THE International Sugar Journal

MAY 1975

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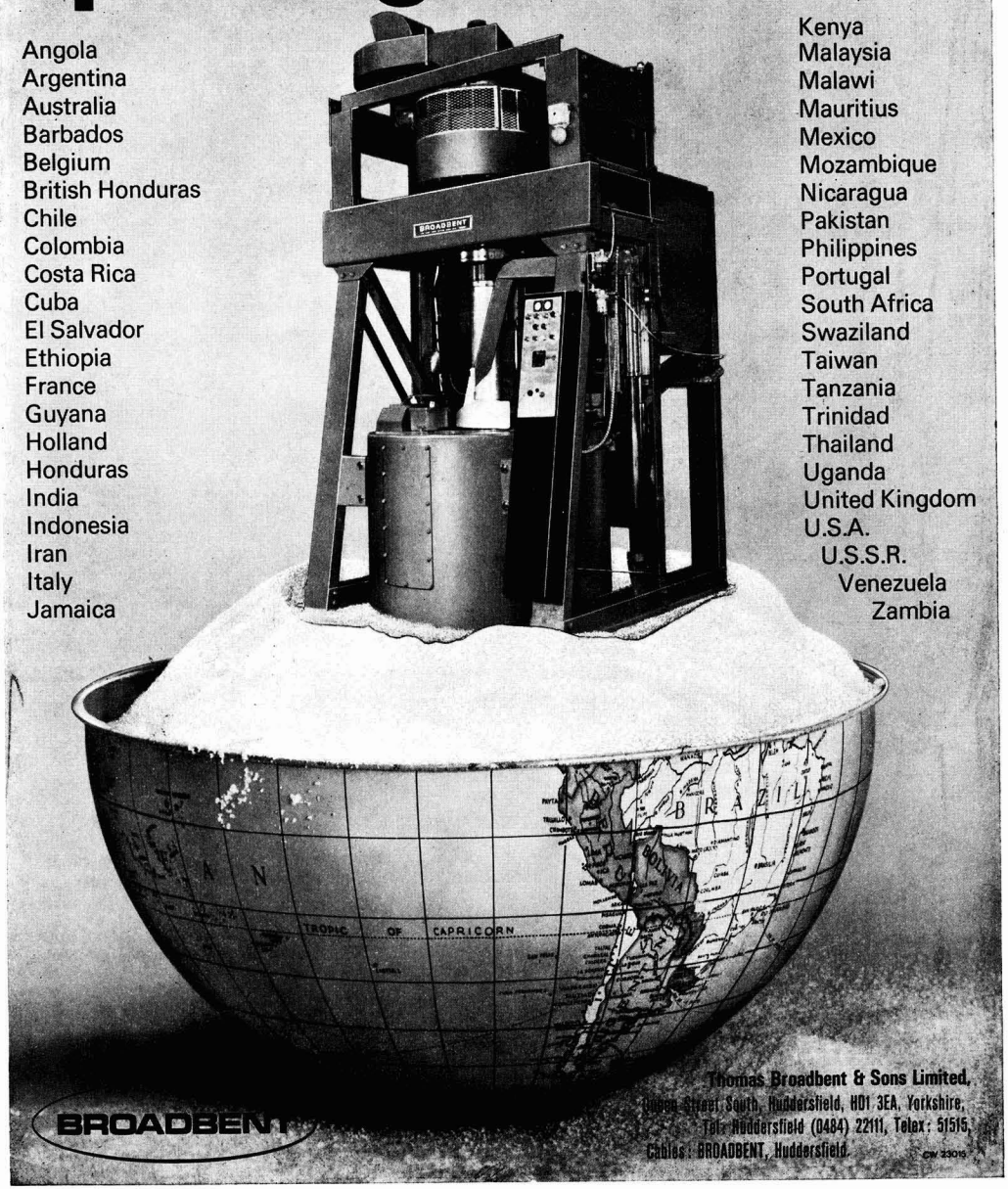

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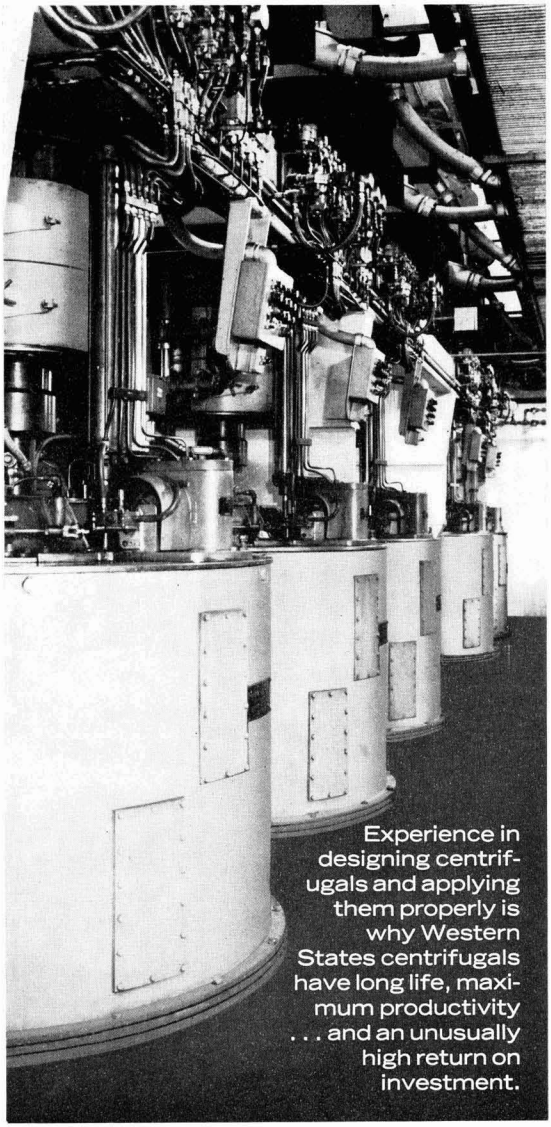

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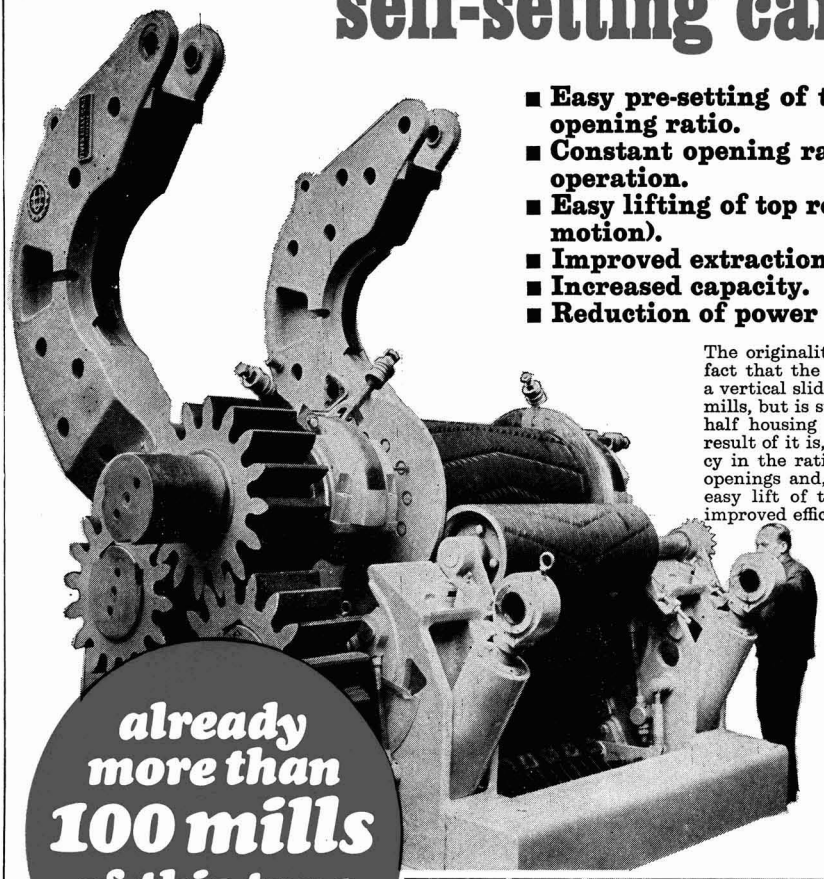

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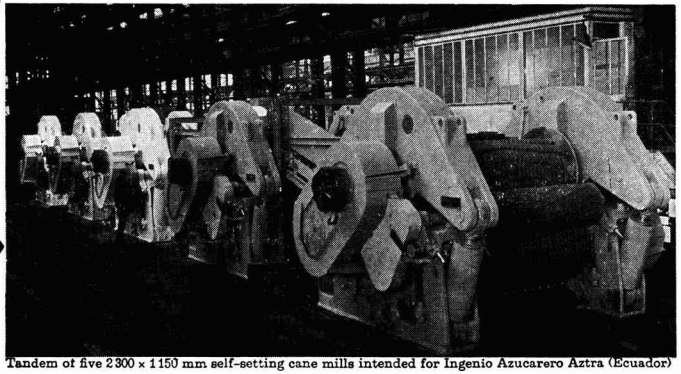

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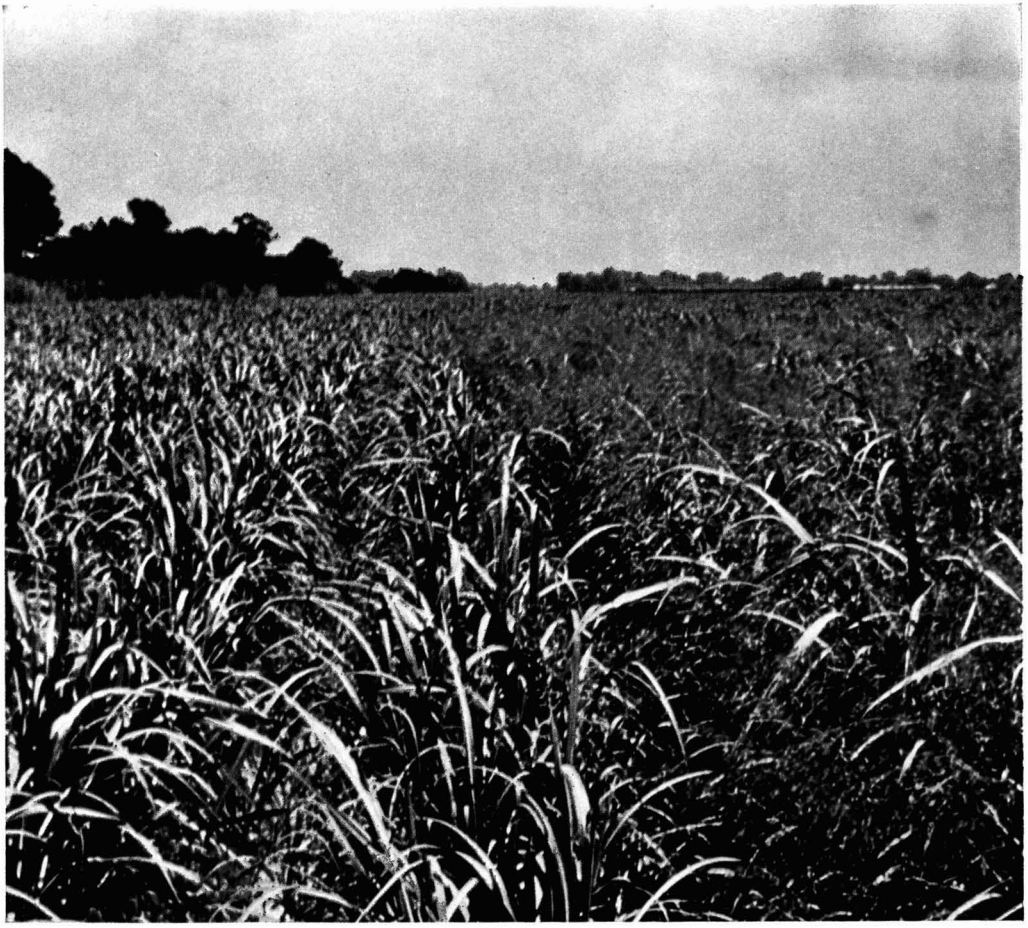

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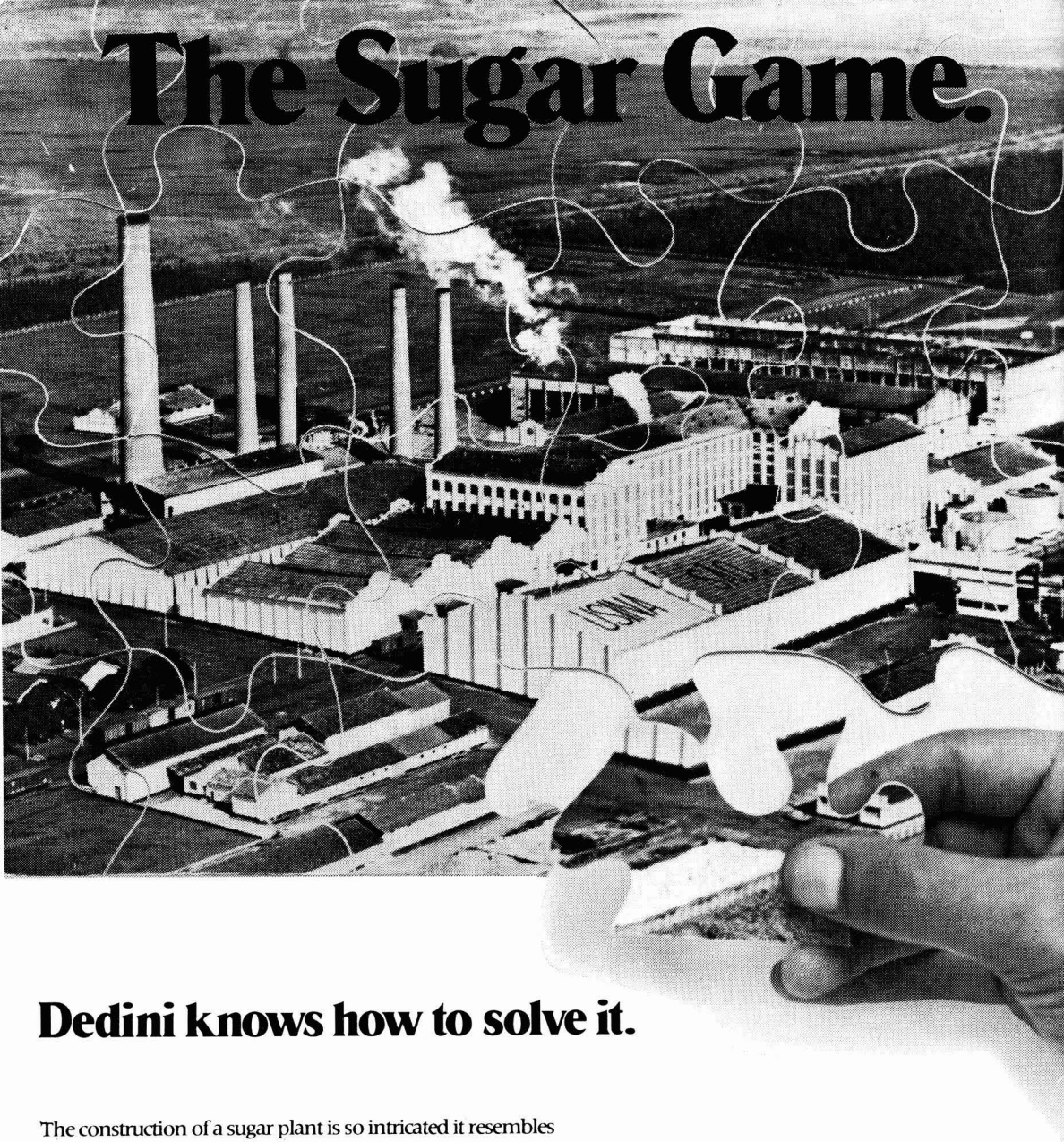

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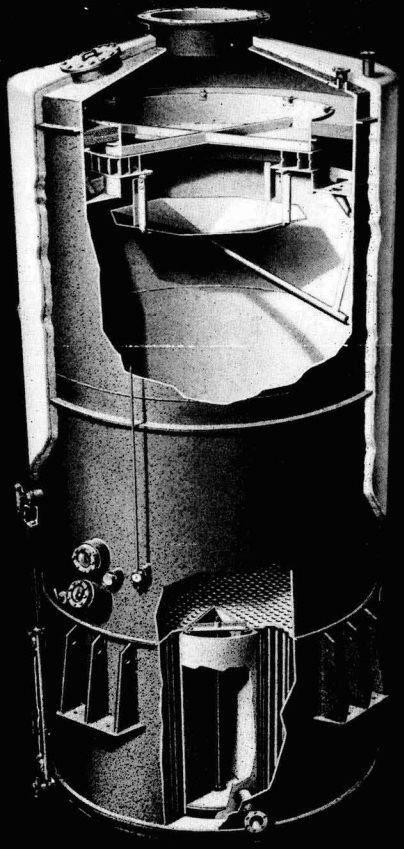

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May 1975

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Influence de la basse température sur les critères de qualité de jus de la canne à sucre. G. SINGH et S. SINGH *p.* 131–132

On a refroidi à —3,3°C neuf variétés de canne pendant 10 heures. Ces échantillons sont passés au moulin 12 jours plus tard. Pour chacun des cas on a mesuré l'importance de la perte en sucre dans les jus recueillis, le pH, l'augmentation d'acidité, la teneur en gomme et les sucres réducteurs. Les résultats sont groupés en tableaux.

