range of 1000–1400 g was optimum for beet sugar content, differences in weights were not as important as the interrelationships between weather conditions and site location with regard to beet quality. Hence, dividing the total yield per unit area by the plant population to obtain a mean weight is irrelevant for quality assessment, particularly because of the considerable variations in weight. Plant distribution is considered more significant than the number of plants, so that measures aimed at improving emergence to obtain a greater uniformity of growth are of fundamental importance.

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Genetic and ecological effects on beet nitrogen content. I. The formation and content of nitrogenous substances in beet. V. STEHLÍK. *Listy Cukr.*, 1975, **91**, 1–5. Investigations on commercial sugar beet varieties, fodder beet and wild beet species as well as crosses showed that the noxious nitrogen content in beet was a genetically-induced effect involving a relatively labile substance which occurred as a result of albumin formation and decomposition and was transported to required points by conducting tissue.

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Problems of sugar beet pathology in India—a critical appraisal. K. SINGH, S. N. SRIVASTAVA, C. SEN and V. P. AGNIHOTRI. *Indian Sugar*, 1974, **24**, 383–389. Beet diseases encountered in India and possible control measures are described.

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Sugar beet seed pelleting. V. S. BUD'KO, A. I. PRIGOSTKII and I. I. SUSHKO. *Sakhar. Prom.*, 1975, (2), 58–60. Investigations on beet seed pelleting are reported and the question of thickness of the coating discussed.

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Study on the effect of Na-maleic hydrazide on beet storage at Dubovyazovskii sugar combine. V. V. ZHOVNIRSKII, N. P. PREKRASNYI, V. A. POSOSHENKO and A. T. SIROTENKO. *Sakhar. Prom.*, 1975, (2), 60–62. Treatment of beet samples with 1% sodium salt of maleic hydrazide (0·025 kg a.i. per 8–10 kg of samples) followed by 97 days' storage reduced the total sugar and weight losses as well as the daily sugar losses compared with untreated controls. The incidence of mould, rotting and wilting as well as the proportion of frozen roots were also lower than in the controls, while the total N, non-protein N and amino-N contents were increased in relation to both untreated controls and the initial unstored beets.

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Beet virus yellows. P. CORNUET. *Hautes Etudes Betterav. Agric.*, 1975, (28), 7–13.—Two major forms of the disease, referred to as beet virus yellows and persistent beet virus yellows, are described, including identity of the virus, transmission and possible control methods.

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Beet damage by wireworms. C. RAYNAUD. *Hautes Etudes Betterav. Agric.*, 1975, (28), 20–21.—The life cycle of the click beetle and its larval form, the wireworm, is described, and the damage caused to beet by the pest during the four years from hatching of the eggs to the nymphal stage is indicated. Control can be achieved with "Dotan", a new micro-granular organophosphorus compound, which is also effective against millepedes, cockchafers, white grubs and symphilids.

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Sugar beet in the irrigated Mediterranean environment of Haut-Chéliff. R. CLAUS and J. C. LEGOUPIL. *Hautes Etudes Betterav. Agric.*, 1975, (27), 28–33; 1975, (28), 22–30.—Information is given on the beet agriculture in this region of Algeria where the average 470 mm of rainfall per annum occurs in the autumn-winter period, thus dictating use of autumn sowing. The irrigation requirements and responses of the beet to irrigation in the autumn and spring are discussed, and tabulated data presented showing the effect of irrigation at different growth stages on the final sugar yield. It is shown, as was established in Morocco, that if the water table is kept at 70% during formation of the leaf bunch, irrigation can be withheld for the 30 days before harvest without any adverse effect on sugar yield. The recommended levels of irrigation throughout an average year are set out in tabular form. Other aspects of beet agriculture in the region include soil preparation, beet plant density, chemical weed control and fertilization.

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Processing properties of sugar beet as a function of nitrogen application. E. REINEFELD and G. BAUMGARTEN. *Zucker*, 1975, **28**, 61–68.—Investigations of the effect of nitrogen application to beet on its processing properties showed that at rates above 2 g N per plant (120 kg.ha^{-1} at a plant density of 60,000 per ha) there was marked deterioration in all factors studied. These included brei sugar content; ash, alkali and amino-N contents in brei and thick juice obtained from it; purity of both raw and thick juice; raw juice reducing matter; thick juice alkalinity, pH, lime salts and colour; beet "corrected sugar content" and estimated molasses sugar yield. Results for 1971 and 1972 are expressed in graph form.

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The effect of sodium fertilization of sugar beet with good potassium dressing in pot trials. G. K. JUDEL and H. KÜHN. *Zucker*, 1975, **28**, 68–71.—Pot trials were carried out during 1972 and 1973 in which potassium was applied to each beet plant as sulphate and chloride and leaf weight, beet weight, sugar yield, pol, soluble ash and noxious N determined in

the presence or absence of sodium added as chloride or "Rhenania phosphate". Results, given in tabular form, indicate that the sodium increased sugar yield and pol when added as NaCl, while in its other form it increased the two factors yet further. The effects of sodium on the other factors mentioned above varied between years, but "Rhenania phosphate" tended to have a better effect than did NaCl. The effects of sodium on beet and leaf mineral composition was also determined.

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Soil insecticides. E. SEUTIN and L. VAN STEYVOORT. *Le Betteravier*, 1975, **9**, (84), 17.—Advice is given on the most suitable insecticides to apply for control of soil-inhabiting beet pests, a table being presented showing the various products available and the rates at which to apply them before sowing and before emergence.

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Care with liquid manure. R. VANSTALLEN. *Le Betteravier*, 1975, **9**, (84), 17.—In a brief note, the author emphasizes the need to restrict application of liquid manure to beet fields, since excessive amounts will give low sugar contents and reduce beet yield. The importance of time of application is also mentioned—the nitrogen in the manure will inhibit maturation if it is applied too late in the season.

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How can sugar beet be weeded in 1975? J. F. SALEMBIER and J. M. BELIEN. *Le Betteravier*, 1975, **9**, (84), 18–19.—In discussing the best means of weed control in beet fields, the authors emphasize that the most economical approach is judicious use of both mechanical and chemical means. Most of the short article is devoted, however, to the most suitable combinations of herbicides for given conditions.

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Soil structure. R. VANSTALLEN. *Le Betteravier*, 1975, **9**, (84), 20.—The harmful effect of excessive rainfall on soil structure is stressed and means of obtaining a good structure are indicated.

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Weed control in beet with a ready-made combination of "Pyrazone" + "Diallate". G. SERRA, G. LARTAUD, V. LIPATOFF, J. F. MORIN and J. C. POISSON. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 5–19.—Results of tests, in which the effectiveness of "Purazone" and "Diallate" combined in a special formulation was compared with that of the two herbicides applied separately, showed that a combination of 2535 g "Pyrazone" and 1365 g "Diallate" was as effective as 2560 g "Pyrazone" plus 1400 g "Diallate", both being applied before sowing followed by soil incorporation. Both types of mixtures were highly effective against *Avena fatua* and *Alopecurus agrestis* as well as a number of dicotyledons.

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Sequential application of herbicides for season-long weed control in sugar beet. T. M. THOMAS and J. BURKE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 21–38.—The practice of sowing to a final stand has led to greater interest in obtaining effective weed control throughout the growing season. In experiments with a number of pre-emergence herbicides, the degrees of weed control varied considerably, but none gave more than 60% control. However, this was increased by 20–65% when the pre-emergence treatment was followed by post-emergence "Phenmedipham" application. Critical factors were the activity of the pre-emergence herbicide and the time of application of "Phenmedipham", as well as prevalent weed species and soil and weather conditions. In some cases, a second application of "Phenmedipham" may be necessary or a residual herbicide mixed with "Phenmedipham" for the one application. The problem of perennial broad-leaved weeds is also mentioned.

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Weed control in sugar beet with single and split applications of herbicides. M. EDDOWES. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 39–47.—In 1973, when April and May rainfall was sufficient to give suitable soil moisture conditions for chemical weed control, good results were obtained when a pre-emergence herbicide was followed by post-emergence application of "Phenmedipham", although best control (over 95% of annual weeds destroyed) was achieved with 1·68 kg.ha^{-2} "Ethofumesate" plus 1·12 kg.ha^{-2} "Phenmedipham", both applied as post-emergence herbicides. However, at the start of the 1974 growing season, conditions were very dry, and the levels of weed control obtained with individual herbicides or combinations were initially not significantly different; however, by the end of May the differences widened, and again "Ethofumesate" + "Phenmedipham" gave very good results. At final beet harvest there was, nevertheless, no significant difference between treatments as regards beet yield despite marked differences in weed infestation of treated plots in July. The great value of "Phenmedipham" under dry conditions and the comparative failure of residual herbicides under such conditions is underlined.

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The use of pre- and post-emergence herbicides for prolonged weed control in sugar beet grown with minimal hand labour in the United Kingdom. W. E. BRAY. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 49–63.—Details are given of tests in which effective control was obtained by a pre-emergence herbicide followed by post-emergence application of "Phenmedipham". In some cases, it was found possible to achieve the same results but with three-quarters of the normal pre-emergence herbicide dose, adjustments then being made to the post-emergence herbicide rate. While "Pyrazone" was inferior to "Phenmedipham" as a post-emergence herbicide, the effectiveness of the latter is governed by the climatic conditions and the stage of growth of individual weed species.

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Equipment for treatment: present state of the art and development prospects. M. GIVELET. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 107–122.—Types of equipment available for herbicide spraying and their methods of operation are described and future prospects, particularly concerning the application of microgranular herbicides, briefly considered.

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Experiences with herbicide spray systems in mechanized beet agriculture in Western Europe. J. EITEL and X. BERGERON. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 65–76.—Chemical weed control practices in Belgium, France, Holland and

West Germany, based on application of "Pyrazone" before or at the time of sowing, are briefly surveyed. While the methods adopted in France and West Germany are based primarily on the weed spectrum, in Belgium and Holland the choice of method is governed primarily by the type of soil.

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Evolution of herbicide methods: conception and organization of programmes. L. A. DURGEAT and J. F. MORIN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 77–89.—The need for a well-established programme of chemical weed control in the absence of an "ideal" herbicide permitting weed-free beet fields during the growing season is emphasized and trials reported with pre- and post-emergence treatments. Best results were obtained with use of "Pyrazone" + "Diallate" as pre-emergence and "Phenmedipham" as post-emergence herbicides.

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Underleaf spraying of herbicides. N. V. TURNER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 93–97.—A brief account is given of an arrangement of band spraying nozzles which eject herbicide towards the base of the growing beet (when it has 6–8 leaves) after the lower beet leaves have been lifted by the blades of a tractor steerage hoe. Good results have been obtained in preliminary work in the UK, and it is suggested that herbicides which are more potent than "Phenmedipham" (to which tests have been confined) may be applied, since direct application to the beet leaves is not involved. Linking the operation with side-hoeing restricts the forward speed.

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Survey of the possibilities of reducing the volume per hectare in herbicide spraying. S. MUSILLAMI and P. GOFFRE. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 99–106.—Means of reducing herbicide consumption are discussed, including the use of slit nozzles which have a wide angle of throw, reducing the spray pressure, increasing the distance between nozzles on a spray boom and periodic spraying with large-calibre slit nozzles. The need for efficient filtration so as to prevent blockage of slit nozzles is emphasized.

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Important factors in the technique of herbicide application to beet. H. NEUPURER. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 123–134. Trials of herbicide application methods and equipment are discussed. Results indicated that slit nozzles were more effective at 3 atm feed pressure than hollow-cone nozzles at 15 atm pressure, as normally used in beet fields; the difference lay in the larger droplet size with the former type, whereby the herbicide quickly adheres to the surface, whereas with the latter type the finer spray may drift under any but completely wind-free conditions. The forward speed of spray equipment and factors affecting it are discussed. While pre-emergence herbicides are better applied with higher quantities of water, post-emergence herbicides (with the exception of "Paraquat") form a fine spray and require less water. Broadcast or band application of granular material, incorporated to a given depth (according to the herbicides in question) in the soil, was also the subject of tests, and suitable equipment is discussed.

Effect of herbicides on the metabolism of sugar beet and *Chenopodium* plants and tissue cultures. G. GÜNTHER and S. SCHMIDT. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 137–147. Investigations were aimed at elucidating the selectivity of "Pyrazone", which was applied before sowing of beet and *Chenopodium album* seed. Tissue culture studies revealed the toxic effects of the herbicide, which prevented growth as represented by fresh and dry mass. However, while there was marked detrimental effect on ribonuclease activity, the ribonucleic acid content was unaffected. It is considered therefore that "Pyrazone" does not act selectively and that the effects mentioned are not attributable to toxicity. It is also thought impossible to draw a direct comparison between tissue culture and whole plants.

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The effect on sugar beet of applying TCA pre-drilling followed by various pre-emergence herbicides after sowing. W. E. BRAY and J. G. HILTON. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 149–160.—While trials during 1970–73 showed that drilling sugar beet soon after applying TCA and using a pre-emergence herbicide at the recommended rate after sowing may produce marked detrimental effects on the beet seedlings, it was equally found that no consistent reductions in yield resulted from the early effects. However, it is recommended to leave an interval of 10 days between TCA application and drilling, or reduce seed spacing to a maximum of 7·5 cm in order to ensure that the final beet population is not affected by reduced emergence.

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Herbicides as plant growth regulators. D. L. GERWITZ. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 163–171.—A brief survey is presented of the literature on the possible use of herbicides to regulate beet growth. While a number of effects on beet physiology have been noted, the phytotoxic nature of herbicides tends to preclude their use as ripeners.

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Growth regulators and weed control—a model. E. F. SULLIVAN. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 173–180.—Reference is made to the use of combinations of pre- and post-emergence residual and semi-residual herbicides and herbistats (which prevent seed formation) to maintain beet fields completely free of weeds, permitting sowing to final stand and complete elimination of soil cultivation. The growth-regulating effects of certain named herbicides are briefly discussed.

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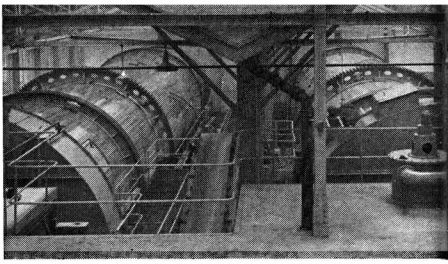
Herbicide tests in sugar beet agriculture, with particular regard to the question of effects of the combination of seed treatment with insecticide and spraying with herbicide. F. KOCH. *Proc. 3rd Int. Meeting on Selective Weed Control in Beet Crops*, 1975, 201–207.—Results of trials in which pelleted seed was treated with "Carbofuran" showed that herbicide application to the field soil before sowing and before and after emergence did not adversely affect emergence and plant performance, although it is emphasized that these results must be confirmed by results for other soils and climatic conditions than those involved in the tests.

Beet sugar manufacture



A condensate scheme for boiler feed with two-stage evaporation. T. I. LATUSHKO and A. V. TOLSTOI. *Sakhar. Prom.*, 1974, (12), 40–41.—The double-evaporation condensate scheme for regulating boiler feed water alkalinity is described and its advantages mentioned (reduction in steam consumption for de-aeration and in heat losses with continuous blow-off as well as removal of the need for chemical treatment).

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Research on the possibility of descaling multi-pass heat exchangers in the sugar industry by means of rubber balls. D. BABEV, G. KIMENOV and L. BOZHKOV. *Nauch. Tr. Vissh. Inst. Khran. Vkusova Prom.* (Plovdiv), 1969, **16,** (2), 213–318; through *S.I.A.*, 1974, **36,** Abs. 74-1674.—Rubber balls 28–30 mm in diameter, of s.g. 1·03, suspended in diffusion juice, were pumped through the vertical tubes (32 mm in diameter) of a multi-pass shell-and-tube heater at a juice velocity of 31 cm.sec^{-1} (Re = 9000) or 1·02 m.sec^{-1} (Re = 29700). At 31 m.sec^{-1}, dead zones were observed, but at 1·02 m.sec^{-1} the motion was uniform and turbulent, achieving descaling of up to half the surface area of the tubes.

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Storage of low-purity thick juice in factory conditions. L. BOZHKOV, D. BABEV and KH. MICHEV. *Nauch. Tr. Vissh. Inst. Khran. Vkusova Prom.* (Plovdiv), 1972, **19,** (3), 73–79; through *S.I.A.*, 1974, **36,** Abs. 74-1589. Twenty tons of thick juice of about 89 purity was treated with NaOH and HCHO, and stored under paraffin for 44–60 days; quality parameters at approx. 10-day intervals are tabulated. Sugar losses were lower than those during the corresponding storage of fresh beet, the stored juice was of superior quality to that of factory thick juice at the end of the campaign and the existing 2-massecuite scheme was operated without difficulty. The sugar produced was better than that being produced at the end of the campaign, but its ash content and colour exceeded the standard values. It is therefore suggested that if thick juice storage is practised, additional decolorization be used and the boiling scheme modified.

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Theory and practice of fully-automatic boiling with the rheometric system. H. THIELE and A. LUISE. *Ind. Sacc. Ital.*, 1974, **67,** 103–110.—The Pfeifer & Langen fully-automatic boiling system based on use of a rheometer is explained and results obtained during the 1972/73 campaign with three such systems are briefly discussed. (See also THIELE & LANGEN: *I.S.J.*, 1974, **76,** 136–140, 169–172.)

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Post-harvest storage of sugar beets. D. ANALOGIDES. *Hellenic Sugar Ind. Quarterly Bull.*, 1974, (19), 187–199.—Beet storage practices in European countries are described and average daily sugar and weight losses indicated. It is pointed out that because of high air temperatures (losses increase considerably at air temperatures above 20°C), beet storage during the period from August (or before) to October is not practical in Mediterranean countries.