* * *

Extraction du sucre par diffusion dans des conditions non stationnaires. G. V. GENIE. *p.* 133–138

Les lois fondamentales de la diffusion linéaire sont examinées pour des états non stationnaires et une méthode différente est proposée pour le calcul de l'extraction du sucre des cossettes de betterave. Au lieu de considérer la diminution de la concentration dans les cossettes pendant un intervalle de temps, le flux instantané de sucre au travers d'un plan de référence, lequel peut coïncider ou non avec la limite entre les cossettes et le jus d'extraction, est integré pendant le même intervalle de temps. En dépit des apparences, cette méthode est beaucoup plus simple et plus souple que la méthode habituelle. Un exemple est donné en admettant que la cossette est entourée par une mince couche de jus immobile au delà de laquelle existe une convection infinie.

* * *

Colloque International du Sucre. ANON. *p.* 138–139

On donne les comptes rendus du Colloque International du Sucre qui s'est déroulé à Londres les 4 et 5 mars. Ce colloque avait comme thème: la situation mondiale du sucre et les possibilités de production de sucre dans les pays développés et en voie de développement *pour les 10 années à venir.*

* * *

Hachoir longue-durée pour la canne. V. DUCASSE. *p.* 140–142

On donne la description d'un hachoir étudié pour la canne avant son introduction dans le moulin. L'auteur se réfère à des essais effectués à l'Ile Maurice et plus récemment à Hawaii. On discute les avantages et les inconvenients de la machine, en particulier son rotor unique qui hache la canne à l'entrée et coupe celle-ci en petits morceaux à la sortie.

Der Einfluss tiefer Temperaturen auf die Qualitätsmerkmale des Saftes im Zuckerrohr. G. SINGH und S. SINGH. *S.* 131–132

Zuckerrohrproben von neun Sorten wurden zehn Stunden lang in einem Tiefkühlfach einer Temperatur von —3,3°C ausgesetzt und in Abständen bis zwölf Tagen nach der Behandlung gemahlen. Die Saftproben wurden analysiert, um das Ausmass des Ruckganges bei Zuckergehalt und pH-Wert sowie der Zunahme an titrierbarer Azidität, Gehalt an Pflanzengummi und reduzierenden Zuckern für jede Rohrsorte zu bestimmen. Die Ergebnisse sind in Tabellenform wiedergegeben.

* * *

Zucker-Extraktion durch Diffusion unter nicht stationären Bedingungen. G. V. GENIE. *S.* 133–138

Es wird ein Ueberblick gegeben über die Gesetze für lineare Diffusion unter nicht stationären Bedingungen und eine andere Methode für die Modellberechnung der Zuckerextraktion aus Rübenschnitzeln vorgeschlagen. Anstatt die Abnahme der Konzentration in den Schnitzeln nach einem bestimmten Zeitraum zu berücksichtigen, wird der momentane Zuckerfluss durch eine Referenzebene, die der Grenze zwischen Schnitzel und Extraktionssaft entsprechen kann (oder nicht), über denselben Zeitraum integriert. Trotzdem *ist diese Methode viel einfacher und anpassungsfähiger* als die übliche. In einem Beispiel wird angenommen, dass das Schnitzel von einer dünnen Schicht unbewegten Saftes umgeben ist, ausserhalb der die Konvektion unendlich ist.

* * *

Internationales Zuckerkolloquium. ANON. *S.* 138–139

Es wird über das Internationale Zuckerkolloquium berichtet, das in London am 4. und 5. März abgehalten wurde. Thema dieses Kolloquiums waren die Lage auf dem Weltzuckermarkt sowie die Aussichten für die Zuckererzeugung in den Industrie- und den Entwicklungsländern während der nächsten zehn Jahre.

* * *

Hochleistungsmaschine zum Zerhacken und Zerfasern von Zuckerrohr. V. DUCASSE. *S.* 140–142

Der Verfasser beschreibt eine Vorrichtung zum Zerhacken und Zerfasern von Zuckerrohr, die zur Aufbereitung des Rohrs vor dem Mahlprozess entwickelt wurde. Er berichtet dabei über Versuche, die auf Mauritius und in letzter Zeit auf Hawaii durchgeführt wurden. Die Vor- und Nachteile der Maschine und der Rotor, welcher das Rohr am Eintrittsende zerhackt und gleichzeitig das zerhackte Rohr am Austrittsende zerfasert, werden besprochen. Ferner werden die Faktoren untersucht, welche die Leistung der Maschine bestimmen.

Efecto de temperaturas de congelación sobre indicadores de calidad de jugo de caña de azúcar. G. SINGH y S. SINGH. *Pág.* 131–132

Caña de neuve variedades se expuso durante 10 horas a una temperatura de —3,3°C en equipo congelador y muestras se molieron a intervalos hasta 12 días después del tratamiento. Las muestras de jugo se analizaron para determinar el extensión de la caída del contenido de sacarosa y del pH, y los aumentos en acidez titulable, contenido de goma y azúcares reductores para cada variedad. Las resultas se presentan en forma tabular.

* * *

Extracción de azucar por difusión en condiciones no-estacionarias. G. V. GENIE. *Pág.* 133–138

Los leyes fundamentales de difusión lineal se examinan para estados no-estacionarios y un nuevo método se propone para calcular el extracción de azúcar de las cosetas de remolacha. En lugar de considerar la disminución de la concentración en las cosetas durante un intervalo de tiempo, el flujo instantáneo de azúcar a través de un plano de referencia, que puede o no coincidir con el limite entre las cosetas y el jugo de extracción, es integrado durante el mismo intervalo de tiempo. A despecho de aparencias, este método es mucho más sencillo y más flexible que el método usual. Se presenta un ejemplo en que se considera que la coseta se rodea de una capa delgada de jugo inmóvil con alrededor una convección infinita.

* * *

Coloquio Internacional sobre Azúcar. ANON. *Pág.* 138–139

Se presenta un informe sobre el Coloquio Internacional sobre Azúcar en Londres el 4–5 marzo para examinar la situación mundial de azúcar y perspectivos para producción de azúcar en paises desarrollados y sub-desarrollados durante de los diez años que vienen.

* * *

Picadora-desfibradora de trabajo pesado. V. DUCASSE. *Pág.* 140–142

Se describe una picadora-desfibradora desarrollado para preparar caña antes de molienda. El autor refiere a experimentos en Mauricio y, más recientemente, en Hawai. Los ventajes y desvantajes de la máquina se discuten; su solo rotor pica la caña en el lado de alimentación y desfibra la caña partida al lado de descarga. Se examinan los factores gobernando su cumplimiento.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXVII MAY 1975 No. 917

Notes & Comments

International Sugar Agreement

The Executive Committee met during the last week of February for consideration of administrative affairs. The working groups established by the consultative sub-committee met also, however, and have examined two documents prepared by the I.S.O. Secretariat on prices and a buffer working stock.

Preliminary talks on the framework of a new Agreement took place and will be resumed early in May[1]. Informed sources said that discussions went no deeper than a general exchange of initial reactions to the contents of the documents, one of which dealt with the possibility of incorporating a buffer stock into a new agreement while the other examined the methodology of calculating daily and prevailing prices.

Dr. A. VITON, Head of the Sugar Division of F.A.O., discussed the form of a new Agreement during a speech to the New York Sugar Club on the 26th February[2]. He strongly advocated an international agreement and stressed that, "to be effective the agreement would have to be fundamentally different from the previous ones. Quotas and prices must be realistic and forward-looking instead of backward-looking.

"There should be no paper quotas; quotas should be given to countries able and willing to expand production and exports. To negotiate a realistic price range which would stimulate investment in production expansion would certainly not be easy; but there is enough information on production costs in efficient producing countries to make possible meaningful negotiation among men of good will.

"Since the international price is only part of the structure of national sugar economies, it is imperative that the agreement contain provisions for reviewing prices in producing countries."

Dr. VITON said it was unreasonable and wrong in the past to have domestic prices in exporting countries subsidize exports; it is equally unreasonable and self-defeating to do the reverse.

"An international agreement is necessary for attracting investment in production expansion because the nature of the world sugar economy has changed fundamentally and it can no longer be relied on to bring forth automatically the necessary expansion by the normal operation of free market supply and demand forces.

"The cost expansion has become too great for adventurous entrepreneurs; national economies are too tied up by regulations inspired by different national purposes; private capital is no longer encouraged to move freely across frontiers; in many countries demand growth is stimulated more than production expansion."

In many important and efficient exporting countries, he said, exportable supplies will surely decline during the next 10 years unless very large amounts of new capital are invested in sugar production.

An agreement with effective provisions to assure supplies at reasonable and relatively stable prices may not be acceptable to all of the major exporting and importing countries. And Dr. VITON is prepared to believe that a few would stay out. But he is convinced that enough would join to make an agreement effective among the participants.

"Better an effective agreement among a limited number of reliable trading partners than chasing after a will-o'-the-wisp of universality which results in anaemia and paralysis."

Dr. VITON found it disconcerting that the United States is not contributing to amelioration of the world shortage by expanding production. The United States is not one of the cheapest producers; but neither is it one of the most expensive, and certainly not one of the least efficient.

* * *

Caribbean sugar unrest

The five sugar factories in Trinidad were closed from the 11th March owing to labour unrest in the industry. Industry leaders have warned that sugar exports could be endangered if the strike continued since stocks started to dwindle rapidly. The country's largest producer, Caroni Ltd., now state-owned, estimates that the strike, over wage claims, profit-sharing and related issues, is losing the company 12,000 tons of sugar a day[3] but that production should not be resumed before the trade union involved gives security that production will not be interrupted during the crop[4].

The strike is part of a surge of unrest throughout the Caribbean sugar belt as workers press for a larger share of booming financial returns. Guyana, biggest of the Caribbean common market sugar producers, is crippled by strikes involving an estimated 16,000 workers in cane fields and sugar factories.

[1] *Public Ledger*, 1st March 1975.
[2] *The Times*, 3rd March 1975.
[3] *Public Ledger*, 22nd March 1975.
[4] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (9), **10.**

Europe beet area, 1975

F. O. Licht K.G. have recently published[1] their first estimates of the area to be sown to beet in Europe for the 1974/76 crop. The actual figures are likely to be slightly lower, since the figures are for contracted areas rather than actual sowings, since these have not yet taken place, but the overall total is nevertheless set at 554,000 hectares greater than for 1974/75, with 313,000 ha more in Western Europe and 241,000 ha more in Eastern Europe. The estimates are reproduced below:

	1975	1974
	hectares	
Belgium	110,000	105,000
Denmark	80,000	67,300
France	550,000	504,000
Germany, West	410,000	374,289
Holland	125,000	115,640
Ireland	30,200	25,600
Italy	225,000	185,000
UK	202,000	182,432
Total EEC	1,732,200	1,559,261
Austria	55,000	53,666
Finland	25,000	22,319
Greece	40,000	27,100
Spain	200,000	127,918
Sweden	52,600	46,524
Switzerland	12,000	10,528
Turkey	205,500	187,000
Yugoslavia	128,500	101,000
Total Western Europe	2,450,800	2,135,316
Albania	6,000	6,000
Bulgaria	62,700	58,000
Czechoslovakia	202,000	189,000
Germany, East	250,000	230,000
Hungary	125,000	98,338
Poland	520,000	440,000
Rumania	275,000	250,000
USSR	3,650,000	3,579,000
Total Eastern Europe	5,090,700	4,850,338
Total Europe	7,541,500	6,985,654

* * *

UK refined sugar prices

A price equalization scheme was introduced in the UK in November 1974 because of the wide differential in price between that of refined sugar produced from imported raw sugar bought at £260 per ton and that of home-produced white beet sugar. Originally set at £190, the equalized price was set at £285 in early January and the UK Government recently announced that it intends that the equalized price will move during the second half of 1975 so that it remains competitive with other sugars available in quantity to the UK market at lower prices which may arise from a normal 1975/76 beet crop. If as a result it becomes necessary, the Government will implement the guarantee in respect of ACP sugar shipped in 1975 by means of subsidy payments to the refiners.

* * *

EEC sugar requirements

Early in March it was being claimed that EEC sugar requirements in the six months to end-September were about 500,000 metric tons, of which 400,000 tons were needed by Italy[2]. This amount was the difference between likely consumption and domestic production as well as imports from the ACP countries under the Lomé agreement. The shortfall in UK supplies was set at about 80,000 tons and that of Holland at 23,000 tons. The EEC Executive Commission authorized subsidies on imports of 250,000 tons and a series of tenders were held over the following month. All bids were rejected at the first, but subsequently imports of all but 24,000 tons of the total amount were secured[3]. Estimates of requirements by the Commission were then reduced by 100,000 tons and preparations made for a new series of tenders to secure the balance.

* * *

US sugar supplies

The demise of the US Sugar Act has permitted Canadian refiners to ship to the US market for the first time in many years, and, since their purchases are at prices pegged to the fluctuations of the London Daily Price whereas US refiners buy their supplies at straight or outright prices which can lack flexibility at times of market fluctuations, the Canadians are able to take advantage of price differentials which arise in their favour. As a consequence, Canadian sugar has been selling recently in the north-eastern US at a delivered price of $36 per 100 pounds compared with the $42.40 of US refiners[4]. One refiner estimates that 50,000 tons of Canadian refined sugar could be sold in the US in 1975.

The US Department of Agriculture has reported[5] that farmers intend to increase their beet sowings by 23·6% to 1,549,900 acres, against 1,254,000 acres in 1974 and 1,219,900 acres in 1973. Mr. SAXON TATE, Chairman of Tate & Lyle Ltd., in a speech made before the Sugar Club in New York, noted however that, without the price protection afforded by the Act, the trend over the next few years would be for a reduction in sugar beet production in the US if any price weakness occurs[6].

* * *

Japan sugar refiners' difficulties[7]

Imports of raw sugar by Japan during 1974 totalled 2,782,801 metric tons, an increase of 410,784 tons on the 1973 level. It is generally believed, however, that refined sales in January were down by 50–60% on the same month in normal years. The average cost of raw sugar during the period April–September 1975 is anticipated to be above £350 per ton and refiners are consequently pressing for permission to raise the current ceiling price of 253 yen per kilogram (equivalent to £265 per ton of raw sugar) to a realistic level.

A Japanese trade house was of the opinion that the ceiling price would be raised from April but feared that this will not alleviate the difficult situation for the following reasons: (1) Consumption has declined sharply even at current levels and a further price increase will enounter strong consumer resistance; (2) a further decrease in consumption will result in increased stocks, which will cause financial problems; (3) refiners will then have to resell or export more sugar, which might depress the world market. If the world market falls considerably, the cost-conscious industrial users will import refined sugar at depressed levels.

---

[1] *International Sugar Rpt.*, 1975, **107**, (7), 1.
[2] *The Times*, 11th March 1975.
[3] *Public Ledger*, 29th March 1975.
[4] *ibid.*, 22nd March 1975.
[5] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (10), 7.
[6] *Public Ledger*, 15th March 1975.
[7] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (5), ix.

Effect of freeze temperature on quality indicators of juice in sugar cane

By GURBAKSH SINGH and SANGAT SINGH

(Punjab Agricultural University, Ludhiana, India)

Introduction

LOW temperature effects on sugar cane have been reported by many workers[1–6] but their studies were related to the screening of sugar cane varieties for frost tolerance from the bud viability and tissue damage aspects. Other workers[7–9] studied the freeze effects on juice quality. In northern India the incidence of frost and continued low temperatures during winter months are not uncommon. In this region sugar cane is planted in the months of February–March and is harvested after 10–12 months so the crop has to face the low temperatures during its ripening period in the field. Moreover, the harvesting is extended over 2–3 months and the cane cannot be milled immediately after harvest. It was, therefore, considered worthwhile to screen the sugar cane varieties grown in the Punjab for frost tolerance from the point of view of factors affecting juice quality so that the deterioration of cane after harvest may be reduced by adjusting the time of harvest of different varieties.

Material and methods

Nine varieties of sugar cane (CoJ 58, CoJ 64, CoJ 65, Co 312, Co 975, Co 1148, Co 1158 and Co 62399) were planted on 24th March 1972 in a randomized block design with four replications in the Botanical area of Punjab Agricultural University, Ludhiana. The crop was raised under optimum conditions of irrigation and fertilization. Insecticides were sprayed according to schedule. The stalks were cut at ground level and topped at the last formed internode. Each sample contained twelve stalks. Samples were exposed to low temperature (—3·3°C) in a deep-freeze for 10 hours. These samples were analysed for quality indicators after 0, 2, 7 and 12 days. The samples were milled at the appropriate time. After thorough mixing, sub-samples of juice were taken for laboratory analysis by standard methods: sucrose by polarimetry following clarification with lead sub-acetate, juice pH with a pH meter and juice acidity by titration. For juice acidity, the volume of 0·1N NaOH required to raise the pH of 50 ml of juice to 8·3 was determined but data are given on a 10 ml of juice basis. The gum (soluble polysaccharides) content was determined colorimetrically by the method of ROBERTS & FRILOUX[10] and reducing sugars (%) in the filtered juice were determined by titrating with Fehling's solution.

Results and discussion

Pol: Data given in Table I show that there was minor decrease in pol content two days after low temperature treatment but 7 and 12 days after freeze treatment a significant decrease in pol content occurred in all the varieties except Co 1148 which did not show any decrease. The greatest decrease in pol content was observed in the juice of Co 312 12 days after freeze treatment. Thus it can be concluded that, as a result of the low-temperature treatment, there was a reduction in juice pol in all the varieties except Co 1148 which maintained the same level. This is in agreement with the rating of Co 1148 as a frost-resistant variety by GILL & SINGH[6] on the basis of leaf desiccation and bud viability. On the other hand, Co 312 showed frost susceptibility for the above two characters according to GILL & SINGH[6] and this variety also showed the most significant deterioration in juice as a result of the low temperature treatment.

Titratable acidity: From perusal of data given in Table I it is clear that titratable acidity increased significantly during the post-freeze period and this increase was correlated with the increase in the period following the freeze treatment. The increase in titratable acidity was less in CoJ 46, CoJ 64 and Co 1148 than in the other variables whilst the juice of Co 312 showed the highest increase in titratable acidity 12 days after the freeze treatment. Those varieties showing higher increases in titratable acidity following freeze treatment are more susceptible to frost damage than the other varieties.

Gum content (soluble polysaccharides): The data show that varieties differed in their gum content initially. Maximum increase in gum content of juice occurred in Co 312 followed by Co 62399 12 days after the freeze treatment. The smallest increase in juice gum content was recorded with CoJ 65 followed by Co 1148 at the same interval after the freeze treatment. There was a significant increase in the gum content as the post-freeze period increased. IRVINE[8] and IRVINE & FRILOUX[9] also reported an increase in soluble polysaccharides after severe freezing.

pH: It is revealed from the data given in Table I that there were no significant varietal differences in juice pH prior to freezing, but significant decreases in pH of the juice occurred following freeze treatment in each variety. The pH of juice decreased as the period between freezing and analysis increased.

Reducing sugars: The data show that there were significant increases in reducing sugars in all varieties in the post-freeze period. The increase in reducing sugars was positively correlated with the time interval

[1] BARTON: *Proc. 5th Congr. ISSCT*, 1935, through VIJAYASARADHY: *Indian J. Sugarcane Res. Dev.*, 1960, **5**, (1), 49.
[2] DUTT & VIJAYASARADHY: *Proc. 34th Session Indian Sci. Congr.* (Delhi), 1947.
[3] VIJAYASARADHY: *Indian J. Sugarcane Res. Dev.*, 1960, **5**, (1), 49.
[4] KNIPLING: *Ecology*, 1967, **48**, 1038–1041.
[5] NAIDU & BHAGYALAKSHMI: *Indian J. Plant Physiol.*, 1968, **11**, (2), 207.
[6] GILL & SINGH: *Indian Sugar*, 1972, **22**, 627–632.
[7] LAURITZEN *et al.*: *U.S. Dept. Agric. Tech. Bull*, 1949, (991), 35pp.
[8] IRVINE: *Sugar Bull.*, 1963, **42**, 54–58; 1964, **42**, 317–320; *Proc. 12th Congr. ISSCT*, 1965, 569–574; *Sugar J.*, 1968, **30**, (8), 23–25: *Crop Sci.*, 1968, **60**, 637–638; *Proc. 13th Congr., ISSCT*, 837–839; *Proc. 14th Congr. ISSCT*, 1971, 1–8; *Sugar Bull.*, 1971, **50**, (Dec. 15), 9–11.
[9] IRVINE & FRILOUX: *Sugar y Azúcar*, 1965, **60**, (11), 58–59.
[10] *ibid.*, 66–67.

Table I. Quality indicator changes in sugar cane varieties following freeze temperature treatment

Varieties	*Days after freeze treatment* 0	2	7	12	*Mean*
			Juice pol %		
CoJ 46	17·95	17·77	17·29	16·88	17·67
CoJ 58	16·99	16·98	16·31	15·10	16·10
CoJ 64	17·97	17·77	17·49	16·68	17·47
CoJ 65	17·19	17·66	16·73	16·25	16·96
Co 312	16·88	16·68	15·67	15·00	16·06
Co 975	16·93	16·73	16·69	16·35	16·65
Co 1148	16·51	16·52	16·47	16·25	16·44
Co 1158	18·05	17·74	17·03	16·38	17·30
Co 62399	16·88	16·84	15·96	15·60	16·32
Mean	17·27	17·11	16·60	16·05	

C.D. at 5% (*i*) varieties 0·512, (*ii*) intervals 0·328, (*iii*) interaction $V \times I$ not significant.

	Titratable acidity, cm³ 0·1N NaOH				
CoJ 46	2·1	2·6	3·2	3·4	2·8
CoJ 58	1·5	2·1	3·0	3·1	2·4
CoJ 64	1·7	2·3	2·3	2·8	2·3
CoJ 65	1·7	2·2	2·8	3·3	2·4
Co 312	1·8	2·1	2·7	3·8	2·6
Co 975	1·7	2·4	2·8	3·5	2·6
Co 1148	2·1	2·7	2·9	3·2	2·7
Co 1158	1·9	2·0	2·6	3·1	2·4
Co 62399	1·7	2·1	3·3	3·4	2·6
Mean	1·8	2·3	2·8	3·3	

C.D. at 5% (*i*) varieties 0·193, (*ii*) intervals 0·018, (*iii*) interaction $V \times I$ not significant

	Juice soluble polysaccharides, mg.cm⁻³				
CoJ 46	0·820	1·262	1·437	1·620	1·285
CoJ 58	0·500	0·712	0·720	0·960	0·723
CoJ 64	0·614	0·908	1·088	1·446	1·014
CoJ 65	1·050	1·112	1·250	1·453	1·216
Co 312	0·525	0·687	1·250	1·883	1·086
Co 975	0·663	0·941	1·146	2·024	1·193
Co 1148	0·415	0·437	0·637	0·720	0·552
Co 1158	0·512	0·670	0·870	0·962	0·753
Co 62399	0·562	0·620	0·833	1·437	0·863
Mean	0·630	0·816	1·026	1·390	

C.D. at 5% (*i*) varieties 0·063, (*ii*) intervals 0·049, (*iii*) interaction $V \times I$ not significant.

	pH				
CoJ 46	6·0	5·7	5·5	5·2	5·60
CoJ 58	5·9	5·8	5·3	5·1	5·52
CoJ 64	6·1	5·9	5·7	5·5	5·80
CoJ 65	6·3	5·8	5·4	5·1	5·65
Co 312	6·3	5·9	5·3	5·2	5·67
Co 975	6·2	5·9	5·7	5·5	5·80
Co 1148	5·6	5·9	5·6	5·5	5·65
Co 1158	6·5	6·0	5·4	5·2	5·78
Co 62399	6·3	5·8	5·2	5·0	5·58
Mean	6·13	5·85	5·41	5·18	

C.D. at 5% (*i*) varieties 0·092, (*ii*) intervals 0·109, (*iii*) interaction $V \times I$ not significant.

	Reducing sugars, %				
CoJ 46	0·78	0·91	1·20	2·22	1·28
CoJ 58	0·74	1·02	1·23	1·70	1·17
CoJ 64	0·31	0·42	0·57	0·64	0·49
CoJ 65	0·68	0·99	1·09	1·11	0·97
Co 312	0·83	0·93	1·26	1·81	1·21
Co 975	0·60	0·69	1·20	1·75	1·06
Co 1148	0·61	1·03	1·08	1·12	0·96
Co 1158	0·65	0·82	0·94	1·47	0·97
Co 62399	0·62	0·92	1·06	1·24	0·96
Mean	0·65	0·86	1·07	1·45	

C.D. at 5% (*i*) varieties 0·118, (*ii*) intervals 0·113, (*iii*) interaction $V \times I$ not significant.

during the post freeze period particularly in the interval from 7 to 12 days. The speed of inversion was low in the beginning after freeze treatment but it increased rapidly later. The juice of CoJ 64 showed very low reducing sugars (%) initially and the increase following freeze treatment was also slow.

Data given for quality indicators of different cane varieties following the freeze treatment showed that Co 1148 had a much smaller increase in titratable acidity, gum content and reducing sugars (%) and a lower decrease in sucrose (%) and pH in its juice as compared with the other varieties. On the other hand Co 312 showed the greatest deterioration in juice quality. The other varieties were intermediate between these two extremes. Varieties showing a higher increase in the incidence of gums following freeze damage also showed higher titratable acidity, higher reducing sugars content and lower pol % cane and *vice versa*. These results corroborate the findings of IRVINE[8]. He considered that screening of varieties for frost tolerance on the basis of all the juice quality indicators would not be the most reliable method since pH and titratable acidity vary widely with location and variety but that the *increase* in gum content (soluble polysaccharides) would be the more reliable method. A number of workers[8,9,11,12] have stated that gums increase after a severe freeze followed by staling and that this increase in soluble polysaccharides has been associated with lower quality. IRVINE[8] stated that delayed milling of frozen cane is characterized by an increase in soluble polysaccharides accompanied by sucrose losses in the more susceptible varieties. He also found a net loss of invertase activity during the lowering of internal stalk temperature without tissue damage in frost-tolerant varieties.

It may thus be concluded that titratable acidity and gum content of the juice are the quality indicators which have shown the closest positive correlation with susceptibility and resistance of a variety to freeze treatment. Out of nine varieties under investigation, Co 312 showed most susceptibility and Co 1148 most tolerance to frost.

Summary

Cane stalks of nine varieties were exposed to low temperature in a deep-freeze (— 3·3°C) for 10 hours and were milled 0, 2, 7 and 12 days after treatment. Juice samples were analysed for quality indicators. Maximum decrease in sucrose content was recorded in the juice of Co 312 while minimum decrease was observed in Co 1148 12 days after the freeze treatment. Titratable acidity increased during the post-freeze period. The smallest increase in titratable acidity was recorded in the juice of CoJ 64 followed by CoJ 46 and Co 1148 while Co 312 showed the highest increase in the quality indicator. Maximum increase in gum content of juice (soluble polysaccharides), 12 days after treatment, was found with Co 312, while Co 1148 showed the smallest increase in gum content. Freeze treatment decreased the pH of juice in all the varieties but the smallest decrease was recorded in Co 1148. As the interval between freeze treatment and analysis of juice increased, the sucrose and pH decreased while titratable acidity, gum content and reducing sugars increased.

[11] FORT & LAURITZEN: *Sugar Bull.*, 1938, **17**, (1), 17–20.
[12] EGAN: *Proc. 13th Congr. ISSCT*, 1968, 1730–1735.

Sugar extraction by diffusion under non-steady conditions

By G. V. GENIE Dr. Sc.
(Consultant, Chaumont-Gistoux, Belgium)

Introduction

THREE ways have been hitherto used to link sugar extraction with the fundamental laws of diffusion:

(*a*) direct application of Fick's first law (SILIN);

(*b*) integration of Fick's second law by means of Fourier series (OPLATKA, BRÜNICHE-OLSEN);

(*c*) integration of Fick's second law by means of error functions (GENIE).

All these theories were developed in terms of concentration, assuming implicitly that the concentration would be the fundamental parameter of diffusion as it is for osmotic pressure. However, the diffusion process is not controlled by the concentration, nor even by the difference of concentration; it depends on the strictly local *gradient of concentration* in and around the cossettes. As this gradient cannot be measured, the final equations have, of course, to be expressed in concentrations, but this is for convenience only and it should be borne in mind that the gradient of concentration is the real determinant. For instance, the first step of SILIN's theory, which is to replace the gradient of concentration appearing in Fick's first law by a difference of concentration divided by a length, though understandable at that time, was surely wrong, first, because this should have been the *last* step, and second, because this is acceptable only if the gradient of concentration is constant, as it is in a steady state diffusion for which Fick's first law was primarily intended. On the other hand, Fick's second law, which is intended for non-steady conditions, does not explicitly contain the gradient of concentration and is more confusing than useful for a good understanding of the diffusion process. To obtain a clear picture of it, it is necessary to examine the extraction of sugar not at the industrial level, but on the molecular or at least the cossette scale. The object of this communication is to study the laws governing linear diffusion under non-steady conditions as applied to sugar extraction. Owing to the limited space, this study cannot of course be exhaustive.

Fick's diffusion laws

Diffusion is the macroscopic aspect of the random dispersion of molecules. Let us suppose that we can count the molecules of solute crossing a particular plane in a solution. Assuming for all molecules within reach of the plane the same probability of crossing it, if the concentration is the same on both sides, there is a statistical equality between the molecules crossing the plane in each direction and the resulting flux is nil *whatever the concentration.* If there is an excess of molecules on one side, those actually crossing the plane have no counterpart in molecules coming from the other side and a net differential flux results, proportional to that excess of molecules. But a difference of concentration over an infinitely small distance corresponds on a large scale to the gradient of concentration. Hence the first—and in fact only—law of diffusion:

$$F = -D\frac{\delta C}{\delta x} \qquad \ldots\ldots(1)$$

The flux F is the amount of solute crossing the plane per unit area in one time unit. It opposes increase of concentration and is therefore a negative function of the gradient of concentration. D is the coefficient of diffusion; it represents the "mobility" of molecules and the probability of their crossing the plane; it is hereafter assumed to be independent of the concentration. This concept of flux is important for practical extractors as well, because the object of an industrial diffuser is to generate a flux of sugar out of cossettes, and its efficiency is linked to the sum of all these elementary fluxes around the cossettes. The higher they are, the shorter the required extraction time.

Now, what about the second law? Let us consider another plane $(x + \Delta x)$ parallel to the first one (x) at a small distance Δx and a prismatic element of unit cross-section area between them. If the gradient of concentration for $x + \Delta x$ is the same as for x, the flux is constant and an equal number of molecules enters at one end and leaves at the other. The number of molecules in the element, and consequently the concentration, remains constant. If the gradients at both ends are different, the number of molecules contained in the element increases or decreases and we have for Δt time units:

$$\Delta C = (F_x - F_{x+\Delta x})\,\Delta t$$
$$= D\left[\left(\frac{\delta C}{\delta x}\right)_{x+\Delta x} - \left(\frac{\delta C}{\delta x}\right)_x\right]\Delta t \qquad \ldots\ldots(2)$$

or for infinitely small Δx and Δt:

$$\frac{\delta C}{\delta t} = D\frac{\delta^2 C}{\delta x^2} \qquad \ldots\ldots(3)$$

This is Fick's second law, which is merely a consequence of the first one and the keystone of most calculations in diffusion problems. But we are talking about sugar technology, so let us see what is important from our viewpoint.

Mechanism of extraction

The structure of the cellular material is complex in both beet and cane and the mechanism of extraction is probably not a simple diffusion inside the cell. Outside the cells, however, the displacement of sugar can only be explained either by diffusion or by convection of liquid through the pores or bundles of the material. As there is no preferential direction, this can be compared to a random dispersion, for which the general mass transfer laws apply. This is even more true in the juice layers adjacent to the cossettes, where only á dispersion mechanism can account for the removal of sugar, removal without which the extraction inside the cossettes would stop, whatever its mechanism. We believe the bottleneck in the extraction is mainly in these boundary layers of juice and this opinion is supported by the fact that the inhibition caused by the cell structure measured by BRÜNICHE-OLSEN[1] is much lower than could be expected, i.e. that the diffusion coefficient of sucrose in such convoluted cellulose structure as beet marc is not very different from what it is in a pure

[1] "Solid-liquid extraction". (Nyt Nordisk Forlag, Copenhagen.) 1962.

solution. This could be explained by the fact that the mechanism of extraction inside the cellular material—for instance that suggested by RATHJE[2]—has a faster action than molecular dispersion around the cossettes. An analogy can be found in sucrose crystallization, where the mechanism of actual crystal build-up is still a matter of controversy, but where the rate of crystallization is controlled in most instances by sucrose diffusion in the mother liquor around the crystal. We therefore feel that the displacement of sugar in the boundary layers of juice around the cossettes is an important factor for the efficiency of industrial extractors. The object of a practical diffuser being thus supposed to remove sugar from these boundary layers, we can, in a model of linear diffusion, integrate the flux crossing a plane at some distance from the cossette instead of measuring the decrease of concentration inside the cossette. Under non-steady conditions—which is the rule for cossettes because they contain a limited non-renewable amount of sugar—this flux is a function of time and the weight of sugar Q crossing an area A of the plane in a time interval $t_2 - t_1$ is:

$$Q = A\int_{t_1}^{t_2} F.\mathrm{d}t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

This equation can be directly expanded to industrial diffusers if A is replaced by the total area of the cossettes. All we have to do is to evaluate the average flux around cossettes of different thickness (and of various shapes in the case of two-dimensional diffusion).

More diffusion laws

The concentrations hitherto considered are the true local and instantaneous ones. However, the only concentrations accessible to measurement are the *mean* concentrations of cossettes and juice, and sugar technologists have endeavoured to link the extraction theory to them. It should first be pointed out that the physical process itself does not at all depend on the mean concentration and that its mere insertion in the diffusion laws, as by SILIN, can lead to serious mistakes. In the case of a well-stirred solution of *constant* concentration J_0, the mean concentration $\overline{C}$ of a cossette of thickness 2ε whose initial concentration was C_0 can be calculated from Fick's second law, equation (3):

$$\frac{\overline{C} - J_0}{C_0 - J_0} = \frac{8}{\pi^2} \sum_{v=0}^{v=\infty} \frac{1}{(2v+1)^2} e^{\left\{-\left[\frac{(2v+1)\pi}{2\varepsilon}\right]^2 Dt\right\}} \quad \ldots\ldots (5)$$

For convenience the series is restricted to the first term and written in Naperian logarithms:

$$\ln(\overline{C} - J_0) = \ln\left[\frac{8}{\pi^2}(C_0 - J_0)\right] - \frac{\pi^2 D}{4\varepsilon^2} t \quad \ldots\ldots (6)$$

This is differentiated with respect to time; assuming a mass transfer coefficient $K = \pi^2 D/4\varepsilon^2$ we have:

$$\frac{d\overline{C}}{dt} = -K(\overline{C} - J_0) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

This simple equation looks very nice and has been adopted by most authors after BRÜNICHE-OLSEN. It is however incorrect for two reasons: (*a*) the hypothesis of a well-stirred juice of *constant* concentration at the *surface* of the cossettes does not hold in industrial practice; (*b*) the second and following terms of the exponential series cannot be neglected for short-time extraction.