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Effects of thermophilic activity in diffusion on sugar beet processing. J. F. T. OLDFIELD, J. V. DUTTON and M. SHORE. *Sucr. Belge*, 1974, **93,** 495–505.—See *I.S.J.*, 1974, **76,** 260–263, 301–305.

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Influence of certain non-sugars on length of filter cycle in standard liquor filtration. M. AUTH and G. SISLER. *Zeitsch. Zuckerind.*, 1974, **99,** 651–653.—The effects of suspended matter in standard liquor on filtration are discussed. There are two groups: (i) the high molecular weight material such as polysaccharide gums, colloidal suspensions of proteinaceous matter and other constituents exhibiting surface activity, and gels; and (ii) particulate matter, especially precipitated calcium salts of ions such as oxalate, citrate, malate and carbonate; in normal processing, these constitute the bulk of the load in standard liquor filtration, the largest amount of suspended matter originating from thin juice evaporation. Means of establishing the nature, source and amount of specific substances which may affect filtration are briefly reviewed, and details given of a filtration test and of methods for recovering polysaccharides from filter cake and for dextran determination using a modification of the NICHOLSON & HORSLEY "haze" method.

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Tender documents to be prepared on the results of a feasibility study and technical data for plant specifications in the sugar industry. R. HULPIAU. *Paper presented at meeting on selection of equipment for the sugar processing industry* (UNIDO, Vienna), 1974, 66 pp.—The author sets out the programme for studying the feasibility of and setting up of a beet sugar factory and the necessary beet-growing area for its raw material supply. The paper is divided into three main sections: (i) feasibility studies covering both agricultural and factory processing aspects as well as the financial side of the operations; (ii) the various factors involved in submission of tenders for a beet sugar scheme, including the items to be covered, units and symbols used in the specifications and guidance on target figures and guarantees to demand from the bidder; and (iii) aspects of sugar technology to consider in evaluating tenders, with further advice on requirements which should be met.

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Unit operations and unit processes for beet and cane sugar production. G. AUMÜLLER. *Paper presented at meeting on selection of equipment for the sugar processing industry* (UNIDO, Vienna), 1974, 66 pp. The author considers various facets of beet and cane sugar production with the aim of indicating the best

processing means for a final sugar product which is suitable for local purposes or export. Climatic conditions and their effect on harvesting time are examined, as well as local availability of labour and particularly raw materials required for various processes. For cane sugar manufacture, the pros and cons of milling and diffusion are discussed, and three juice purification schemes compared. Boiling schemes are described for use where raw sugar is produced by defecation, where white sugar is produced by carbonatation and where refined sugar is manufactured by remelt sulphitation. For beet sugar manufacture, continuous diffusion combined with Braunschweig carbonatation are examined. Boiling schemes for white and for refined sugar production are described. The other processes involved in both beet and cane sugar manufacture are also examined.

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Review of security and sanitary measures to be taken in a sugar factory. L. NESVADBA. *Paper presented at meeting on selection of equipment for the sugar processing industry* (UNIDO, Vienna), 1974, 29 pp. Safety requirements in a sugar factory, from the standpoint of machinery protection, behaviour of operators, and management responsibilities, are discussed.

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New sugar factory in Poland. ANON. *Die Lebensmittelind.*, 1974, **21**, 536.—A brief report is given on Lapy sugar factory, with particular mention of waste water treatment and the forced ventilation scheme for beet based on a 15-day storage period.

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***Pollution and demineralization ion exchange resins:* a new process. I. Explanation of the process and experimental results.** P. DEVILLERS, J. C. GIORGI and R. GONTIER. *Sucr. Franç.*, 1974, **115**, 487–496.—Demineralization by ion exchange has the advantage of reducing molasses yield, but also results in extra waste in the form of organic matter adsorbed by the resin; a factory having a daily slice of 300 metric tons of beet and treating virtually all of its molasses would, it is stated, produce an extra 30 tons of organic matter per day, equivalent to 25 tons of COD. A new process, which is described, aims at solving this problem by passing eluate from the anion exchange column through the cation exchange column which is then eluted to remove the organic impurities before acid regeneration of the resin. The cations in the regenerated anion exchanger eluate (Na^+ or NH_4^+) replace the amino-acids and other organic matter in the cation exchange resin; the eluate from the cation exchange resin (so-called "regeneration eluate") is concentrated to 50–70°Bx and may be added to pulp for use as animal fodder because of its high N content. Results of laboratory experiments have indicated a daily COD of 25–70 kg for a 3000-ton factory. Concentration to a Brix of up to 70° was not accompanied by crystallization; the concentrated product was liquid when hot and somewhat viscous when cold. If it was allowed to stand, a slow sedimentation took place at 50°Bx, but the sediment could be re-dissolved under heat with agitation. The regeneration eluate was not heat-sensitive, and storage for 15 days at ambient temperature was not accompanied by development of thermophiles at a Brix greater than 50°, while mesophilic infection was slight. Use of ammonia alone for regeneration of the anion exchanger necessitated use of stainless steel for the eluate evaporator because of the high corrosion properties; use of NaOH alone gave an eluate pH of 13, while a 9:1 mixture of NaOH and NH_4OH gave a pH of 9·5–10.

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The effect of calcium salts on the value of the isoelectric point of $CaCO_3$ and $Ca_3(PO_4)_2$ muds. L. D. BOBROVNIK, V. Z. SEMENENKO and YU. V. ANIKEEV. *Izv. Vuzov, Pishch. Tekh.*, 1974, (5), 42–44.—Investigations on calcium carbonate and phosphate have shown that increase in their content in 2nd carbonatation mud causes the isoelectric point to shift to the weakly alkaline zone, so that the optimum pH of 2nd carbonatation juice falls with decrease in the natural alkalinity. Phosphate increases the adsorptive capacity of calcium carbonate, so that addition of sodium phosphate to 1st carbonatation juice has the advantage of increasing the optimum pH as well as adsorption efficiency, as demonstrated by tabulated data.

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The effect of certain factors on the oxidative-reducing system of 2nd carbonatation juice. D. M. LEIBOVICH, V. A. KOLESNIKOV, D. K. POPOVA and T. S. KHARCHENKO. *Izv. Vuzov, Pishch. Tekh.*, 1974, (5), 65–67. The emf of the oxidative-reducing system in sugar factory products (Eh) is given by 0·0295 (rH_2-2pH), where rH_2 is the logarithm of the reciprocal of molecular hydrogen concentration. Studies of the effect of the oxidative-reducing system in 2nd carbonatation juice on its colour involved measurement of Eh at 25°C and photocolorimetric determination of optical density D. Both Eh and rH_2 were found to change with time as a result of addition of H_2O_2, the value of Eh initially rising and then remaining almost constant, while rH_2 fell initially and then became constant. The pH fell from 9·0 to 7·15. On the other hand, with addition of H_2SO_3, rH_2 and D achieved stability well before Eh, but the pH fell by only 0·1 unit. It is thus indicated that a fall in pH causes a fall in the values of rH_2 and D.

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Equation for calculation of the diffusion coefficient in sugar extraction from beet. O. V. STRATIENKO, A. A. LIPETS, V. M. LYSYANSKII, V. A. SHVACHICH and N. F. SEREDA. *Izv. Vuzov, Pishch. Tekh.*, 1974, (5), 98–101.—A semi-empirical equation is derived for calculation of the diffusion coefficient *D*. It takes the form $D = \frac{R^2 t^{2\cdot9}}{\tau^{0\cdot54}} 1{\cdot}89 \times 10^{-8}$ m².sec^{-1}, where R = cossette length (m), t = temperature (°C) and τ = process time (sec). The equation is valid for temperatures in the range 65–75°C, time in the range 540–2700 sec and a cossette length of $1{\cdot}61$–$1{\cdot}91 \times 10^{-3}$ m.

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A hydrodynamic calculation method for vacuum pans. V. T. GARYAZHA, YU. G. ARTYUKHOV and V. I. PAVELKO. *Izv. Vuzov, Pishch. Tekh.*, 1974, (5), 108–111.—The hydrodynamics and heat transfer processes in massecuite boiling have been studied in an experimental unit at Brix values in the range 58–92°, 0–54% crystal content, crystal sizes of 0·5–5 mm, massecuite flow rates of 0·01–3 m.sec^{-1}, air flow rates of 0·35–53 m.sec^{-1}, pressures of 20–99·5 kg.m^{-2} and heat flows of 4·5–70 kW.m^{-2}. From the studies, equations have been derived for calculation of the various parameters.

Purification of sugar juices. E. HAVLOVÁ, A. COUFALOVÁ and D. ROZSÍVALOVÁ. *Listy Cukr.*, 1974, **90,** 275–277.—Investigations showed a linear relationship between lime dose and purification efficiency of liming, but since amounts greater than 2% CaO had a very much reduced effect, it is recommended to add 2% at a raw juice purity of 86. Addition of lime to 1st carbonatation juice at up to 0·40% reduced lime salts, colour and ash content, and was particularly effective with turbid juice.

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The process computer and its application in the juice purification field. J. DOBER. *Zucker*, 1975, **28,** 8–19. Results obtained at Tulln sugar factory (Austria) with a system including a Siemens 4004/135 central computer unit and a 304 process computer are reported in detail. Juice level and flow control in the Braunschweig 65 carbonatation system and control of the filter-thickeners and rotary filters are described with the aid of diagrams and charts. Advantages and disadvantages of the scheme are discussed.

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Comparison of juice deliming methods. H. ZAORSKA. *Gaz. Cukr.*, 1974, **82,** 313–318.—Comparison was made between deliming by (1) carbonatation, (2) soda and carbonatation, (3) cation exchange resin in Na^+ form, (4) ammonia and soda, and (5) as (4) but followed by decolorization with granular active carbon. In terms of juice lime content, purity and colour and molasses sugar content, method (5) proved the most effective method.

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Beet storage. G. D. JARDINE. *Upbeet*, 1974, **62,** (3), 13–14.—Illustrated descriptions are given of various forms of beet pile ventilated canopies employed at different beet sugar factories in the USA. Particular attention is focused on an experimental plastic "bubble" structure which is supported by air pressure and stabilized by plastic-coated steel cable. Photographs show beet pilers operating beneath the "tent" roof which spanned 17,000 tons of beet. The Great Western Sugar Co. has commenced a programme of installing ventilated canopies for use where a storage period of more than 100 days is envisaged.

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Sugar beet pile losses—causes and corrections. W. R. AKESON. *Upbeet*, 1974, **62,** (3), 15.—Of a number of factors affecting losses in stored beet, the most important is considered to be temperature, but other factors mentioned include pile size, trash accumulation and speed of piling (excessive speeds will reduce the natural cooling rate, and the author indicates that artificial cooling is not economically feasible). Differences occur between beet varieties as regards respiration rate and accumulation of invert sugar and raffinose. Herbicides and pesticides have been found not to have a detrimental effect on storage, while an experimental growth regulator which has shown promise in increasing sugar yield per acre has also been found to reduce sugar losses in stored beet.

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Effect of raffinose content on low-grade work. L. WIENINGER. *Zeitsch. Zuckerind.*, 1975, **100,** 12–16. Analysis of molasses from Austrian sugar factories in 1969–73 showed that problems in low-grade work were associated with the raffinose content which, however, did not affect molasses viscosity or, hence, the crystallization rate. On the other hand, raffinose distorts the polarimeter reading and causes a considerable difference between apparent sucrose solubility and the true solubility. Thus, basing low-grade massecuite crystallization on the apparent purity without correcting for the raffinose content will give a lower cooling rate than is calculated. It is therefore recommended to make frequent determinations of the raffinose content of molasses, particularly in view of the marked change in the content throughout the campaign.

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Energy saving in sugar factories. An improved evaporation crystallization system. D. HOKS. *Zeitsch. Zuckerind.*, 1975, **100,** 23–29.—Details are given of a proposed system in which thick juice from the evaporator is further concentrated to saturation in a continuous concentrator when it is fed via a spherical storage tank to a batch-type stirred vacuum pan. The concentrator thus takes over part of the evaporation process in conventional boiling. Maintenance of atmospheric pressure in the storage tank prevents the juice boiling, so that there is no further increase in concentration and formation of fines is avoided. The article indicates the savings in steam and power (for turbine operation) possible with the process, and demonstrates the increase in capacity of a batch pan which the process permits.

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Application of gas turbines in sugar factories. U. HANTSCH. *Zeitsch. Zuckerind.*, 1975, **100,** 31–33. The advantages of installing a gas turbine for power production in a beet sugar factory are discussed and calculations of output and costs given for a factory slicing 4500 tons of beet per day. The most suitable position for a gas turbine is shown to be before a pulp dryer, since its waste gas can be fed to the dryer, while conversion and installation costs are lower than for any other location.

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Juice softening with regeneration of cation exchange resin with syrup. YA. O. KRAVETS, A. A. IVANYUK and G. V. BUZOVETSKAYA. *Sakhar. Prom.*, 1975, (1), 11–14.—Tests are reported which had as aim the selection of the most suitable Soviet cation exchange resins for use in the Hungarian patented system, whereby 2nd carbonatation juice is passed through a cation exchange resin and Mg and Ca exchanged for K and Na, after which the resin is regenerated with syrup made up from the delimed juice so that the Mg and Ca adsorbed by the resin are replaced by the K and Na in the syrup.

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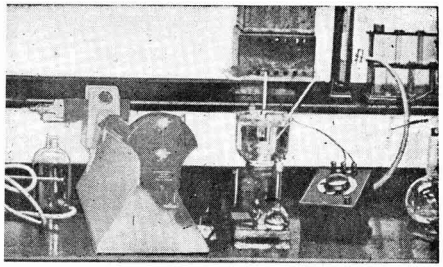
Intensification of massecuite boiling in vacuum pans. V. T. GARYAZHA, YU. G. ARTYUKHOV, V. I. PAVELKO, V. R. KULINCHENKO and V. A. PODLESNYI. *Sakhar. Prom.*, 1975, (1), 14–17.—For purposes of increasing massecuite circulation in a vacuum pan, a device was built which comprises a series of perforated branch pipes beneath the calandria and acting as extensions of the calandria tubes. Through the perforations, directed upwards with their vertical axis no more than 30° from the perpendicular, steam was forced up into the normal boiling tubes. (The steam was fed into the system via a lateral port located some distance below the normal vapour feed port.) Results for 2nd and 3rd massecuites indicated a 25–30% reduction in boiling time and a 1–2 unit purity drop in the mother-liquor compared with conventional boiling.



Laboratory methods & Chemical reports

Problems in the sugar laboratory. II. J. P. STUPIELLO and E. R. DE OLIVEIRA. *Brasil Açuc.*, 1974, **84,** 360–365.—Molasses pol was measured by a number of methods and compared with true sucrose determined on the same samples. The method described by MEADE[1] gave the nearest figures to the true sucrose.

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The optical density of concentrated sugar solutions. N. V. ORLOVA and M. I. DAISHEV. *Izv. Vuzov, Pishch. Tekh.*, 1974, (5), 157–158.—The specific optical density has been determined for pure sugar solutions of 64·5–69·4°Bx at wavelengths in the range 320–560 nm and a temperature of 28–29°C. Tabulated values indicate a rise in the optical density with Brix; but at Brix values below 68·2 (saturation point) this increase was not associated with any change in the physico-chemical conditions, while above 68·2°Bx the increase, much more pronounced, was caused by changes in the physico-chemical state.

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Albumins in the various component parts of the beet root. G. P. VOLOSHANENKO, S. S. MIROSHNICHENKO, N. I. NASTALENKO and S. N. KEISER. *Pishch. Prom.*, 1974, **18,** 13–16.—Albumin extract and raw juice obtained from the beet crown, root and tail by 60 minutes' diffusion at 70–72°C were subjected to electrophoresis on a column of polyacrylamide gel, using a triglycine buffering solution. The albumin extract electrophoregrams yielded 12 albumin fractions, while the raw juices yielded only 2–3 fractions. The relative electrophoretic mobility was calculated for each fraction, and the values tabulated. Subsequent gel filtration on "Sephadex 50-G" was used to determine the albumin content in each fraction, and the optical density then measured at 610 nm. For each, the curve was characterized by two peaks, the first corresponding to high-molecular substances containing albumins, and the second corresponding to low-molecular substances (sucrose, peptides, amino-acids and colorants). It is concluded that formation of the high-molecular albumins proceeds from the beet tail upwards.

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The volumetric specific heat of sugar solutions and massecuites. D. E. SINAT-RADCHENKO and V. D. POPOV. *Pishch. Prom.*, 1974, **18,** 83–85.—A nomogram is presented for determination of volumetric specific heats of pure sugar solutions, crystal sugar and massecuites at temperatures in the range 0–140°C, Brix of 0–90° and massecuite crystal content of up to 70%. The effect of purity on specific heat was also examined.

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The enthalpy of sugar solutions and massecuites. D. E. SINAT-RADCHENKO and V. D. POPOV. *Pishch. Prom.*, 1974, **18,** 85–87.—A nomogram is presented for establishing the enthalpy of pure and factory sugar solutions, crystal sugar and massecuites in the temperature range 0–140°C, Brix of 0–90°, purity of 40–100 and massecuite crystal content of up to 75%.

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A method for determining raw sugar sucrose content. A. YA. ZAGORUL'KO, R. TS. MISHCHUK and E. S. BOIKO. *Sakhar. Prom.*, 1975, (1), 49–52.—Details are given of a method for raw sugar sucrose determination which involves initial treatment with resin in Cl^- form to remove colorants followed by reducing sugars determination by the MÜLLER method and fructose by iodometric determination. The sucrose content is determined by direct polarization and allowance made for the distorting effects of the reducing sugars by means of a formula which is presented.