Finally, considering again equation (2), we can derive another law which could have been Fick's third law:

$$\frac{\delta F}{\delta x} = -D\frac{\delta^2 C}{\delta x^2} = -\frac{\delta C}{\delta t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The gradient of flux is thus equal and opposite to the time differential of the concentration. This is obvious because, when the flux changes at some place, it causes a local accumulation or depletion of molecules and consequently a change of concentration proportional to the time. This law is useful because it allows the re-use of part of the mathematics previously developed for concentration patterns. Moreover flux calculations are usually much simpler.

Flux versus *time and distance*

Before they are in contact, cossettes and juice are assumed to have homogeneous concentrations and the flux is therefore nil in both. When they come into contact, a high flux is suddenly generated at the boundary while it remains nil on both sides. This flux then spreads in both directions while decreasing as a flat Gaussian curve until, after an infinite time, the flux is again nil on both sides (Fig. 1).

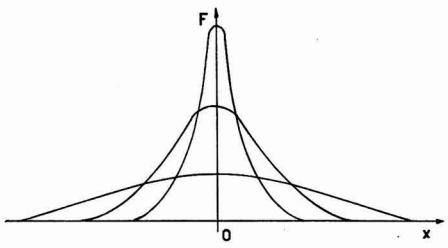


Fig. 1

If the transfer coefficient is the same in beet and juice, the curve is symmetrical and the flux at a distance x from the boundary is:

$$F = \frac{C_0 - J_0}{\sqrt{\pi t}} \frac{\sqrt{D}}{2} e^{-(x^2/4Dt)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

It will be seen that the flux at point x is nil for $t = 0$ on account of the exponential term, then it increases, goes through a maximum and decreases to return to nil for $t = \infty$ on account of the first square root. Equation (9) assumes however that the flux wave can develop undisturbed on both sides. Three kinds of obstacles may be met: another flux wave, a change of transfer coefficient and a change of concentration imposed by external factors such as juice circulation. The most common case is to meet the flux wave coming from the opposite side of the cossette (Fig. 2). As these fluxes are of opposite sign, they subtract from each other and the resulting flux at point x is, for a cossette thickness 2ε:

$$F = \frac{C_0 - J_0}{2}\sqrt{\frac{D}{\pi t}}\left\{e^{-(x^2/4Dt)} - e^{-[(2\varepsilon + x)^2/4Dt]}\right\} \quad \ldots\ldots (10)$$

[2] *Zeitsch. Zuckerind.*, 1970, **95**, 410-3413.

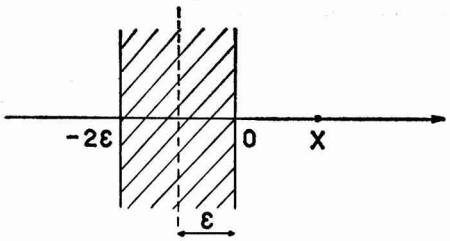


Fig. 2

It should be noted that for $x = -\varepsilon$ the flux is nil at any time and that no sugar crosses the central plane of the cossette. This plane acts in the same way as an impermeable wall and the equation (10) is suitable for this case as well. Instead of considering the influence of an opposite wave, one can thus assume that the flux wave simply has its sign changed and is reflected by the central plane. This "reflection" method is quite common for solving diffusion problems.

Other flux waves coming from a neighbouring cossette may also be met, for instance the case of two cossettes of thickness 2ε separated by a layer of juice of thickness 2λ represented in Fig. 3.

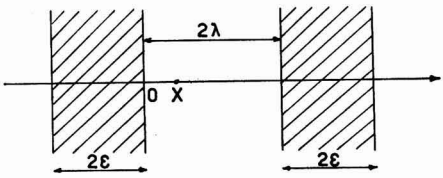


Fig. 3

The resulting flux at point X can be immediately written as the algebraic sum of the waves moving to the right and to the left, each one with its own sign:

$$F = \frac{C_0 - J_0}{2}\sqrt{\frac{D}{\pi t}}\left\{e^{-(x^2/4Dt)} - e^{-[(2\varepsilon+x)^2/4Dt]} - e^{-[(2\lambda-x)^2/4Dt]} + e^{-[(2\varepsilon+2\lambda-x)^2/4Dt]}\right\} \quad (11)$$

This simple method can of course be applied to any other combination of juice and cossettes.

Flux versus *convection*

Let us now see what happens when a flux comes across a change of transfer coefficient. We consider here only aqueous solutions for which the distribution coefficient is unity and disregard of course discontinuous concentration patterns as with organic solvents. The first case is when the instantaneous flux is generated between two media of different coefficients of transfer, for instance D_1 for beet and D_2 for juice. Then the coefficient $\sqrt{D/2}$ in equation (9) is replaced by $\sqrt{D_1 D_2}/(\sqrt{D_1} + \sqrt{D_2})$ and D in the exponential term by D_1 on the beet side and D_2 on the juice side. This last change can be avoided by expressing x on the juice side in $\sqrt{D_2/D_1}$ units, which keeps the Gaussian curve (Fig. 1) symmetrical and equation (9) valid except for the divisor 2, which—assuming an inhibition factor 0·6 as determined by BRÜNICHE-OLSEN[1]—should be 1·8. For cossettes of finite thickness 2ε an equation homologous to (10) can be drawn from EHRENBURG's work[3]. It is extremely complicated and will not be reproduced here, but a suitable approximation is obtained when the same changes are made in equation (10) as in equation (9).

It is interesting to consider the case for which D_2 is infinite, as for instance in a stirred solution. Then, dividing the coefficient by $\sqrt{D_2}$, it is found that its limit when D_2 is infinite is $\sqrt{D_1}$, i.e. that the divisor 2 disappears from equation (9). In other words, the flux is exactly twice what it would be without convection and this corresponds to previous results[4]. Convection is indeed the main cause of change of transfer coefficient, which it can increase ten- or hundredfold, whereas the change of transfer coefficient between beet and juice has only a limited effect, less anyway than the accuracy we expect from these model calculations. When D_2 is infinite, there is no longer a concentration gradient on the juice side but this does not mean that the flux is nil, because equation (1) shows an indeterminate value $\infty \times 0$. In fact the flux is constant *vs.* distance on the juice side because the argument of the exponential term of equation (9) is nil when $D = \infty$. We have thus for any value $x \geqslant 0$:

$$F = (C_0 - J_0)\sqrt{\frac{D_1}{\pi t}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

The second case is when a flux wave enters a medium in which it has a different transfer coefficient. As no concentration discontinuity nor sucrose accumulation or depletion is permitted at the boundary, the condition is that the flux arriving be equal to the flux leaving and the concentration be the same on both sides at any time. Assuming that the change occurs when $x = l$ and that x is measured in $\sqrt{D_2/D_1}$ units beyond that point, the flux is:

$$F = \frac{C_0 - J_0}{\sqrt{\pi t}}\,\frac{\sqrt{D_1 D_2}}{\sqrt{D_1}+\sqrt{D_2}}\,\frac{1}{2}\left\{\left(1 + \sqrt{\frac{D_1}{D_2}}\right)e^{-(x^2/4D_1 t)} + \left(1 - \sqrt{\frac{D_1}{D_2}}\right)e^{-[(2l-x)^2/4D_1 t)]}\right\} \quad \ldots\ldots\ldots (13)$$

when $x < l$ and

$$F = \frac{C_0 - J_0}{\sqrt{\pi t}}\,\frac{\sqrt{D_1 D_2}}{\sqrt{D_1}+\sqrt{D_2}}\,e^{-(x^2/4D_1 t)} \quad \ldots\ldots\ldots (14)$$

when $x = l$. It will be seen that these equations break down correctly to the simpler ones hitherto cited when $l = 0$ or $D_1 = D_2$. When D_2 is infinite and $D_1 = D$, the flux at the boundary is:

$$F = \frac{C_0 - J_0}{\sqrt{\pi t}}\sqrt{D}\,e^{-(l^2/4Dt)} \quad \ldots\ldots\ldots\ldots (15)$$

Taking into account the flux generated on the opposite side of a cossette of finite thickness 2ε, we have:

$$F = (C_0 - J_0)\sqrt{\frac{D}{\pi t}}\left\{e^{-(l^2/4Dt)} - e^{-[(2\varepsilon+l)^2/4Dt]} - e^{-[(2\varepsilon+3l)^2/4Dt]} + e^{-[(4\varepsilon+3l)^2/4Dt]} + e^{-[(4\varepsilon+5l)^2/4Dt]} \ldots\right\} \quad \ldots\ldots\ldots\ldots (16)$$

[3] EHRENBURG: *Univ. Colo. Stud.*, 1932, **19**, 327–355; through LOVERING: *Bull. Geol. Soc. Amer.*, 1936, **47**, 87–100.
[4] GENIE: *Zucker*, 1972, **25**, 117–122.

The analogy with equation (10) justifies the second term, but the origin of the following ones is less obvious. The detailed explanation, which is comparable to a multiple reflection in two mirrors facing each other at $x = -\varepsilon$ and $x = +l$ (Fig. 4) cannot be developed here. Equation (16) governs the instantaneous amount of sugar actually removed from the cossette per unit area when it is surrounded by a layer of stationary juice of thickness l. This equation is obviously more realistic than equation (5) which assumes that the stirring action is able to keep the concentration J_0 constant at the surface of the cossettes and which was responsible for BRÜNICHE-OLSEN's questioning of the validity of Fick's law.

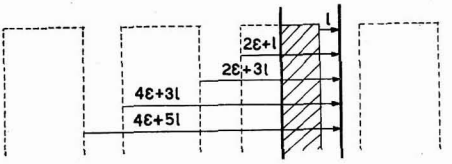


Fig. 4

Two types of convection should however be considered, i.e. "mixing" convection which is "isotropic" and creates an accelerated dispersion without preferential direction, for which a random pattern may still be assumed, and "transfer" convection in which the solution is flowing uniformly in a direction defined by a vector. In linear diffusion we have only to consider the case where the flow is parallel to the direction of diffusion. Then the convection is responsible on its own for an independent flux of molecules through the reference plane and the total flow due to convection and diffusion is the algebraic sum of both fluxes. This case has however little importance in sugar extraction and the most interesting one is when the flow of juice is perpendicular to the direction of diffusion. Three fluxes should then be considered, the one generated in the stationary juice by the cossette, the one generated at preceding stages and carried by the incoming juice and a third one generated at the boundary of both juices by the difference of concentration. Moreover this boundary is, of course, not sharp and a laminar flow of juice with a gradient of transverse velocity should be considered.

Owing to limited space, it is however not possible to go deeper into this theory in this communication. Nevertheless, as will be shown hereafter, the simple principles outlined here allow a much closer look into the diffusion process than equations (5) or (7) used by previous authors and—at least with a computer—an easy calculation of the flux of sucrose in any extraction model.

Non-steadiness of extraction

A steady state would mean a constant flux and consequently a constant concentration at any point, a condition which is never fully realised as shown by the time differentials. Considering equation (9) we have for instance:

$$\frac{\delta F}{\delta t} = \frac{C_0 - J_0}{2t}\sqrt{\frac{D}{\pi t}}\left(\frac{1}{2} - \frac{x^2}{4Dt}\right) e^{-(x^2/4Dt)} = -F.\frac{1}{t}\left(\frac{1}{2} - \frac{x^2}{4Dt}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

$$\frac{\delta C}{\delta t} = -\frac{\delta F}{\delta x} = \frac{C_0 - J_0}{4t\sqrt{\pi Dt}} x\, e^{-(x^2/4Dt)} = F.\frac{x}{2Dt} \quad \ldots\ldots (18)$$

Except for two particular points to be discussed below, both differentials are nil only when $F = 0$ and $t = \infty$ and no steady state is possible. To achieve a steady state, a "source" and a "sink" are required; the extracting juice flowing around the cossette acts as a "sink" but there is obviously no "source" of sugar inside the cossette. Some authors considered however that a quasi-stationary state prevails and this is of course true when a countercurrent diffuser is considered as a whole in which the fresh cossettes act as the "source"; however each individual cossette is extracted by a non-steady process and this must be borne in mind when applying Fick's law, which is of course valid for cossettes and *not* for diffusers. Let us define a quasi-stationary state as the state in which the flux changes only 25% per minute at a distance of 0·02 cm from the boundary. With cossettes of infinite thickness this condition is met after one minute and the flux is then $1{\cdot}67 \times 10^{-4}$ g.cm^{-2}sec^{-1} per unit of difference of concentration when $D = 0{\cdot}8 \times 10^{-5}$ cm^2.sec.$^{-1}$ With cossettes of equivalent half thickness, i.e. the ratio between volume and surface $\varepsilon = 0{\cdot}05$ cm, this condition is only met after twenty minutes, the flux then being $1{\cdot}64 \times 10^{-6}$ g.cm^{-2}sec^{-1} and 99·7% of the extractable sugar has already crossed the reference plane. This considerable difference is caused by the abrupt starvation of the transfer process caused by the limited amount of sugar contained in the cossette. Any theory—such as SILIN's—based on a steady-state extraction is thus useless, especially for the study of the stepwise extraction of industrial cossettes in rotary diffusers. As far as BRÜNICHE-OLSEN's theory is concerned, it can be argued that equation (7) does not at all represent a steady state, but it will be seen below that it is also not suitable for short extractions.

Let us return to equations (17) and (18). The factor $x/2Dt$ in equation (18) results in a constant concentration when $x = 0$, but this is of no practical consequence as it happens only for extremely thick cossettes. More interesting is the factor $(1/2 - x^2/4Dt)$ in equation (17) which causes the flux to go through a maximum when $t = x^2/2D$. This maximum is always present whatever the size of the cossettes, but then for a slightly different value of t. As explained before, if we consider a point at some distance x from the boundary where the flux is generated, the flux is nil when $t = 0$, then it increases very quickly, reaches a maximum at $t = x^2/2D$ or at a neighbouring value, decreases at first quickly and then very slowly returns to nil when $t = \infty$. The diagram in Figure 5 shows the variation of the flux at 0·02 cm from the boundary when $C_0 - J_0 = 1$ g.cm^{-3}, $\varepsilon = 0{\cdot}05$ cm and $D = 0{\cdot}8 \times 10^{-5}$ cm^{2}sec^{-1}. This study has a great practical importance in intermittent extractors such as rotary diffusers for determining the most economical contact time for each step.

Sugar extraction

To know the amount of sugar removed from the cossettes, the flux should be integrated over a time interval and multiplied by the area of the cossettes. This area is to be determined from the equivalent half thickness simultaneously with the transfer coefficient D by a published method[5,6]. The sugar

[5] *idem*: *Ind. Alim. Agric.*, 1972, **89**, 1021–1025.
[6] *idem*: *I.S.J.*, 1973, **75**, 99–103.

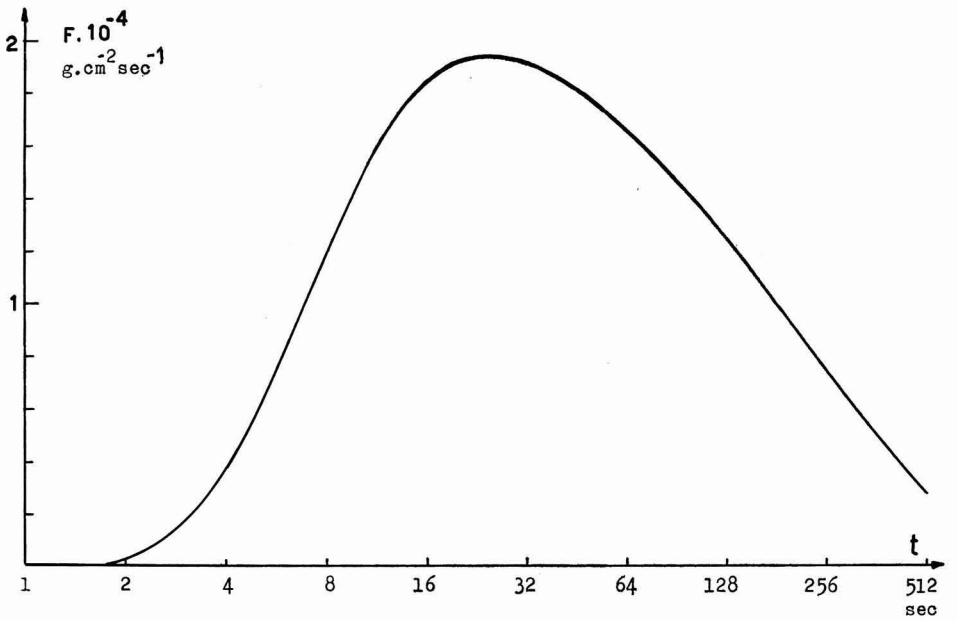


Fig. 5

removed per cubic centimetre of beet, neglecting the volume of the marc, is:

$$Q = \frac{1}{\varepsilon} \int_{t_1}^{t_2} F.dt \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)$$

The flux being in any case a polynomial of similar exponential terms, the integration is immediate if one knows that:

$$\frac{1}{2}\int_0^{t_0} \frac{1}{\sqrt{t}}\, e^{-(a^2/t)}\, dt$$

$$= \sqrt{t_0}\, e^{-(a^2/t_0)} - a\sqrt{\pi}\, erfc \frac{a}{\sqrt{t_0}}$$

$$= \sqrt{\pi\, t_0}\, ierfc \frac{a}{\sqrt{t_0}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (20)$$

The complementary error function (*erfc*) and its integral (*ierfc*) are tabulated functions. For instance, in the case of equation (16) we have:

$$Q = (C_0 - J_0)\frac{2}{\varepsilon}\sqrt{Dt}\left(ierfc\frac{l}{2\sqrt{Dt}} - ierfc\frac{2\varepsilon + l}{2\sqrt{Dt}} - ierfc\frac{2\varepsilon + 3l}{2\sqrt{Dt}} + \ldots\right) \quad \ldots (21)$$

This allows a comparison of the present theory with those of other authors, for instance SILIN[1] (p.19), OPLATKA (equation 5) and BRÜNICHE-OLSEN (equation 7). The percentage of sugar extracted *vs.* time when $\varepsilon = 0{\cdot}05$ cm and $D = 0{\cdot}8 \times 10^{-5}$ cm².sec^{-1} is shown in Fig. 6. It should be noted that as SILIN's theory assumes a constant flux, the resulting extraction exceeds 100% after three minutes. On the other hand, BRÜNICHE-OLSEN's exponential law assumes 19% extraction before the cossettes and the juice are in contact. Only OPLATKA's formula is consistent throughout the time interval $0 \to \infty$. The percentage of extracted sugar when $l = 0{\cdot}01$ and $l = 0{\cdot}02$ is also shown in the diagram. When $l = 0$ equation (21) is identical with OPLATKA's formula, of which it is in fact a generalization. As might be expected, the presence of a thin stationary layer of juice around the cossettes causes an appreciable delay in the sugar transfer, expecially during the first four minutes of the extraction.

Summary

The fundamental laws for linear diffusion under non-steady conditions are reviewed and an alternative method for the model calculation of the extraction of sugar from beet cossettes is suggested. Instead of considering the decrease of concentration in the cossettes after a time interval, the instantaneous flow of sugar through a reference plane, which may be the boundary between the cossette and the extracting juice or not, is integrated over the same time interval. In spite of appearances, this method is much simpler and more flexible than the conventional one. An example is given assuming that a thin layer of stationary juice surrounds the cossette and that an infinite convection exists beyond it.

Nomenclature

- a constant
- C concentration of sugar in the cossettes (g.cm^{-3} cellular juice)
- C_0 the same concentration when $t = 0$
- $\bar{C}$ mean concentration in the cossettes during extraction
- D coefficient of diffusion or sucrose transfer coefficient (cm².sec^{-1})
- D_1 the same coefficient in beet and adjacent stationary juice layer

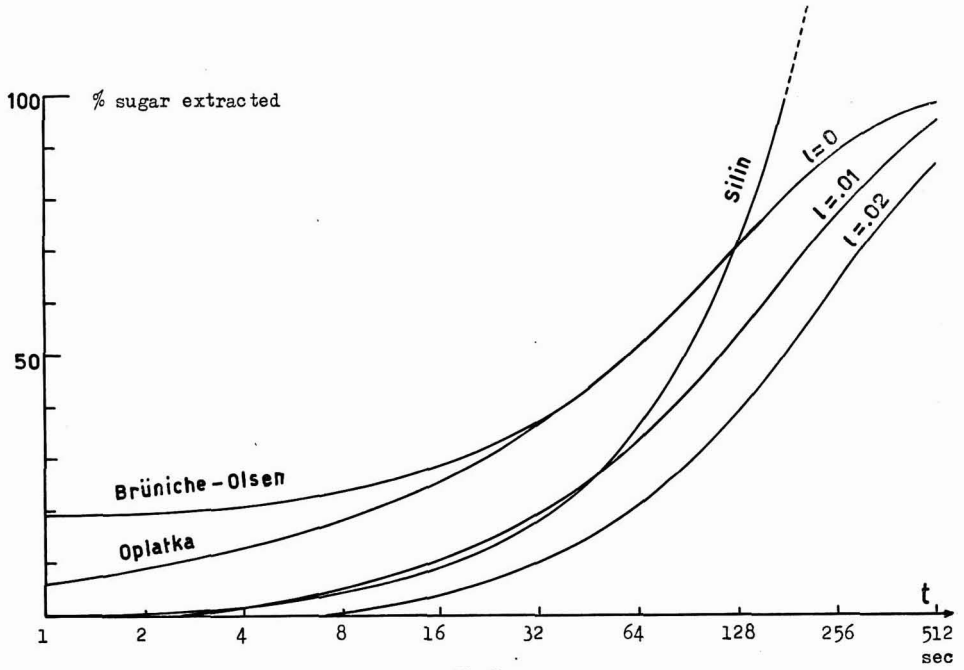


Fig. 6

D_2 the same coefficient in extracting juice
F Flux ($g.cm^{-2}sec^{-1}$)
J_0 concentration of the extracting juice when $t = 0$ ($g.cm^{-3}$)
l thickness of stationary juice layer surrounding the cossettes (cm)
Q amount of sugar removed from the cossettes during a time interval ($g.cm^{-3}$)
x distance from the boundary where the flux is generated (cm)
ε half thickness of cossettes (or ratio between volume and area) (cm)
λ half thickness of the juice layer between two cossettes (cm)
ν parameter (= 1, 2, 3, etc.)

International Sugar Colloquium

INTERNATIONAL Sugar Colloquia have been held since 1970 when the first, in Brussels, established that there was a growing likelihood of a sugar scarcity. At the second, held in Paris in 1972, two schools of thought became identified among members of the sugar trade: those who considered it imperative to mobilise all resources to avoid high sugar prices and those who considered them only a temporary phenomenon which would be corrected with passage of time.

A third colloquium was held in London during the 4th–5th March, under the auspices of the Comité Européen des Fabricants de Sucre (CEFS), Conféderation International des Betteraviers Européens (CIBE), and Association des Organisations Professionelles du Commerce de Sucre pour les Pays de la CEE (ASSUC). The purpose of this third colloquium was to consider the situation and prospects for sugar production in both the developed and developing countries during the next few years.

To this end, about 600 of the leading personalities on the international sugar scene gathered in London, registering on the evening of the 3rd March. On the following morning, after a speech of welcome by Mr. K. SINCLAIR, President of CEFS, they were addressed by the Minister of State at the UK Ministry of Agriculture, Fisheries & Food, and by M. C. CHEYSSON, Member of the EEC Commission. Subsequently, a global picture was presented by Dr. A. VITON, Chief of the Sugar and Beverages Division of the FAO, in the form of a world sugar balance forecast for 1975/85.

The situation and prospects for Latin America were surveyed by Sr. M. CARVALLO, Manager of Distribuidora Venezolana de Azucares. Sir GUY SAUZIER of Mauritius discussed the situation and prospects for Commonwealth countries, while those for the Philippines were presented by Mr. P. ARAQUE, of the Philippine Sugar Institute.

The views of the Japanese sugar industry on its situation and prospects were presented by Mr. T. MIZUNO, of the Japan Sugar Refiners' Association, while those for North America were surveyed by Mr. R. QUITTMEYER, President of Amstar Corporation. Similar surveys were then presented for Western Europe by M. E. DEMONT, President of the Syndicat National des Fabricants de Sucre de France, for Poland by Mr. W. GIEDWIDZ of the Sugar Industry Union of Poland, and for Australia by Mr. J. G. CAMPBELL, Chief Executive Officer of CSR Ltd.

Luncheon was given by the host organizations while an evening reception was provided by the British Government, participants being received by the Minister of State at the UK Ministry of Agriculture.

On the 5th March, Mr. SINCLAIR summarized the work of the previous day, which was then discussed generally by those present. Subsequently individual presentations were made, including a discussion of technological and financial aspects of world sugar production development, by Mr. G. S. BISHOP, Chairman of Booker McConnell Ltd., prospects for a new International Sugar Agreement, by Mr. E. PARRY-JONES, Chief Executive of the International Sugar Organization, and an agricultural point of view on an International Sugar Agreement by M. H. CAYRE, President of the Common Market Countries' Commission of the CIBE.

After luncheon, given by the British Sugar Bureau on behalf of the British sugar industry, the outlook for the international sugar trade was discussed by Messrs. J. VARSANO, J. FRAITES and J. HARCOURT, of, respectively, the Paris, New York and London markets. There followed a general discussion on the colloquium, after which it was brought to a conclusion by Mr. SINCLAIR.

It cannot be said that the aims of the Colloquium were met satisfactorily; nevertheless, the difficulty—if not impossibility—of achieving them became apparent during the two days. Dr. VITON's paper recorded how the forecast of 1973 production, made in 1971, had been accurate and he went on to conclude that the methodology could be considered reliable for 1980 and 1985 forecasts on a basis of the same level of prices as in 1973. He recognised the inhibitory effect of higher real prices, however, and gave alternative figures corresponding to different conditions, such that a range of 104 to 108 million metric tons, raw value, is anticipated by 1985.

But there are immensely complicating factors; in Western Europe, North America and Japan, customer resistance to higher prices has been much greater than was anticipated even six months ago, so that the quantification of the reduced world demand by 1985 if high prices continued is hazardous. In the USA corn sweeteners, particularly those with increased fructose contents, have taken part of the market hitherto met by sucrose and this is likely to be permanently lost and the use of such sweeteners even to increase in the future.

World inflation is continuing to raise costs and it is difficult to forecast what the levels of prices will be in terms of purchasing power—and hence what will be the effect on sugar consumption. It was pointed out, moreover, that in many countries of South America, the price of sugar had remained almost static for up to thirty years while a recent review of retail prices had revealed a 40% drop in "real" terms in many countries during the past quarter-century. Whether this could continue under present circumstances and if consumption and export availability would be affected is difficult to estimate.

A further complication is in respect of the controlled economies of Cuba, East Europe and China where administrative decisions rather than market forces determine levels of production, consumption and exports. A large contribution to the sugar shortage of recent years arose from the switch by the USSR from being a net exporter to a net importer of large quantities. It is impossible to predict securely what will be decided by the rulers of these countries in the next decade and this can only add to the uncertainty of predictions of future demand.

It seems clear, nevertheless, that in spite of uncertainty as to the amount involved, increased production will be required by 1985, not only to meet increased consumption demands but also to replenish the stocks which are at very low, almost unworkable levels. This could involve production of an additional 25 million tons a year more by 1985 and the question was asked more than once at the colloquium—where will it come from?

A survey of the various areas by the representatives mentioned above indicated some possibilities, although it was unfortunate that no-one was present to speak for Cuba or Africa, especially as one of the largest proportional increases in demand was anticipated by Dr. VITON for the Dark Continent. Mr. BISHOP's useful paper emphasized two points: first, the potential for increased production at no or little cost by application of knowledge which already existed in respect of cultivation techniques, use of more productive varieties and elimination of unnecessary losses. Second, he discussed the enormous cost of the establishment of new projects both for capital, interest and amortization.

It was no wonder that great emphasis was placed by several of the speakers on the need for security of a reasonable return on these huge capital investments. There is scope for increased production in many areas for meeting the world's higher demand but competing calls for private investment, political barriers to international transfer of funds, and lack of long-term security are hindrances to such developments. Two measures seemed to be generally considered advisable: finance through the World Bank or a special international sugar development fund, and establishment of a new International Sugar Agreement.

Agreements in the past have been concerned with maintaining prices on the world market within a range acceptable to producers and consuming countries, with regulation by means of quotas. This does not seem to be an appropriate system for the future, and limitation of production was roundly condemned by speakers who compared the levels of sugar consumption in the less-developed world with those of the advanced countries. Mr. JONES-PARRY's ideas concerning a buffer or intervention stock are controversial and involve a number of difficulties. Nonetheless, new ideas will be required for ensuring adequate sugar supplies for world consumption at remunerative prices, and one can only wish the ISO well in its efforts to seek a solution to the problems which have been clarified so well during the Colloquium.

Heavy-duty chopper fiberizer

By VICTOR DUCASSE

(Laupahoehoe Sugar Co., Hawaii, USA)

Paper presented to the 15th Congr. ISSCT, 1974

Introduction

DEVELOPMENT of the machine began in Mauritius eight years ago, when experiments were undertaken to examine the practicability of cane preparation by a so-called chopper-fiberizer.

A prototype was built by modifying an existing 34-blade cane knife and the first experiments, carried out a few hours before the end of the 1965 crop, gave promising results.

Today, after six years of progress, six of these machines, intended for the preparation of cane prior to milling, are working satisfactorily in Hawaii and Brazil.

Description of the machine

Referring to Fig. 1, the machine comprises a casing within which is supported a rotor consisting of a shaft on which are rigidly mounted a series of heavily built hubs and to which, in turn, are bolted the blades, the rotor being arranged across the delivery end of a feeding carrier (the primary feeder).

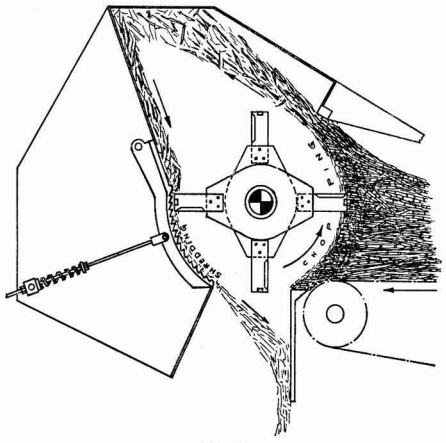


Fig. 1

Each blade has a cutting edge provided on the leading side of the stem with two hammers, projecting laterally and in opposite directions, at the top. (See Fig. 2.)

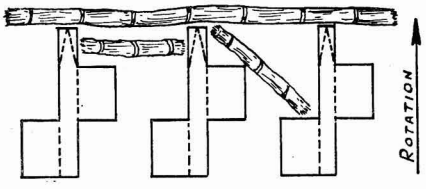


Fig. 2

The casing is formed by the two sidewalls, the top cover and the rear chute (the secondary feeder) at the bottom of which is mounted an anvil, here shown to be of the "washboard" type, the position of which can be adjusted and set by means of a spring-loaded device.

The rotor measures 1680 mm diameter at the blade tips and is designed to rotate at 1000 rpm, in the direction shown, by means of an electric motor (or steam turbine and gearbox) directly coupled to its shaft, on which is preferably mounted a flywheel.

The machine operates in the following way: the cane stalks, which are fed by the primary feeder, are first chopped by the blades which, at the same time, throw up the chopped cane onto the secondary feeder which, in turn, directs them into the fiberizer. The prepared cane leaves through an opening provided at the bottom of the casing.

This dual performance is made possible by the built-in secondary feeder which serves the purpose of a conveyor usually to be seen between cane knives and conventional shredders. The secondary feeder not only collects the chopped cane, which is impelled against it by the velocity of the rotor, but allows it to form a layer (of thickness depending on the inclination of the secondary feeder) which slides down into the fiberizer formed by the anvil serrations and the rotating hammers located at the tips of the blades.

The number of blades to be used with a given machine depends generally on the preparation expected which, in turn, depends on whether the preparation is intended for use in a diffuser or milling plant and the number of mills the latter comprises. The following is a general formula by which the number of blades to be used with any given machine may be readily determined:

$$N = 2k\left(\frac{L}{152} - 1\right)$$

where N = number of blades, L = width between casing sidewalls (mm), $k = 2$ when the unit is followed by 5 to 6 mills, 3 when the unit is followed by 3 to 4 mills, and 4 when the unit is followed by a diffuser.
Note: In each case, the number of hammers is twice the number of blades.

Discussion

Conventionally, shredders with fixed hammers have been limited to low rotational speeds and have been primarily used for the reduction of very soft material such as cotton, wool, paper, etc., whereas those shredders used for dealing with relatively harder materials have rotated at high speeds and have invariably been equipped with pivoting hammers.

On a recent world tour, the inventor of the Unigrator, Mr. Victor Ducasse, was asked a number of questions relative to the unique features and performance of this revolutionary fiberising machine.

Q1 What is a Unigrator?

The Unigrator is a single rotary machine combining the merits of a cane knife and a cane shredder to thoroughly cut and shred the sugar cane stalks prior to milling or diffusion. The Unigrator achieves unusually good cane preparation, actually assisting the milling tandem while avoiding the problems which frequently plague conventional shredders, such as choking and erratic shredding.

Q2 What are the advantages of the Unigrator?

The Unigrator employs a rotor with fixed blades containing hammers welded perpendicularly at the ends of the knives. The cane is cut upwards by the knife hammers, thrown against a rear chute which then feeds the cut cane continuously to the shredding area on the opposite side of the rotor. The rotor, therefore, cuts upwards on one side and shreds downward on the other. The bending moment on the shaft is therefore virtually eliminated due to the couple generated by the opposite reactions on the rotor blades.

The fully adjustable spring-loaded anvil which forms the shredding area acts like a shock absorber, constantly oscillating to adjust itself automatically according to the slight variations of the cane entering the shredding area. It also constitutes a safety device in that any tramp iron entering the machine would, under the action of the hammers, thrust out the anvil allowing the safe expulsion of the tramp iron from the machine.

Because the rotor blades are fixed, no extra start-up power is needed to move them out into a radial position as required with conventional shredders. AND there is no surging in the operation of the Unigrator. *The preparation of the cane is uniform moment by moment as it is discharged from the machine. The reason for this unique uniformity is the combined qualities of cutting, intermediate continuous feeding and anvil oscillation.* The cane as initially cut upwards is thrown against the rear chute in the fully enclosed hood. The velocity of the cut cane and the strong windage which is developed by the moving rotor tend to hold the layer of cut cane against the rear chute. The slight but very important continuous oscillation of the spring loaded anvil plate constantly accepts a uniform quantity of falling cane from the chute into the shredding area and its oscillations repeatedly throw back the fiberising cane into the path of the hammers, thereby achieving better fiberisation.