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Measurements of sugar granulometry in massecuites. L. LENARD and B. DUFRENNE. *Sucr. Belge*, 1975, **94,** 3–8.—A method is described for rapid determination of the grain size distribution of wet sugar, in which the 100 g sample is washed with a little sugar-saturated methyl alcohol, drained, then placed on the top sieve of an automatic multi-screen sifter of the Fritsch type which is fitted for dispersion, recovery and recycling of the methyl alcohol. After 2–3 hours' screening, the sieves are drained, dried, cooled and weighed. If the sugar purity is below 95, the sample must be affined after mingling with pure sugar syrup and saturated at ambient temperature. The validity of the method has been tested with high- and low-purity massecuites.

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Atomic absorption analysis of heavy metals in factory water and granulated sugar. R. B. LEW. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17,** 144–153.—Details are given of methods developed for determination of (i) arsenic, (ii) mercury and (iii) cadmium, chromium, copper, iron, lead, manganese and zinc in beet sugar factory water and granulated sugar. The method for arsenic determination involves wet oxidation and conversion of the trivalent arsenic to arsine which is introduced into an argon-hydrogen air flame for atomic absorption analysis; the method for mercury consists of wet oxidation, reduction of ionic mercury to its atomic state and subsequent flameless atomic absorption analysis; the constituents under (iii) are determined by evaporating the water or ashing the sugar before atomic absorption. Detection limits and recovery of various metals added to water and sugar are tabulated.

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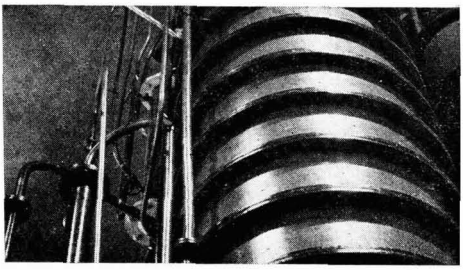
Occlusion of non-sucrose matter during sucrose crystallization. F. SCHNEIDER, A. EMMERICH and O. C. AKYAR. *Zucker*, 1975, **28,** 113–121.—See *I.S.J.*, 1974, **76,** 153.

[1] "Cane sugar handbook" (Wiley, New York) 1963. pp. 557–558.

By-products



Sugar cane as a basis for intensive meat production in the tropics. O. ARGUDÍN and O. ALMAZÁN. *Cuba-Azúcar*, 1974, (Oct./Dec.), 59–74.—Within the context of the protein deficiency in tropical countries, the authors examine the importance of sugar cane by-products as animal fodder whereby meat production and hence protein intake can be increased.

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Fermentative production of cycloheximide by *Streptomyces griseus* and *Streptomyces noursei*. A. A. ABOU-ZEID and S. H. EL-SHERBINI. *J. Appl. Chem. Biotechnol.*, 1974, **24**, 283–291; through *S.I.A.*, 1974, **36**, Abs. 74-1608.—The effects of carbon source (Egyptian cane molasses, glucose, sucrose or starch) and nitrogen source (e.g. peptone, soya bean meal or casein) on the yields of the antibiotic cycloheximide were investigated. Molasses was favoured as the carbon source; the use of 12·5 and 25 g.litre^{-1} for *S. griseus* and *S. noursei* respectively is recommended. Good results were also obtained by using 12·5 g sucrose per litre for the former organism and 80 g glucose per litre for the latter.

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Protein levels and methionine supplementation of sugar diets for broilers. R. GUTIÉRREZ. *Cuban J. Agric. Sci.*, 1974, **8**, 225–230.—The effects of protein and methionine proportions in rations containing at least 44% sugar (on dry matter) were investigated with regard to the live weight gain of broiler chickens. Results indicated an optimum protein level of about 19% of the dry matter content; supplementation with 0·1% methionine is also recommended.

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Protein levels and urea supplementation in semi-liquid molasses-based diets for ducks. R. GUTIÉRREZ. *Cuban J. Agric. Sci.*, 1974, **8**, 231–236.—The live weight gain and feed conversion were better in ducklings fed on molasses-based rations when the protein level was 16 or 18% than when it was 12 or 14%, the 18% level giving a higher carcass yield than the other levels while providing the same amount of edible meat and meat:bone ratio as did the 16% level. The presence of urea tended to improve the results only with the low protein levels.

* * *

A note on the use of high-test molasses for fattening geese. M. VALDIVIÉ and R. PÉREZ. *Cuban J. Agric. Sci.*, 1974, **8**, 237–240.—Dry matter intake, live weight gain and feed conversion did not differ in 6-week-old geese between rations containing high-test molasses and maise as energy sources up to an age of 10 weeks, but thereafter maize gave better results than molasses.

* * *

A note on some chemical characteristics of *in vitro* manure/molasses silage. C. HARDY and A. ELÍAS. *Cuban. J. Agric. Sci.*, 1974, **8**, 285–289.—The chemical properties of a silage mixture composed of cattle manure, final molasses, ground sorghum hay and urea were determined by analysis up to 35 days after storage in laboratory glass silos at room temperature. The pH increased from 6·4 to 7·6 within 1 day and thereafter slowly fell to 4·8. After 8 days there was marked formation of volatile fatty acids and destruction of any lactic acid which had accumulated during the first 4 days. Insoluble N as a percentage of total N increased almost ten-fold during the first 8 days, while soluble N fell to almost half its initial value in the same time. Further studies on a wider basis are recommended for determining the possibility of using the product as animal fodder.

* * *

Effects of dried molasses as carbohydrate feeds on the performance of growing-finishing swine. N. L. TAI, Y. S. SHIH and K. TZENG. *Taiwan Sugar*, 1974, **21**, 181.—Results of tests showed that the highest average daily weight gain in growing-finishing pigs was obtained with a basal diet compared with diets containing 10% or 30% molasses in dried or liquid form. However, the results achieved with the diet containing 10% dried molasses were the next best and were only slightly below those obtained with the basal diet: moreover, the feed costs per kg of weight gain were lower for the molasses diet than for the basal diet. Lowest feed costs per kg of weight gain were obtained with a diet containing 10% liquid molasses, which gave the third best weight gain results. Increase in the molasses proportion was accompanied by a fall in growth rate and feed efficiency, so that the 20% molasses diets were not recommended.

* * *

Effect of sterilization during heat treatment of molasses. V. N. SHVETS, T. P. SLYUSARENKO and E. I. KNOGOTKOVA. *Pishch. Prom.*, 1974, **19**, 21–25.—The effect of molasses sterilization on its chemical and microbiological properties in fermentation processes was examined and found to depend largely on the dry solids content, whereby a fall in concentration resulted in a reduction in the impurities content in the ethanol. It is recommended to sterilize a 50% molasses mash at 120–130°C for 1 minute.

* * *

Influence of the method of storage on the properties of bagasse fibre boards. I. E. BATLLE, N. RODRÍGUEZ and J. SUÁREZ. *Revista Icidca*, 1974, **8**, (3), 9–15. Bagasse was stored in bales over a period of 12 months and changes in its chemical composition and morphology determined. The alpha-cellulose and holocellulose content increased during the first 7 months, followed by a slight decrease. The number of fines increased and the average fibre length as well as the average fibre length:diameter ratio decreased. The particle uniformity was also greater at the beginning than after storage, all of which factors reduce board quality.

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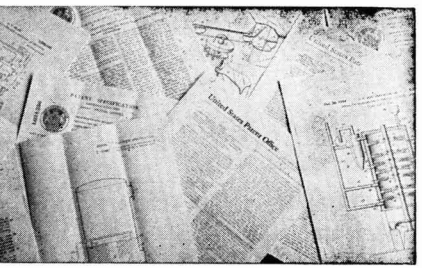


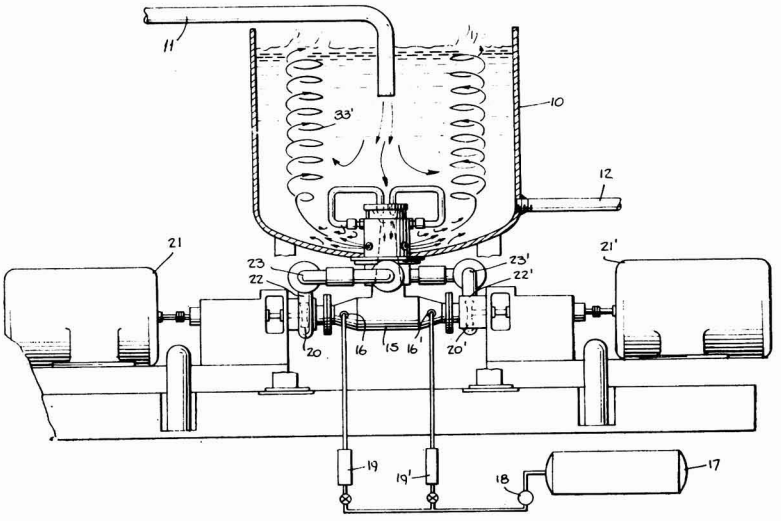
Patents

UNITED STATES

High energy mixing device. D. W. HEGE, of Woodland Hills, Calif., USA, assr. HEGE ADVANCED SYSTEMS CORP. **3,762,689.** 5th January 1972; 2nd October 1973.