Performance

Reduced Mill Extraction
1% increase guaranteed
2 to 3% typical increase

Milling Rate
5% increase guaranteed
6 to 8% typical

Fiber Size
55% 1 to 5 inches
15% ½ to 1 inch
30% less than ½ inch

Percent Open Cells
85% by Hawaiian Method

Cane Mat Density
10 to 30% increase

Bagasse Moisture
1 to 2% decrease

Q3 What kind of cane preparation can be expected from the Unigrator?

Unigrator preparation is characterized by unusually long, thin fibers which interlock to form a homogenous mat of cane. This type of mat actually increases milling with no other change whatsoever, because of its greater density and interlocked characteristic, which literally causes the cane mat to be drawn into the mill. Note: another important characteristic of the Unigrator is that the degree of disintegration of the cane may be varied easily without stopping operation by merely adjusting the nuts on the spring-loaded rods positioning the anvil plate.

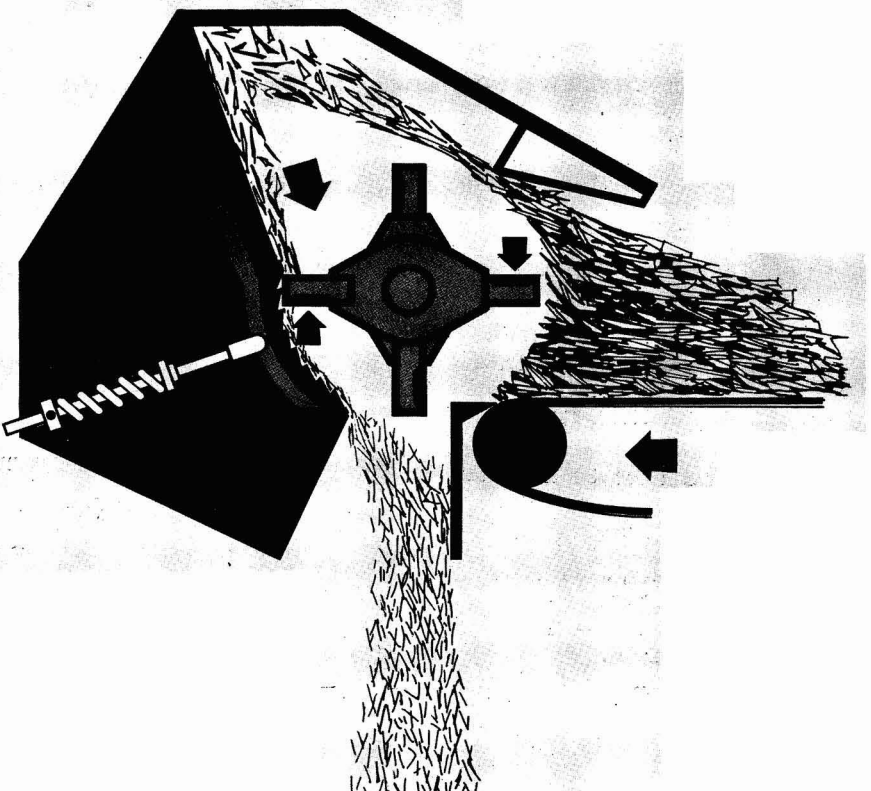
Q4 What is the advantage of the Unigrator compared with using knives only?

Cane prepared by the Unigrator contains 85% open cells, more than twice the percent typically achieved with two knives only. Therefore, juice extraction by either milling or diffusion is easier and faster. The Unigrator leaves behind no large pieces of cane. The prepared cane is principally long, thin fibers which interlock amazingly well, increasing cane blanket density and essentially eliminating choking of first mill. Due to the above characteristics, total power requirement of the milling train invariably goes down despite the fact that there is an automatic increase in grinding rate due to the increased density and uniform feeding of the prepared cane.

Unice Machine Co.
1275 Columbus, San Francisco, Calif. 94133
Phone: (415) 928-2400 Cable: Unice

Questions most frequently asked about the Unigrator*

*DUCASSE HEAVY DUTY CHOPPER-FIBERISER



The provision of pivoting hammers has generally been thought necessary in shredders of the latter category. Whilst the hammers assume a definite position during idle operation (usually radial to the axis of the rotor), they act more or less as shock absorbers during actual processing of the material, i.e. they are in constant oscillation under the combined actions of the impacts (which tend to force them backwards) and the ever-present centrifugal force (which tends to keep them radial). Also, and more importantly, the usefulness of pivoting hammers lies in the fact that they could prevent serious damage to the machine, on encountering some piece of hard foreign material, by readily swinging back to offer generally enough space for the safe expulsion of such material from the machine.

On the other hand, machines having pivoting hammers incur high maintenance costs. The hammers have to be bushed and the bushings, as well as the pivot rods, have to be of specially selected material. Such parts, moreover, have to be replaced owing to wear resulting from the severe impacts to which they are subjected.

In the case of the machine under review, the rotor is provided with rigidly mounted blades simply bolted to the hubs, a construction which considerably reduces maintenance costs, and it is the anvil which acts like a shock absorber, constantly oscillating under the combined forces due to the impacts generated by the hammers working on the material against its serrations and the reactions of the yieldable anvil suspension which always tend to keep it in a preset position.

Any tramp iron entering the machine would, under the action of the hammers, move out the anvil, thereby assisting the safe expulsion of such tramp iron. Thus, the anvil is efficiently adapted here to achieve also that specific purpose so far assigned to the pivoting of shredder hammers.

Conventional shredders are normally preceded by cane knives which deliver the chopped cane to the shredders by some type of conveyor. The chopper-fiberizer has the advantage that it will easily deal with whole cane stalks because it incorporates a cane knife and a shredder, together with their connecting conveyor.

Another advantage, associated with the simultaneous actions of the rotor, is the fact that bending moments on the rotor shaft, are virtually eliminated owing to the couple generated by the opposed reactions of the blades.

An inherent drawback of the chopper-fiberizer is that the rotor, owing to its direction of rotation, tends to repel the cane being fed to it by the primary feeder. For the optimum performance of the machine, there must be a constant flow of cane otherwise there would be an erratic operation giving high peak loads and non-homogeneous preparation. This can readily be understood when one considers the way in which the machine performs in operation. The rotor is in fact confronted with a moving cane anvil, on the primary feed side, into which it chops the cane to be delivered to the secondary feeder. As long as this cane anvil moves constantly, a layer of cane will be removed from it by each row of blades and the resulting operation will be smooth and continuous whilst the power consumed will be almost constant and at a minimum. Also, the preparation would then be very homogeneous with a minimum amount of fine particles produced.

However, if the movement of this cane anvil is erratic, i.e. if because the force required to feed the cane past the rotor is sometimes less than that exerted by the latter, so as to cause the cane anvil to stop and go, a relatively large amount of fine particles will be produced by the hammers revolving past the same layer of cane each time the cane anvil remains stationary. Moreover, the density of the cane immediately preceding the inlet of the machine will increase, owing to the force exerted on that cane by the additional oncoming material being conveyed by the primary feeder, until the cane anvil starts moving again. This is why the horsepower also increases.

The above-mentioned stationary stage of the cane anvil is not to be confused with that when the primary feeder itself stops. In this case, of course, no forward force would be exerted on the cane anvil, resulting in an idle operation of the rotor.

This drawback was actually the cause of the many problems encountered during the experiments which finally showed that the solution called for force feeding of the cane and that, to this end, the angle of elevation of the primary feeder should not exceed 5 degrees on a length of at least 8 metres immediately preceding the machine.

Of course, another positive way to circumvent these difficulties would be to have a feed roller mounted on top of the cane blanket immediately before the latter enters the machine.

The horsepower requirements depend mainly on the number of blades, the rpm of the rotor, the type of cane being handled and the capacity of the unit. The average installed hp for these machines varies from 25 to 35 hp/tfh. The use of a 16-blade knife leveller is recommended ahead of each unit with power requirements of one hp/tch and a setting (gap between tip of knives and feeding carrier slats) of from 450 to 600 mm.

It is interesting to consider the configuration of the blades in order to understand their basic principle, which actually has a direct bearing on the power consumed. Referring to Fig. 2, which shows the top portion of 3 consecutive blades belonging to the same row, imagine these 3 blades cutting into the incoming cane mass at the primary feed side. In actual operation, virtually any given piece of cane must encounter the relatively thin leading edges of the blades before entering into contact with the hammers which follow those leading edges almost instantly. It can therefore be deduced that, during the chopping process, the hammers are actually dealing with loose cane which they throw up and onto the secondary feeder and this fact accounts for the acceptable horsepower requirements.

Incidentally, no noticeable wear could be seen at the anvil in spite of the abrasive nature of the dirty cane being handled in Hawaii. The author's assessment of the situation is that 80% of the power is

Table I

	Prepared cane			*Net cane*	*Bagasse*		
Year	*t.c.h.*	*Fibre %*	*% Dil*	*Pol %*	*Pol %*	*Moisture %*	*Extraction*
1969	117	14·50	33·37	11·83	1·99	47·36	94·41
1970	119	14·42	33·89	11·96	1·94	47·78	94·60
1971	119	14·55	32·77	12·55	1·74	46·37	95·59

used for chopping and 20% for shredding. However, this 20% of the power achieves a very valuable cell rupturing action since, when the anvil is withdrawn, the h.p. drops only slightly whilst the preparation is substantially poorer. The purpose of having the hammers staggered is to prevent "bridging" of the cane between them due to centrifugal force.

The so-called cutting edges of the blades are also intended to prevent forward "sweeping" of the chopped cane on the anvil during the shredding process and allow for a quieter operation of the machine.

The percentage of open cells obtainable from the machine depends mainly on the number of blades and their rpm whilst the amount of fine particles produced depends on the flow of cane through the machine. During the experiments carried out in 1968, in Mauritius, the percentage of open cells obtained with the 34-blade prototype machine, as determined by the BMA method, was reported to be 82% whilst the proportion of fine particles was found to be between 60 and 70%. The unit was directly coupled to a 480 hp electric motor revolving at 580 rpm and dealing with whole hand-cut cane being fed by the primary feeder at rate of 125 tch. The angle of elevation of the primary feeder was 22 degrees.

A chopper-fiberizer started operation, in early 1971, at the Laupahoehoe Sugar Co. factory, Hawaii, ahead of a 1020 mm × 2134 mm 14-roller mill tandem. In this country, the cane is unloaded from the trucks into the cleaning plant which removes most of the rocks, mud and trash. Estimated trash in the prepared cane is between 12 and 15% depending on the condition of the field cane entering the cleaning plant and the efficiency of the latter.

Particulars of the preparatory equipment at Laupahoehoe are given below:

Before 1971:

Cane knife No. 1

Number of knives	32
Diameter to knife tips	1630 mm
Clearance (between knife tips and top of feed carrier slats)	300 mm
Installed hp	200
Speed	580 rpm

Cane knife No. 2

Number of knives	32
Diameter to knife tips	1630 mm
Clearance	30 mm
Installed hp	200
Speed	580 rpm

Starting 1971:

Cane knife (leveller)

Number of knives	16
Diameter to knife tips	1630 mm
Clearance	460 mm
Installed hp	100
Speed	580 rpm

Chopper-fiberizer

Width between sidewalls	2134 mm
Number of blades	46
Diameter to hammer tips	1680 mm
Width of hammers	102 mm
Actual clearance between hammer tips and anvil serrations—	
at top of anvil	55 mm
at bottom of anvil	26 mm
Designed clearance	
at top of anvil	35 mm
at bottom of anvil	10 mm
Installed hp (two 200 hp electric motors)	400
Average current used by each motor	175 amp
Speed	580 rpm
Angle of elevation of primary feed carrier	15°

Table I gives the average figures obtained at the end of the 1969, 1970 and 1971 seasons.

Experiments were undertaken at Laupahoehoe to determine the fineness of the prepared cane leaving the above chopper-fiberizer. The results are given in Table II.

Table II. Fineness (separated by sieving)

Mean of 4 results at 107·5 t.c.h.

Fineness %	× ⩾ 25 mm	25 mm > ×⩾13 mm	13 mm > ×⩾4 mm	×⩽4 mm
	33·3	14·8	18·0	33·9

Owing to the existing set-up at the Laupahoehoe factory, it was found very difficult to alter the angle of elevation of the primary feed carrier and, in late 1973, a force-feed roller was installed at the inlet of the machine which is now being driven at 750 rpm by a 1000 hp Terry steam turbine via a Lufkin gearbox.

The means of four results obtained from recent rests undertaken to determine the percentage of open cells and the fineness of the prepared cane leaving the machine are given in Tables III and IV.

Table III.

Variety	*% fibre*	*t.c.h.*	*% open cells*
775	14·7	167	81

Table IV

Fineness %	×⩾25 mm	25 mm > ×⩾13 mm	13 mm > ×⩾4 mm	×⩽4 mm
	56·4	12·9	12·7	18

Acknowledgments

The author thanks the Belle Vue Harel Sugar Co., Mauritius, and the Laupahoehoe Sugar Co., Hawaii, for the production facilities afforded.

Summary

A machine for the preparation of sugar cane prior to milling or diffusion combines in a single unit the merits of a cane knife and a shredder. The single rotor performs two different operations simultaneously, at two completely different points, namely, chopping the cane at the feed side whilst shredding the chopped cane at the opposite side of the rotor.

* *Editor's Note:* The Ducasse chopper-fiberizer is marketed by Unice Mfg. Co. Inc., 1275 Columbus Ave., San Francisco, Calif., 94133 USA.

Sugar cane agriculture

Variations in the ratio of dextrose to levulose in sugar cane. J. E. IRVINE. *Proc. 15th Congr. ISSCT*, 1974, 1033–1039.—Results of studies on eight varieties of cane showed that the dextrose:levulose ratio differed (in the range 1·0–2·4) with variety, maturity, site location and trash content, and was inversely correlated with sucrose content and purity. The average ratio fell from 1·6 in October to 1·1 in December, and ranged from 1·47 to 1·75 according to location. The fall in value of the ratio was from 1·58 in trash-free samples to 1·43 in cane with 30% dry trash; replacement of the dry trash with fresh, green trash caused a similar pattern, but the ratio had lower values. When sucrose was determined by polarization, the error caused by variation in the dextrose:levulose ratio was greatest in low-purity varieties harvested early and smallest in high-purity varieties.

* * *

Detection of isoenzymes in sugar cane leaves by disc electrophoresis. Y. T. LIU, S. S. CHEN, S. LEE and H. C. LEE. *Proc. 15th Congr. ISSCT*, 1974, 1048–1057. Experiments showed that cane leaves stored in a freezer for up to 6 months but not dried during storage could be stained to give zymograms as clear as those from fresh leaves. While pre-treatment with acetone or ethanol before electrophoresis did not alter the isoenzyme pattern for peroxidase compared with that of leaves not pre-treated, it did cause the disappearance of the esterase isoenzymes. Assays of peroxidase and esterase isoenzymes in different sections of the same leaf blade revealed that the isoenzyme patterns of the leaf tip section were similar to those of the old leaf. Patterns from sections near the leaf sheath were identical with those for young leaves. Less than 5% of plants derived from tissue culture had peroxidase isoenzyme patterns different from those of the original clone; the corresponding figure for plants obtained after gamma-irradiation was up to 8%. For both groups of plants, the esterase patterns were similar to those of the original clone. Variations in morphological characters were not directly associated with differences in enzyme systems.

* * *

A mechanical harvesting system without burning. W. F. ALLISON. *Proc. 15th Congr. ISSCT*, 1974, 1088–1095.—The system investigated involves use of a McConnel harvester of the cutter-cleaner-windrow type; two rows of cane are simultaneously cut and the stalks topped, stripped and windrowed, after which the windrow is picked up, the cane chopped into short billets, pneumatically cleaned and loaded into transport. Unburnt cane loaded with a push-pile-grab loader contained 6·3% extraneous matter, and the harvesting efficiency was 95·4%. These figures were improved to 4·7% and 97·8%, respectively, by burning after windrowing, compared with 9·3% and 78·9% obtained with a whole stick-topper-windrow system as used in Louisiana. The McConnel system is estimated to be more economical than the Louisiana system. The flail-topper cleaner incorporated in the McConnel system has shown great promise, despite certain limitations which are discussed.

* * *

The BSPA cane cutter. J. C. HUDSON. *Proc. 15th Congr. ISSCT*, 1974, 1096–1105.—The cane harvester developed by the Barbados Sugar Producers' Association in collaboration with F. W. McConnel Ltd. is described and the advantages of its use in Barbados discussed. The flail-topping device (see preceding abstract) has encountered some problems which are mentioned.

* * *

Physico-mechanical properties of sugar cane and the geometric and kinetic parameters that influence sugar cane cutting. J. A. SILVEIRA R. *Proc. 15th Congr. ISSCT*, 1974, 1074–1087.—Research on the physico-mechanical properties of sugar cane, reported earlier[1], has been continued and conclusions drawn on a number of knife parameters as well as cane properties which affect the work expended in harvesting. The findings, discussed at some length, are intended for application to mechanical harvester design and operation.

* * *

Determining optimum parameters for sugar cane harvester choppers. G. B. RIVAS N. *Proc. 15th Congr. ISSCT*, 1974, 1106–1113.—Analysis of results obtained in cane harvester trials has led to a number of conclusions with respect to the percentages of stalks and tops chopped and length of billets as a function of cutter blade parameters. A mathematical model, in the form of a regression system, obtained from the analysis is reproduced. Application of the findings to the design of new harvesters has been recommended.