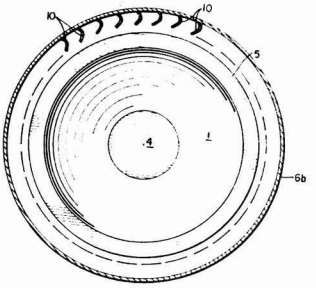
Mixing of clarifying materials, e.g. lime and phosphoric acid, with sugar syrup is achieved by the mixing device which includes a tank 10 having a feed pipe 11 and an outlet pipe 12. The contents of the tank are withdrawn through a venturi in a housing at the bottom of the tank and so into chamber 15 from which they are directed by centrifugal pumps 20, 20′ driven by motors 21, 21′ into return pipes 23, 23′. Air from compressed air tank 17 is supplied through regulators 18, 19, 19′ into injectors 16, 16′ and enters the liquid stream.

The pipes 23, 23′ feed into the housing which surrounds the venturi at the bottom of tank 10 and discharges from this through radial ports, the lower ones feeding into the base of the tank while the upper



ports supply the recirculation pipes which deliver the aerated mixture back into the top of the venturi. The ratio between the amount of liquid dispersed and that recirculated may be varied by altering the size of the ports.

Centrifugal. J. HALDER L., of Alajuela, Costa Rica. **3,791,577.** 8th August 1972; 12th February 1974. Surrounding a deflector plate 5 mounted at the top of the conical basket 1 of a continuous centrifugal is an annular assembly supported and driven from above by a variable-speed unit. The assembly includes a vertical plate 6b to the inside of which are affixed a series of curved baffles 10. The axis of each



curve is vertical and parallel to the axis of the centrifugal, and the outer convex surface of the baffle faces the direction of rotation of the basket 1 and of the annular assembly, the speed of the latter being such as to provide the smoothest possible discharge.

Massecuite fed to the basket is separated into molasses which passes through the screen and crystals which are discharged over the deflector plate. They traverse the short distance between the plate 5 and the assembly, moving at a small angle almost parallel with the inner surfaces of the baffles and so around the interior of the curve until their speed is reduced to the extent that they fall down into a hopper inside the casing of the machine. The gradual reduction of the crystal speed eliminates impact with the curb and so reduces crystal damage.

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch Block C, Station Square House, St. Mary Cray, Orpington, Kent, England (price 25p each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C., 20231 USA (price 50 cents each).

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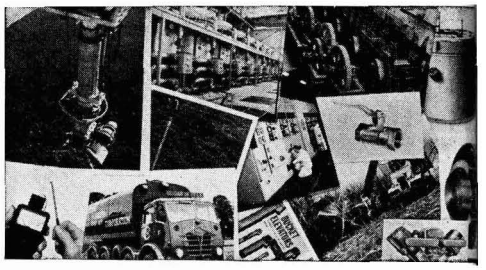

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

PUBLICATIONS RECEIVED

BEET PULP PRESSES. Stord Bartz Industri A/S, PO Box 777, Bergen, Norway.

The latest available issue of "Stord Bartz Review" includes a résumé of the company's history; a survey of the 1974 market in beet pulp presses (90 Stord Bartz presses were supplied to 44 sugar factories in 12 different countries); an article explaining how it is possible to reduce the heat consumption and fuel costs of pulp drying by installing a Stord press to give 22–24% dry solids at a throughput corresponding to 900–1000 tons of beet per day; and information on a new press, a prototype of which was installed for the 1973/74 campaign in a sugar factory of Süddeutsche Zucker-AG to handle 1500–1600 tons of beet per day.

* * *

AGRICULTURAL CHEMICALS FROM UNION CARBIDE. Union Carbide Corp., Agricultural Products and Services, PO Box 1906, Salinas, Calif., 93901 USA.

"Sevin" carbaryl insecticide, effective against a wide range of insect pests on many crops, including sugar beet and cane, is featured in a 39-page booklet from Union Carbide. A 63-page publication from the same company gives detailed information on "Temik" ("Aldicarb"), which has proved highly successful against nematodes in both beet and cane fields, while it effectively controls practically all serious beet pests in addition to nematodes.

* * *

"DUOLITE" ION EXCHANGE RESINS IN THE TREATMENT OF SUGAR SOLUTIONS. Diamond Shamrock Chemical Co., 1901 Spring St., Redwood City, Calif., 94063 USA.

A publication bearing the above title briefly explains the principles of ion exchange processes followed by ten chapters dealing with various aspects of ion exchange as used for beet and cane juice and syrup treatment as well as in sugar refining; a short chapter covers by-products recovery from regenerant wastes and from juices, while starch hydrolysate treatment is also explained. The economics of sugar recovery by ion exchange are similarly discussed.

* * *

HODAG PRODUCTS FOR THE SUGAR INDUSTRY. Hodag Chemical Corporation, 7247 North Central Park Ave., Skokie, Ill., 60076 USA.

Leaflets from Hodag describe the advantages obtained by using "CB-6" massecuite additive in pan boiling, and give brief details of other Hodag chemicals, including "Vap-99" (a surface-active additive for evaporator scale reduction), "HCA-21" chelating and dispersing agent for scale inhibition in alcohol stills, evaporators and heat exchangers, "Flocs 411" and "Flocs 433" polyacrylamide-type products for use as coagulants and flocculants in clarification, "Rapisol" surface-active additive for increasing the penetration and cleaning powers of caustic solutions used in evaporator cleaning, "PH-2" descaler for use in evaporators, pans and heat exchangers, "FLO-1" molasses additive used to increase fluidity and reduce stickiness and foaming, "Sanitrol" bactericide used to reduce inversion losses in milling and help towards mill sanitation, BX-series anti-foam agents for use in beet sugar manufacture, and "MG-89" anti-foam agent for use with agricultural sprays.

ILLINOIS WATER TREATMENT COMPANY. Illinois Water Treatment Co., Rockford, Ill., USA.

A 9-page booklet reviews the work done by IWT, a subsidiary of Sunbeam Corporation, in the field of water and process liquid treatment by ion exchange (including beet juice and syrup treatment). Other liquid treatment systems offered by IWT are also included, such as carbon adsorption and reverse osmosis. Major customers of IWT equipment listed include Holly Sugar Corp. and Utah-Idaho Sugar Co.

* * *

"MINI BULK". Pertwee Landforce Ltd., Industrial Division, Harbour House, Hythe Quay, Colchester, Essex, CO2 8JF England.

"Mini Bulk" is a materials handling system devised by the producers of a beet fertilizer "Magnatrox" to permit easy movement of dry, free-flowing materials. The patented "Mini Bulk" bag is a very strong woven polypropylene bag with polyethylene liner for use with hygroscopic materials; it has a capacity of about 1 metric ton, according to material being carried, and during filling is suspended from the arms of a fork-lift truck. The filled bag can be stacked and is emptied by untying a chute at the bottom of the bag. No pallets are required for storage purposes. Bags are available in three sizes: 26, 42 and 49 ft^3.

* * *

pH INSTRUMENTATION. Great Lakes Instruments Inc., 7552 North Teutonia Avenue, Milwaukee, Wisconsin, 53209 USA.

Bulletin 740 gives information on the GLI Model 60 pH analyser and Model 70 conductivity analyser (also available for pH measurement) and describes the new type of pH probe GLI introduced in 1970 on which the analysers are based. This probe acts on the principle of differential pH measurement and is very robust and extremely reliable. The system embodies pH electrode, standard electrode (pH electrode plus chemical pH standard and intermediate solution to protect the pH standard from the process solution) and differential electronics which permit output signals of sufficient strength to be transmitted through 3000 feet of cable without any degradation. Temperature compensation is provided by a precision thermistor.

* * *

BMA INFORMATION. Braunschweigische Maschinenbauanstalt, 33 Braunschweig, Germany.

Issue No. 13 of "BMA Information" contains a number of articles concerning BMA sugar factory equipment and processes, including latest developments in the BMA tower diffuser (the 250th of which was installed at Schladen for the 1974/75 campaign while the largest, of 7·9 m diameter, is located at Vierverlaten in Holland); hydraulic drives and their application, particularly in tower diffusers; thin juice softening by the BMA-Zsigmond-Gryllus ion exchange process; Curico sugar factory in Chile of 3000 tons/day slicing capacity, completed by BMA in 1974; BMA filters and their application; the plant at Béja (Tunisia) for production of baker's yeast from beet molasses; and various items mentioned in brief. The publication, of 31 pages, is well illustrated with black-and-white and colour photographs.

* * *

SUGAR CANE DIFFUSION. Extraction De Smet S.A., 265 Prins Boudewijnlaan, B-2520 Edegem-Antwerp, Belgium.

The latest brochure from Extraction De Smet gives full details of the company's well-known TS bagasse diffuser and TN cane diffuser (into which the TS can easily be converted) as well as their controls and auxiliary equipment. Both models are available for throughputs of 2000–9000 metric tons per day. Photographs and diagrams clearly describe the method of operation, which is basically the same for both models.