* * *

Traction, compaction and flotation in soft soils. J. H. TAYLOR. *Proc. 15th Congr. ISSCT*, 1974, 1114–1123. Research conducted by the US Dept. of Agriculture in the past on the effects of tyre and track design on traction, compaction and flotation is summarized and more recent work on the effects of various equipment parameters is described. Forces in the soil under tyres and tracks are compared, and the relative merits of steel track, pneumatic track and a pneumatic tyre discussed. Also compared are a wide, low-pressure tyre, dual tyres and a normal single tyre. While four- or all-wheel drive is shown to be of advantage for traction, a pneumatic track is also of some benefit as regards the soil.

* * *

Aerodynamic properties of sugar cane. N. LEÓN. *Proc. 15th Congr. ISSCT*, 1974, 1136–1154.—Research on the aerodynamic behaviour of the different parts

[1] ABLIKOV & SILVEIRA: *I.S.J.*, 1974, **76**, 19.

of the cane plant in an air stream, carried out with a view to the use of pneumatic means to clean cane and unload it from the harvester, is described at length. Graphs are given showing critical speed and drag coefficient as functions of cane geometry and dimensions in the case of a number of varieties. Tabulated data are also presented.

* * *

Air velocities required to convey sugar cane stalk and leaf trash in a vertical air stream. J. E. CLAYTON, W. C. HEDICK and G. N. FRANKS. *Proc. 15th Congr. ISSCT*, 1974, 1155–1161.—Experiments to determine the aerodynamic properties of cane stalks and trash are reported; these were carried out in view of the excessive power being used by harvester blower or suction fans to remove trash from cane in Florida. High variation in the results occurred, but it was found that: (1) loose leaf trash can be readily separated from millable cane in a vertical air stream provided the cane mat is broken up to allow the air stream sufficient access to the trash; (2) air velocities required to convey tops and millable cane overlap, although some tops can be removed without significant cane loss; and (3) strict control of air flow rates is necessary for maximum trash removal in a vertical air stream.

* * *

Current status of drip irrigation. W. GIBSON. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 13–18.—Problems encountered with drip irrigation in Hawaii are discussed, including plugging of orifices with soil, enlargement of existing orifices and creation of new ones by ants and wireworms, and piercing of the tubing by nut grass where the tubes were laid just a few inches below the soil surface. The possibility of altering the crop cycle to take advantage of the benefits of drip irrigation is discussed and use of the tube system to administer fertilizers, growth hormones and cane ripeners considered. Economics of drip irrigation are examined.

* * *

Waialua Sugar Company 10-year plan. W. W. PATY. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 19–27. The 10-year plan set out for the agricultural operations at Waialua Sugar Co. includes adoption of flat culture, conversion of about 1000 acres annually to drip irrigation, introduction of Toft chopper-harvesters and modifications to the existing cane transport scheme. Since the cane wet-cleaning plant has proved to be the source of heaviest sugar losses, it is to be by-passed and a dry-cleaner used to reduce the trash content. The economics of the plan are discussed, including those of turning 3250 acres of pine land into cane plantation, a programme started in 1973 and due to be completed in 1977.

* * *

Current status of Toft mechanical harvesting. J. R. MARSHALL. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 1973, 28–32.—A description is given of the Toft DR-564 chopper-harvester which was designed on the basis of data obtained with the earlier DR-564 prototype[1] built by the Australian company in collaboration with Hawaiian interests. Details are also given of the 10-ton capacity Stubenberg track-mounted cane "buggy" which accompanies the harvester for infield cane transport; transfer of the cane billets by push gate from the elevated body of the buggy (raised by hydraulic jacks) to a road trailer can take as little as 1 minute.

* * *

Cane materials handling—1973. C. W. HART. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 33–36.—Information is given on the operation of a cane harvester-cleaner unit which in field tests has considerably reduced the cane extraneous matter content. The cane windrow (obtained by V-cutters) is picked up and passes over a soil gap between two conveyors. The cane is elevated by the second conveyor, additional soil being removed at the head shaft; the cane is then fed to the chopper, after which it falls, as 20-inch billets, onto a third conveyor which has an open grid deck for further soil removal. Cane is accelerated as it passes under extractor fans for trash removal, and falls onto a fourth conveyor for a final elevation. A second set of fans removes more trash, after which the cane falls into the receiving bin. A pendulum-type levelling device provides a uniform blanket of cane for cleaning, ensures that the rear bin load is adequate, and helps maintain sidehill stability.

* * *

Toft harvester operating report. R. B. V. TOLEDO. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 37–39. Results of three months' operation of the Toft DR-564 cane harvester in conjunction with the Stubenberg cane buggy at Laupahoehoe Sugar Co. are reported, indicating that both burnt and unburnt harvested cane contained 14·5% extraneous matter. Modifications are being made to both harvester and buggy to solve problems encountered in the field tests.

* * *

Soil water movement under drip irrigation. H. M, GITLIN. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*. 46–47.—The theory of water movement in soil is examined and its application in establishing a drip irrigation system discussed. From tests it would be possible to determine drip irrigation feasibility, the most suitable emitter and lateral spacing, and optimum irrigation schedule for a given soil and area. A factor considered to be of some importance is the rate of capillary movement in a given soil.

* * *

Cultural practices with drip irrigation. L. L. BUREN, M. ISOBE and Y. YAMASAKI. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 48–55.—Information is given on the practices at nine cane plantations in Hawaii where drip irrigation is used. The survey covers aspects of cane agriculture which could be modified to take advantage of the benefits of drip irrigation, including seedbed preparation, row spacing, chemical weed control and fertilization. An experiment to determine optimum water application rates is also briefly mentioned.

* * *

Insect-related problems in drip irrigation systems. A. K. OTA and V. C. S. CHANG. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 56–58.—Damage to polyethylene tubing used in drip irrigation has been found to be caused mainly by three species of ants in Hawaii: *Solenopsis geminata* (fire ant), *Pheidole megacephala* (big-headed ant), and *Iridomyrmex humilis* (Argentine ant), the first of the three species named being apparently the most destructive. The use of thick-wall tubing (of at least 12 mil thickness) is advocated, as

[1] EVANS & MARSHALL: *I.S.J.*, 1974, **76**, 238.

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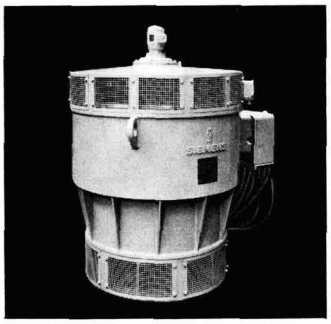

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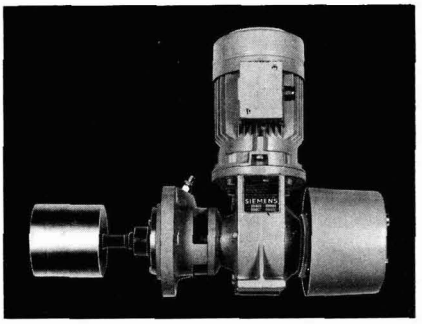

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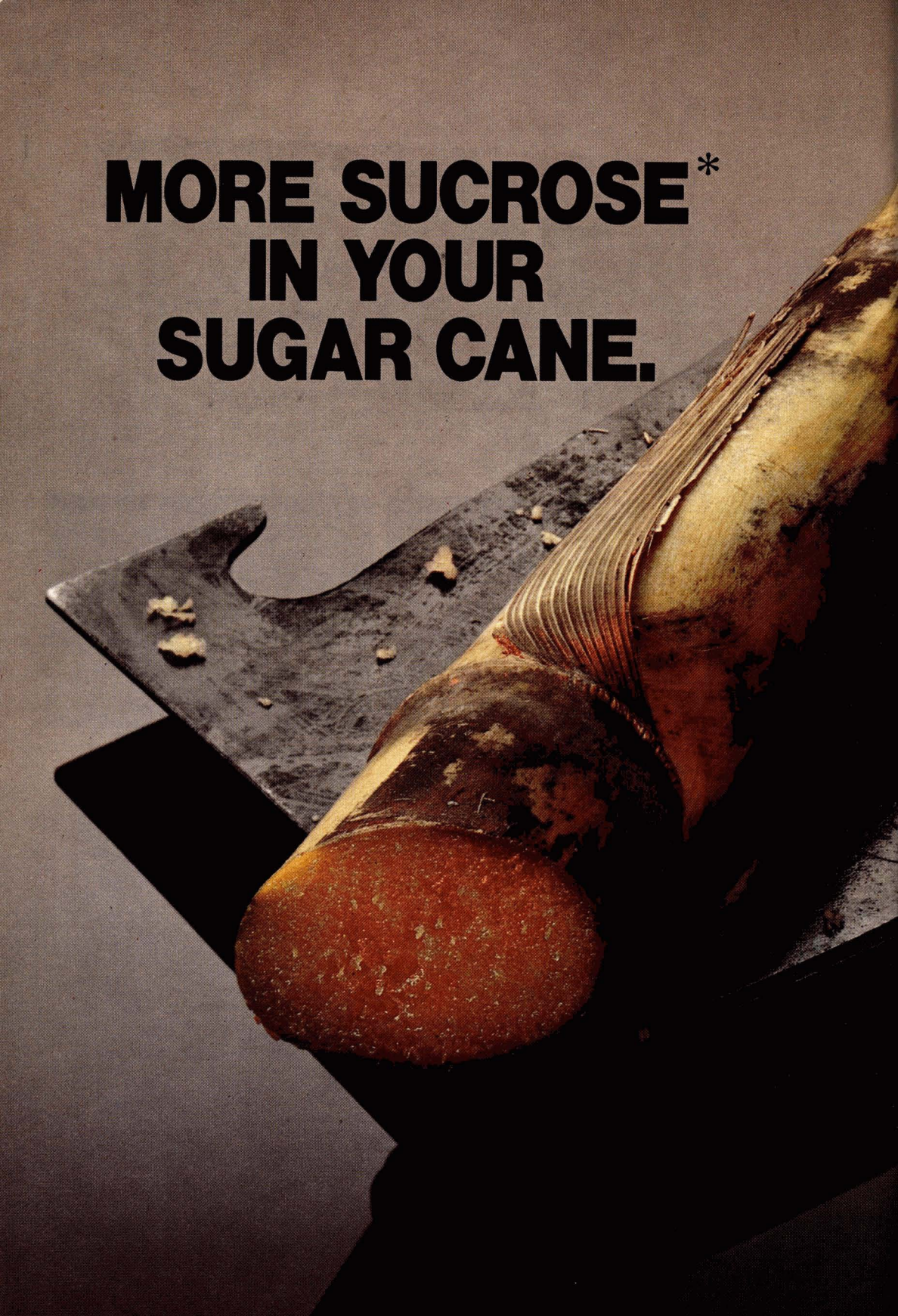
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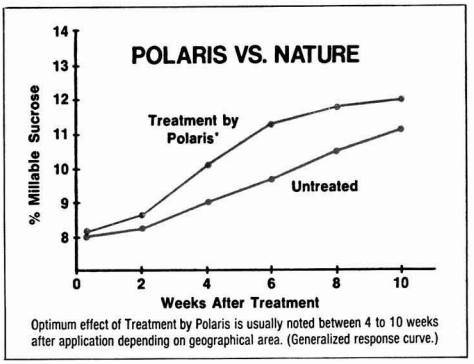

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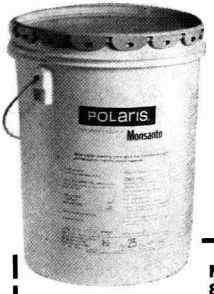

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well as daily wetting of the area adjacent to the orifice and tube wall to reduce ant digging activity (disuse of the tubes for 2 days or more may result in excessive ant damage). Use of "Diazinon" insecticide will reduce the ant population, but only for a number of weeks. Microbial growth in the water and tubing should also be controlled with a distinfectant.

* * *

"Roundup"—a new translocated herbicide. D. A. BROWN. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 59–60.—The chemical composition and properties of "Roundup", a Monsanto herbicide in which the active ingredient is the isopropylamine salt of "Glyphosate", are briefly reported. At 2·5–5·5 lb per acre, the herbicide is reported to have given excellent control of major weeds, including *Sorghum halepense* (Johnson grass), *Pennisetum purpureum* (Napier grass), *Cyperus rotundus* (purple nutsedge), *Barachiaria mutica* (para grass), *Panicum maximum* (Guinea grass), *Paspalum dilatatum* (Dallis grass) and *Coix lacryma-jobi* (Job's tears).

* * *

"Sencor" herbicide for the control of weeds in sugar cane. A. D. COHICK. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 61–64.—Information is given on "Sencor" (a product of Farbenfabriken Bayer GmbH), which is effective against a number of broadleaf weeds as well as grasses. Tests have indicated that at 4 lb a.i. per acre it is more effective than "Diuron" and "Ametryne" at the same or higher rates of application. In most of the tests cane was not adversely affected by "Sencor".

* * *

"Asulam", a selective post-emergence herbicide for use in sugar cane. K. E. WEINKE. *Rpts. 1973 Meeting Hawaiian Sugar Tech.*, 65–70.—"Asulam" (methyl sulfanilylcarbamate), a product of May & Baker Ltd., is a post-emergence herbicide having some pre-emergence activity and is effective against a number of grasses and broadleaf weeds which are listed. Also listed in this article outlining the properties and uses of "Asulam" are the degrees of toxicity of the herbicide to various forms of animal life.

* * *

Breeding, selection and the smut programme. S. L. LADD, H. K. MEYER and D. J. HEINZ. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 71–75.—See LADD *et al.: I.S.J.*, 1975, **77**, 77.

* * *

Sugar cane ripeners in Hawaii—1973. L. G. NICKELL and D. T. TAKAHASHI. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 76–84.—A review is presented of the various chemical ripeners undergoing tests as part of a major programme in Hawaii, and where experimental data are available, these are discussed. A list is also given of chemical compounds which have proved active in screening tests but which have not yet advanced to the field testing stage.

* * *

A progress report on the evaluation of sulphur-coated fertilizers. M. ISOBE, L. L. BUREN and Y. YAMASAKI. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 85–88. Experiments are reported in which sulphur-coated urea (SCU) and sulphur-coated potassium (SCK) were applied in a single dose as a slow-release fertilizer and results compared with those obtained by regular applications of uncoated urea and potassium (muriate of potash). It was found that in terms of fresh cane weight per acre and N uptake, there was no significant difference between the two forms of urea fertilization with 12-month cane. In the potassium tests, the multiple applications gave significantly higher values of K uptake and K-water index than did the SCK.

* * *

Experiments with metering devices for planting short-length sugar cane. J. E. CLAYTON. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 110–113.—As a contribution to mechanical cane planting research, details are given of the construction of and experiments with a device designed to meter the cane uniformly from a container and place it in the furrow in a uniform planting pattern. Operation of the unit was satisfactory, with the 10–12 inch cane pieces generally used, only when the cane was completely free of leaf trash. Various modifications are advocated, including means of handling longer pieces of cane.

* * *

Machinery management: replacement problem. K. P. PEPPELER and A. S. HALL. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 114–124.—The economic problem of agricultural machinery replacement, involving determination of which equipment to replace and when, is discussed.

* * *

Logistics of cane delivery as it affects the Hilo Coast project. J. F. WILLIS. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 125–127.—The Hilo Coast Processing Co. services what was once four independent cane plantations, and operates two sugar factories centrally located along the coastal edge of the plantations. How the company has approached the problem of coordinating operations on the 26,000-acre complex, where once four separate harvesting schedules were used, is explained.

* * *

Dry methods of sugar cane cleaning with conveying mechanisms, cleaning rolls and pneumatics. J. E. CLAYTON. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 128–135.—Describing research work conducted on trash and soil removal from cane, the author indicates that rotary spike-tooth cylinders as a conveyor immediately behind the chopping mechanism in a cane harvester permitted good soil removal, provided a uniform cane flow and prepared the cane for efficient pneumatic trash separation, the efficiency of which was increased by directing the air blast downwards at the conveyor discharge. However, there was found to be no air velocity at which a high percentage of immature cane stalk removal was not accompanied by loss of some of the mature cane. It is also pointed out that equipment for thinning the cane and removal and subsequent disposal of the trash is expensive and its maintenance costly; moreover, cleaning is not needed during some seasons, so that operation of such equipment is not necessary.

* * *

High-speed photographic analysis of sugar cane harvesting and cleaning mechanisms. J. E. CLAYTON. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 136–140. Application of high-speed photography to studies of cane stalk chopping by harvester blades and of cane

cleaning by rotating cylinders and pneumatic means is discussed.

* * *

Mini-computers for plantations—general. M. TANAKA. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 141–146. The application and advantages of a Wang 720 computer used for a number of general clerical tasks at Hawaiian Commercial and Sugar Co. are discussed. One field in which it has proved of considerable benefit is the publishing of a report on the number of cane haulers required for harvesting each cane field—the total computation time has been cut from 16 hours to about ½ hour.

* * *

Mini-computers for plantation field applications. J. WILLIS. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 147–149.—The system used at Hawaiian Sugar Co. Ltd. in reporting, scheduling and analysing a large number of cane agricultural parameters is outlined.

* * *

Drip irrigation pipe design. I. P. WU. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 156–160.—The designing of a drip irrigation system by means of computer simulation and laboratory tests is explained.

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Effect of hot water treatment on the bud formation of three cane varieties. M. MORÁN S. *Saccharum* (Publ. Cientifica Inst. Central Invest. Azuc., Peru), 1973, (2), 23–50.—Setts from 10, 12- and 14-month cane of varieties H 32-8560, H 37-1933 and PCG 12-745 were subjected to treatment with water at 51°C for 2½ hours to determine the effect on bud sprouting as part of a programme of obtaining seed free from R.S.D. Losses were nearly 70% in all cases, but the first-named variety at the age of 12 months exhibited the highest resistance.