Dominican Republic sugar exports 1974[1]

	Short tons, tel quel
Algeria	15,353
Canada	17,527
Chile	16,976
Egypt	8,818
France	37,754
Iran	10,914
Japan	23,198
Morocco	103,644
New Zealand	12,936
Portugal	12,096
Sweden	25,368
Tunisia	13,426
UK	36,230
USA	794,759
	1,128,999

India sugar exports[2]

	1974	1973	1972
	(metric tons, raw value)		
Bangladesh	0	20,475	0
Egypt	12,529	0	0
Indonesia	80,458	50,617	0
Iran	141,598	22,401	0
Jordan	25,058	0	0
Kuwait	0	8,672	0
Malaysia	0	3,801	0
Maldives	1,519	0	0
Morocco	24,407	0	0
Southern Yemen	38,621	0	0
Sri Lanka	22,572	0	0
Sudan	71,422	0	0
UK	26,781	26,847	26,851
USA	78,794	75,892	77,667
Yemen	12,529	0	0
	536,288	208,705	104,518

Giant cane mill order for Queensland[3].—A Goninan & Co. Ltd., a subsidiary of Howard Smith Ltd., has received orders for two cane milling units for Pioneer Sugar Co. The mills will be three-roller units of 1·25 mm × 2·50 m roller size (approx. 48 × 96 in), and will have two-roller pressure feeders with rollers of the same size. The order includes the design, manufacture and supply of the mills together with 1500 h.p. steam turbines.

* * *

Czechoslovakia sugar factories for Iran[4].—Reconstruction and extension of the Shahabad sugar factory is under way while in March 1977 the Desful factory, with a daily slicing capacity of 5000 tons of beet, is to be commissioned. In September 1977 two cane sugar factories supplied by Technoexport Praha are to be put into operation with a third by June 1978. The three cane sugar factories will have a total crushing capacity of 20,000 t.c.d. and the contract is one of the largest ever signed in the history of Czechoslovak sugar engineering.

* * *

Kenya sugar refinery order for France[5].—Fives-Cail Babcock have announced the award of a Kenya Government order worth 145 million francs (about £15·5m) for the construction of a sugar refinery.

* * *

Broadbent centrifugals for Indonesia.—Thomas Broadbent & Sons Ltd., in the face of international competition from Germany, France, Sweden and Japan, have won a £1m. order for sugar centrifugals and associated equipment. The order was placed by the Republic of Indonesia which is undertaking a major re-equipment of three high grade sugar centrifugal stations at Sragi in Central Java and Pesantren and Gempolkrep, both in Eastern Java. Broadbent have exported sugar centrifugals to 55 countries, the majority being in cane-growing areas.

Brevities

New Philippines sugar factory[6].—A new $52 million sugar factory is to be supplied by Fives-Cail Babcock for the East Negros Milling Co. Inc. and will be erected at Ayungon, Negros Oriental. It will have a capacity of 6000 t.c.d. and is to be operational by 1977. Financing is by the Banque de Paris et des Pays-Bas.

* * *

Clarke Chapman boiler plant for El Salvador.—The International Combustion Division of Clarke Chapman Ltd. has been awarded a £700,000 contract for the supply of two 2-drum water-tube boilers for Central Jiboa, a sugar factory in El Salvador, Central America. The order, placed by the main contractors for the project, Fletcher and Stewart Ltd., Derby, calls for two natural circulation boilers designed for firing bagasse on a dump grate spreader stoker. Oil firing equipment also supplied will be capable of producing 100% evaporation. Ancillary equipment to be supplied under the contract will include the bagasse carrier, individual chimneys, full instrumentation and automatic boiler controls as well as oil pumping and heating plant, oil service tanks and deaerator and pressure reducing plant. The boilers will be suitable for continuous, 24 hours-a-day, operation between November and May each year under tropical conditions. The contract follows the awarding of a £1·4 million contract for the supply of similar boiler plant to a sugar factory in the Sudan. Clarke Chapman has become a major supplier of boiler equipment to the international sugar industry and is increasing the export proportion of its diverse engineering business with world-wide orders for cranes, power plant, pumps and advanced welding systems.

* * *

HSPA Experiment Station.—The HSPA Library, with some 86,000 volumes, was the first part of the Experiment Station facilities to move to the new building[7] which is adjacent to the California & Hawaiian Sugar Refinery at Aiea. The total move of all offices and laboratories will be completed by the end of the year, but from 1st December 1975 the new address will be 99–193 Aiea Heights Drive, Aiea, Hawaii, 96701 USA, with a mailing address of P.O. Box 1057, Aiea, Hawaii, 96701 USA. The new address will also apply to the HSPA, Hawaiian Development Company and the Hawaiian Sugar Technologists.

* * *

Sugar Technologists' Association of India Jubilee.—The Golden Jubilee Congress of the S.T.A.I. is to be celebrated during October 1975 at the National Sugar Institute in Kanpur where the Association was founded 50 years ago and where it still functions in close association with the Institute. Leading technologists of the Indian sugar industry will be presenting papers at the Congress as well several overseas visitors. The Congress will include an exhibition depicting the Indian sugar industry, with participation by various research institutes, machinery manufacturers and suppliers, while a post-Congress tour to places of historical interest has been arranged. The Sugar Technologists' Association of India is to be congratulated on having reached this milestone in its history and service to the country's sugar industry.

* * *

Morocco sugar production, 1974[8].—In the 1974 campaign 1,987,997 tons of beets were harvested and yielded a total sugar production of 264,830 tons, which included 66,996 tons of white sugar and 197,834 tons of raw sugar. The 1974 crop covered about 58% of domestic requirements.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1975, (1234), 95.
[2] *I.S.O. Stat. Bull.*, 1975, **34**, (5), 56.
[3] *Amerop Noticias*, 1975, (19), 12.
[4] *Czechoslovak Heavy Ind.*, 1975, (8), 23.
[5] *The Times*, 12th August 1975.
[6] *Sugar News* (Philippines), 1975, **51**, 128.
[7] *I.S.J.*, 1974, **76**, 319.
[8] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (22), 16.

Brevities

New Greek sugar factory[1].—It has been announced that the new sugar factory[2] is to be erected on the border of the Trikala and Karditsa Nomes, in Western Thessaly which is in northern Greece. The factory will have a capacity of 6000–10,000 tons, and construction was to start in July.

* * *

El Salvador sugar exports 1974[3].—Sugar exports last year totalled 146,162 metric tons as against 78,823 tons in 1973. Japan (63,225 tons) and the USA (62,116 tons) accounted for the bulk of this, other destinations being Algeria (2599 tons), Egypt (9372 tons), Finland (3142 tons), Morocco (2754 tons) and Venezuela (2954 tons).

* * *

Laos sugar project[4].—The Laotian Government has said it will allow a Japanese private company to set up a sugar factory with a maximum output of 30,000 metric tons. The company, Lao-Japan Development, proposed sharing one-third of the factory's production during the first few years of a trial period and, after recovery of the investments and a 5–10 year period of free profits, it would be handed over to the Government.

* * *

Indian factory premature closures[5].—Out of 74 sugar factories in Uttar Pradesh 45 have already closed down and 13 others are expected to close shortly owing to the shortage of finance for purchasing sugar cane. The State Government has approached the Reserve Bank of India for finance to the extent of Rs 250 million to help alleviate the situation.

* * *

Greek sugar imports, 1974[6].—Imports of sugar by Greece in 1974 fell to 49,585 metric tons, white value, as against 60,731 tons in 1973 and 82,087 tons in 1972. The principal supplier was the UK (25,022 tons) while other sources included Holland (14,256 tons), France (4045 tons), Belgium (2552 tons), Brazil (1428 tons), Denmark (1390 tons), West Germany (732 tons), Austria (100 tons) and Spain (60 tons).

* * *

Jamaica sugar exports 1974[7].—Sugar exports from Jamaica totalled 278,364 metric tons, raw value, in 1974 as against 271,474 tons in the previous year. In 1973 all exports were to the UK; last year these fell to 157,285 tons while 89,182 tons went to the USA, 21,714 tons went to Canada and 10,183 tons to China.

* * *

Mexico-Cuba sugar cooperation[8].—The joint Mexican-Cuban Committee for Cooperation in the sugar industry held its first meeting in Havana in mid-May. The talks covered the building of a sugar factory, the site of which has not yet been decided. Mexico and Cuba signed a technical and scientific cooperation agreement in April to improve sugar industry planning and facilities.

* * *

Greek sugar research institute[9].—According to reports from Greece, the Board of Directors of Hellenic Sugar Industry S.A. have decided to set up an Institute for sugar beets and sugar; its object will be the creation of new varieties of beet which will be appropriate to the soil and climatic conditions of the country, control of diseases and the improvement of production. The Institute will study sugar technology and the best use of the factories' by-products as well as production costs and the competition from other crops, etc.

* * *

Zambia sugar expansion[10].—At the Nakambala sugar estate, Mazabuka, a four-year expansion programme costing 42 million Kwacha (£62·5 million) is now in hand to increase the production of raw sugar. A second sugar refinery has commenced production and plans have been announced to double the production of industrial alcohol. The Zambia Sugar Co. Ltd. is also planning to construct a factory at Nakambala to produce animal fodder from refinery by-products.

Cuban sugar statistics[11]

	1974	1973	1972
	—— *metric tons, raw value* ——		
Initial stocks	261,845	339,201	460,630
Production	4,687,802	5,382,548	5,925,850
	4,949,647	5,721,749	6,386,480
Consumption	470,890	463,742	522,162
Exports—Albania	12,850	13,855	15,108
Algeria	7,182	5,974	25,417
Belgium/Luxbg.	0	0	1,086
Bulgaria	190,144	212,634	154,257
Canada	115,669	46,681	31,125
Chile	0	129,609	172,129
China	358,670	302,030	295,176
Czechoslovakia	160,484	163,018	151,132
Egypt	0	5,172	21,342
Finland	82,702	26,399	16,005
Germany, East	276,003	259,488	243,028
Germany, West	0	0	525
Holland	0	11	551
Honduras	0	11,157	0
Hong Kong	0	0	7,965
Hungary	51,369	52,422	38,069
Iran	0	0	51,845
Iraq	65,162	0	55,528
Japan	1,151,981	984,558	909,381
Kenya	0	37,739	27,278
Korea, North	55,305	135,576	119,233
Lebanon	10,920	9,322	0
Malaysia	64,222	29,223	87,691
Malta	0	0	2,108
Mongolia	2,702	2,670	10,739
Morocco	40,793	61,757	55,204
New Zealand	38,736	13,282	0
Panama	0	1,150	0
Poland	28,278	55,124	22,247
Portugal	51,502	0	0
Rumania	77,953	78,174	72,583
Senegal	0	0	5,117
Sierra Leone	0	0	1,087
Singapore	0	14,280	0
Southern Yemen	0	0	10,539
Spain	363,127	103,522	97,702
Sudan	0	0	24,835
Sweden	50,818	56,308	64,561
Switzerland	2,806	2,282	550
Syria	41,311	106,754	101,147
Turkey	11,925	0	0
UK	70,951	121,880	28,848
USSR	1,974,761	1,660,681	1,097,406
Venezuela	0	5,193	0
Vietnam, North	78,018	75,910	75,633
Yugoslavia	50,371	11,804	43,478
Other countries†	4,532	1,738	1,901
(*Total*)	(*5,491,247*)	(*4,797,377*)	(*4,139,556*)
Final stocks	373,071	460,630	339,201

* Calculated
† Donations of sugar

USSR sugar industry expansion[12].—The production capacity of the Soviet sugar industry has been expanded by 77,000 tons of beet per day during the current five-year plan; two-thirds of this have been by enlargement of existing factories and by organizational-technical measures, while the remainder has involved establishment of nine new sugar factories of which four are in the RSFSR, two in the Ukraine and one each in Lithuania, Kirgizia and Kazakhstan. Capital investment amounting to 257 million roubles are provided for in the current year during which processing capacity is to be raised by 29,000 tons/day, of which 21,770 tons/day will be in the Ukraine.

[1] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (19), 6.
[2] *I.S.J.*, 1975, **77**, 230.
[3] *I.S.O. Stat. Bull.*, 1975, **34**, (6), 37.
[4] *Reuter's Sugar Rpt.*, 6th June 1975.
[5] *Standard and Chartered Review*, July 1975, 20.
[6] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (20), vi–vii.
[7] *I.S.O. Stat. Bull.*, 1975, **34**, (6), 60.
[8] *Public Ledger*, 24th May 1975.
[9] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (15), 8.
[10] *Standard & Chartered Review*, June 1975, 9.
[11] *I.S.O. Stat. Bull.*, 1975, **34**, (6), 32–33.
[12] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (16), 10.

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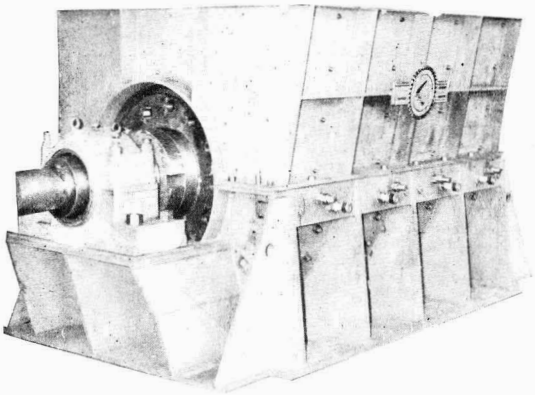

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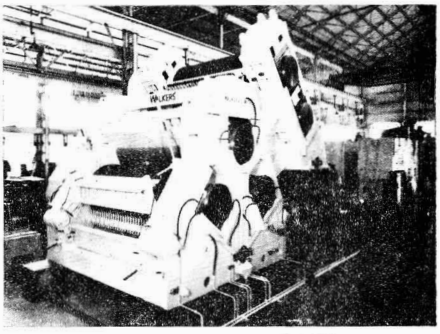

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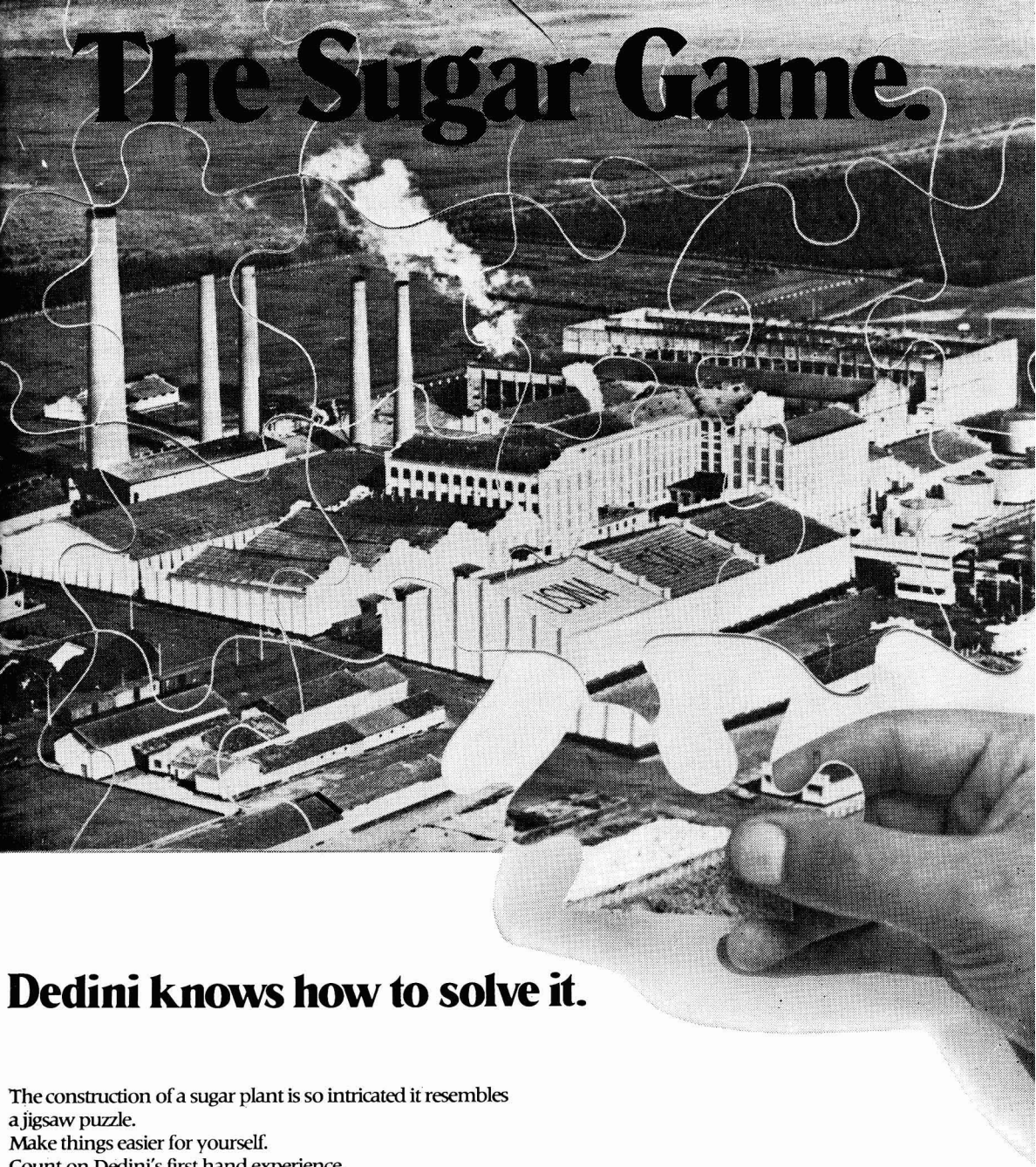

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