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Effect of phosphorus on the quality and production of sugar cane. S. VALDIVIA V. *Saccharum* (Publ. Cientifica Inst. Central Invest. Azuc., Peru), 1973, (2), 51–66.—Randomized block experiments with doses of 0, 50, 100, 150, 200 and 250 kg.ha^{-1} of P_2O_5 as calcium superphosphate showed no effect on cane or sugar yields nor on quality characteristics (pol, purity, fibre, Brix and reducing sugars) or cane nutrient contents (N, P, K, Ca, Mg and Na). Causes are discussed for the negative response and further trials are planned using different forms and other levels of phosphorus.

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Cane breeding in Barbados. ANON. *Ann. Rpts. W. Indies Central Sugar Cane Breeding Sta. and Barbados Sugar Cane Variety Testing Sta.*, 1970/71, 54 pp.—In an account of the results obtained in the 1970/71 breeding programme, mention is made of the work aimed at broadening the genetic base of the parent collection with concentration on new F_1 selections. A drought stress trial has demonstrated large differences in drought resistance, probably with a strong genetic basis; extreme adaptability tests of this nature are to be a regular part of early generation screening. Chromosome counts have proved an essential part of the basic programme, particularly in order to check cases of uncertain parentage. The earliest backcross families from the new basic programme have contained several promising seedlings. Flowering control work was aimed at establishing the effects, and possible manipulation, of factors other than photoperiod, including early planting and irrigation (found to induce flowering in 21 out of 34 non- or only slightly flowering varieties), planting date-flowering time relationships for ten F_1 clones and three *Saccharum spontaneum* clones (in which staggering of planting dates had a limited effect on flowering delay) and removal of young leaves during and after the induction period or date of flowering (found to have a marked delaying and reducing effect on flowering, while removal of old leaves had little effect). It was also found that the evening twilight period must be considered as a period of darkness for the cane plant, light for the plant probably ending 4–5 minutes before sunset. Irradiation of 11 cane varieties yielded 31 non-flowering mutants plus a number of forms which flowered later than the untreated controls. However, some of the mutants had undesirable properties. Mention is made of new commercial varieties in the B series.

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Studies on germination, control and rate of increase of ratoon stunting disease of sugar cane in hot water-treated cane. G. R. SINGH. *Indian Sugar*, 1974, **23**, 883–888.—Experiments in which setts from 18 cane varieties were treated with hot water at 50°C for 2 hours showed that the treatment had effects on germination and RSD control which differed between varieties, although variations in the degree of control occurred between lots from the same variety.

Sprouting efficiency of cane varieties under autumn planting conditions. O. SINGH and O. S. SINGH. *Indian Sugar*, 1974, **23**, 889–890.—Results are given of tests in which 3-bud setts from early, mid-season and late maturing cane varieties were planted in the autumn and the degree of sprouting determined. It is pointed out that while autumn planting in India has the advantage of permitting intercropping, the lower temperatures experienced then are not conducive to sprouting.

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Nitrogen and sugar cane. XI. Linear growth of cane in relation to leaf nitrogen of elongative phase of the crop. U. S. SINGH. *Indian Sugar*, 1974, **23**, 891–893. Field experiments are reported in which the leaves of spring-planted cane were analysed for total N during July-October, i.e. during the period of maximum stalk growth, and the length of cane at harvest determined as well as average height as a function of seed cane rate and N application. Results indicated a positive relationship between cane height and leaf N which was most marked in September, when a unit increase in leaf N was accompanied by a 68·5 cm increase in the average cane height. Maximum cane height was achieved with maximum number of setts planted and maximum N application.

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Effect of infestation by the scale insect on some growth and quality attributes of sugar cane. S. SITHANANTHAM and K. SAIVARAJ. *Indian Sugar*, 1974, **23**, 895–897. Investigations with three cane varieties indicated that the scale insect *Melanaspis glomerata* caused appreciable reductions in cane weight, girth and sugar content in two varieties while the other cane variety was little affected.

Africa—an introduction to the continent and its sugar cane history. A. McMARTIN. *S. African Sugar J.*, 1974, **58**, 206–218.—An outline is presented of the climates, soils, vegetation, ethnography, cultural history and sugar cane growing in African countries.

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The Experiment Station of the South African Sugar Association. J. WILSON. *S. African Sugar J.*, 1974, **58**, 231–233.—Information is given on the history and development of the Mount Edgecombe Experiment Station from its establishment in 1925, with mention of its more notable achievements.

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Production of sugar cane in South Africa. J. WILSON. *S. African Sugar J.*, 1974, **58**, 243–245.—A general survey is presented of South African cane agricultural practices and problems confronted by growers, including pests and diseases.

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Cane payment system in South Africa. E. MORRISON. *S. African Sugar J.*, 1974, **58**, 253–255.—Details are given of the system of payment for cane and sugar used in South Africa, with mention of the various funds set up to stabilize the sugar industry and help cane growers and the methods used to implement the various payments and regulate costs and prices.

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The Equalization Fund—and how it works. E. MORRISON. *S. African Sugar J.*, 1974, **58**, 257.—An explanation is given of the Equalization Fund, which is designed to assist small cane growers in South Africa by providing a cane payment which is greater than is paid to the large growers.

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A new method to estimate the genetic variance in sugar cane. J. Y. KU, C. Y. KUO and C. C. CHU. *Rpt Taiwan Sugar Research Inst.*, 1973, (61), 1–19.—A method for estimating cane genetic variance was tested and found to give greater effective control of soil differences while permitting more observations of F_1 cross combinations to be used to increase estimating efficiency. High flexibility in estimation of genetic variance was attributed to limitation of the quantitative inheritance of cane by the complex genetic constitution and to the effect of environmental factors.

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A study on growth index of sugar cane plants. T. T. YANG and T. S. HSIEH. *Rpt. Taiwan Sugar Research Inst.*, 1973, (61), 21–30.—Since measurement of cane or stalk height has been found to be an unreliable guide to cane growth over a short period, a new method has been developed in which the daily increase in length of the portion between a point at +4 leaf sheath and one at −2 leaf (the furthest inside visible leaf) about 20 cm above the top visible dewlap is determined. Growth rates of early −1 and −2 leaves were found to be very similar, so that the leaves can be used alternately. The method has proved satisfactorily for both short- and long-time studies of growth. Careful selection of the indicator plants (5–10 normal canes) is necessary.

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Studies on sugar cane irrigation. VII. Effect of irrigation and fertilization on the growth and yield of sugar cane at different locations. C. CHEN, P. D. LIU and Y. T. CHANG. *Rpt. Taiwan Sugar Research Inst.*, 1973, (61), 31–41.—Results are given of tests at different sites in Taiwan with the aim of establishing the effect of irrigation-fertilization interaction on cane growth and yield involved three water-table levels, five soil textures and two cane varieties.

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Sugar cane variety tests in Réunion. G. LOYNET. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1973, 47–50. Tabulated results are given of cane varietal trials under irrigation at Mon Caprice. The data, referring to plant cane and three ratoons, indicate the continuing superiority of R 526 (used as control) as a mid-season cane which couples high yield with a very satisfactory sugar content.

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Cane fertilization in Réunion. J. FRITZ. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1973, 51–59.—N-P-K trials at various sites in Réunion, where three-quarters of the arable land (about 44,000 ha) is under cane, are reported, and brief reference made to studies of lime and sulphur needs. The fertilizer requirements are summarized according to soil type (all of which is of volcanic origin), altitude and other variables.

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Cane borer control. J. ETIENNE. *Rpt. Inst. Recherche Agron. Trop. Réunion*, 1973, 61–69.—Details are given of work conducted in breeding of cane borer parasites. While successful control of the pink borer *Sesamia calamistis* has been achieved, particularly by *Apanteles sesamiae*, which is especially effective in the littoral region and at altitudes up to 1500 m, so far only parasites of the nymphal stage of the spotted borer *Chilo sacchariphagus* have been successful, whereas it is felt that control of the larval stage is desirable. *Diatraeophaga striatalis* has not been successful because of the climatic conditions in Réunion which compare unfavourably with those of Java, the country of origin of the parasite. It is therefore suggested that further research be conducted into establishing parasites to which the Réunion climate is more suited.

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Field operations in Texas. Rio Grande Valley project. ANON. *Sugar y Azúcar*, 1974, **69**, (6), 103–104.—A brief account is given of the work done by Massey-Ferguson 201 harvesters during the 1973/74 season in gathering cane for the W. R. Cowley sugar factory in Texas.

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A new sugar cane ripener. M. L. PULIDO. *Sugar y Azúcar*, 1974, **69**, (6), 105–108.—Information is given on "Bualta", a chemical ripening solution containing 60% of an active ingredient described as poly[oxyethylene (dimethyliminio)ethylene (dimethyliminio) ethylene dichloride] and produced by Buckman Laboratories Inc. At a rate of 0·5 gal per acre, "Bualta" has increased sugar yield compared with untreated controls in three tests.

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Field mechanization. I. B. J. COCHRAN. *Sugar y Azúcar*, 1974, **69**, (6), 114–115.—Cane harvesting under unfavourable conditions and the resultant increase in extraneous matter accompanying the cane to the factory are briefly discussed and details given of a chopper-harvester produced by J & L Engineering Co. which is suitable for Louisiana conditions. The

harvester is provided with pneumatic trash separators, and the chopped cane is fed into a side-dumping trailer without coming into contact with mud and soil. The load densities of cane trailers can be increased (by up to 20% compared with normal loads) by use of hydraulically-operated vibrators attached to the trailer. Removal of mud and soil from windrowed cane can also be improved by increasing the agitation of the cane bundle being pushed by the piler; changing the slope of the bucket prongs on the piler and extending them will enable the cane to be lifted vertically before being pushed forward, thus reducing the amount of mud pushed into the piler during loading.

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Field mechanization. II. W. HUNTER. *Sugar y Azúcar*, 1974, **69**, 114–116.—While Massey-Ferguson 201 chopper-harvesters have proved successful under Florida conditions, operating on both muddy and sandy soils without difficulty, the mechanical topper has not proved as effective as manual cutting, so that the trash content has been somewhat high. On the other hand, the machines cut so close to the ground that one grower has found that they increase the sugar yield by 1–2 tons per acre compared with hand cutting; fields are not damaged by the harvesters, so that ratoon growth has been excellent. Mention is made of a harvester designed and built by the Sugar Cane Growers' Cooperative of Florida, which comprises two machines: one tops, cuts and windrows the cane from two rows, stacking the cane between the rows, while the following unit picks up the cane, chops it into shorter lengths, cleans it and loads it into infield trailers. Advantages include a lower weight than of combines, while the speed of the cutter is not tied to that of the transport. Brief mention is also made of U.S. Sugar Corporation harvesters, which have three extractor fans to remove trash from the cut cane, and a side-mounted topper which cuts the tops of the adjacent row of cane. A semi-automatic ground knife control is now incorporated in the latest design.

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Agronomy and plant physiology research in Mauritius. ANON. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1973, 31–39.—Among results of fertilizer trials were the establishment of yield increases in plant and 1st ratoon cane as a result of K application, even the lowest level tested (70 kg per hectare) causing an increase in the level of extractable K in the more K-deficient soils. A soil Si threshold value was found, below which a net return could be expected following application of calcium silicate. Foliar diagnosis showed that K levels depended on the type of soil, and trials have been instituted to establish optimum levels for each soil type on the island. N, P, Mn and S levels in cane leaf samples were found to decrease with increasing cane age; K, Ca and Mg contents did not alter, while the Si and Cl levels fell with the date of leaf sampling but not with the harvest date. Age corrections are given for N and P. Mention is made of overhead irrigation trials, while a drip irrigation experiment was started at one site to determine cane yields with different spacing between cane rows and dripper lines. A study of the relationship between cane morphology and growth during flowering induction and during inflorescence initiation and development revealed that flowering percentages were greatest in cane 12–16 weeks old at induction and lowest in canes 8 and 24 weeks old. The number of leaves was similar in cane of different ages, but the number of internodes varied. It is concluded that there is an optimum number of internodes for floral induction and that senility may be as important a factor as juvenility in flowering control. The effect of "Mon 045" [N,N bis(phosphonomethyl)glycine] on cane flowering was found to depend on dosage rate and time of application. When applied to cane during the early stages of initiation of inflorescence axis primordium, the chemical reduced flowering, particularly at the highest dosage (3·2 kg per ha). However, at the subsequent stage of development (initiation of inflorescence branch primordia), at rates up to 1·7 kg.ha^{-1} the chemical increased flowering, while at the higher rates it reduced it; at the latest stage of development (elongation of the inflorescence), the chemical reduced flowering, particularly at the high dosage rates. Tests with two cane varieties to establish the effect of flowering on yield showed that generally the effect was beneficial, especially early in the season, and even late in the season there was no adverse effect compared with non-flowering cane. Maturity trials with a number of varieties showed that, generally, date of harvest was the major factor affecting sugar yield, whereby the later the date the lower were the sugar yields, except in the sub-humid zone where sugar yield increased to the latest of the three dates tested. However, increases in sugar content late in the season could not offset the reduction in cane yield caused by late planting. Age of crop had little effect on sugar content and affected cane yield mainly in November (the latest harvest date). Yields were generally very low for late-planted cane. The effects of the above factors on ratoon cane were similar but not so marked. In further trials, fresh weight yield declined significantly with later planting and harvest in all but one of seven environments. The pattern of yield decline depended mainly on locality, but varietal effects were found in some cases. In most instances, the sugar content increased with the later harvest, compensating to some extent for the lower fresh weight yields late in the season. Evaluation of methods of maturity testing confirmed earlier findings of a high correlation between Brix and pol % cane. While the number of samples required for Brix determination was smallest when the top section of cane was used, differences between field- and laboratory-determined Brix were sufficiently small that field determination is recommended in view of the considerably higher costs of laboratory determination. "Ethrel" and "Racuza" ripeners applied to young cane at dosages rates of 1, 2 and 4 kg.ha^{-1} had no significant effect on growth, sugar content or yield; "Mon 045" did increase dry matter and hence sugar content, but affected the cane invertase (which plays a role in sucrose accumulation).

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Levels of starch in sugar cane. M. A. CESAR, E. R. DE OLIVEIRA and M. R. MAZZARI. *Brasil Açuc.*, 1974, **83**, 394–399.—Starch concentrations in a number of Brazilian cane varieties have been measured at intervals during the harvesting season; in general, there was a tendency to increase during the season, but the levels were low by comparison with those of cane varieties in other parts of the world. The highest level, shown at the end of the season by IAC 50-134, was 0·275 mg.cm^{-3} of juice.

Sugar beet agriculture

Summary and conclusions of the investigations carried out on varieties, management and monogerm seed. Years 1964–1970. F. JARA M. *Cultivo de la remolacha azucarera en Chile*, 1973, (2), 84 pp.—The studies were made because of low yields in the Pelchuquín district of Valdivia province and concerned the effects of pre-cultivation, sowing period, plant density and distribution, management and fertility, and the effect of "Dexón" fungicide. The depth and physical nature of the soil imposed limitations on its water-retention capacity so that the yields were closely linked with spring and summer rainfall. While bearing these limitations in mind, improved results could be obtained by adopting standards for sowing and fertilizer application, etc., which are specified for the district.

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Beet yellow wilt. S. ARENTSEN S., R. EHRENFELD and J. PLAZA R. *Cultivo de la remolacha azucarera en Chile*, 1973, (3), 32 pp.—The disease, which is a major cause of loss in Chile, is described in relation to its geographical distribution, history, economic importance, host plants, symptoms, transmission (by the insect vector *Paratanus exitiosus* Beamer and by root exudate), the nature of the pathogenic agent, epidemiology, control (with insecticides), and selection and breeding for resistance. A number of varieties are available in Chile which are adequately resistant to the disease.

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Summary and conclusions from the investigation carried out on "damping-off" of sugar beet plants. Years 1964–1970. ANON. *Cultivo de la remolacha azucarera en Chile*, 1973, (4), 160 pp.—A comprehensive study has been made on this fungal disease affecting sugar beet seedlings in Chile. An account of the work carried out and the findings are under the main headings: the disease (history, hosts, common names, symptoms, pathological histology, distribution, etc.); causal organisms (taxonomy, morphology, physiology, pathogenicity, etc.); pathogenesis (survival of pathogens, inoculum production, viability and dissemination, etc.); saprogenesis and control (cultural practices, effect of sowing period, soil preparation, fertilizers, depth of sowing, spacing, etc.).

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Investigations on soil fertility. Years 1964–1970. O. ROJAS U. *Cultivo de la remolacha azucarera en Chile*, 1973, (5), 140 pp.—The roles of the principal soil nutrients in sugar beet cultivation are described and an account given of fertilizer trials with N, P, K and S in Chile during the period mentioned in the title.

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Occurrence of diseases and pests in 1973 on sugar beet plantations. M. KUBACKA-SZMIDTGAL. *Gaz. Cukr.*, 1974, **82,** 154–157.—A survey is given of the beet pests and diseases occurring in Poland in 1973.

Is it necessary to combat black fly in July? L. VAN STEYVOORT. *Le Betteravier*, 1974, **8,** (77), 9–10.—It is the author's opinion that, provided adequate treatment has been carried out to control beet yellows (application of "Temik" at sowing or repeated spraying with systemic insecticides until the end of June), there is no need to spray the plants in July for black fly control, unless more than 20% of the plants are infested, since such treatment will have no effect on yellows and the populations of black fly rapidly fall to zero by the end of July.

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Wild beet. ANON. *Le Betteravier*, 1974, **8,** (77), 10. Until chemical removal of wild beet is possible, the only method of eliminating this "weed" is removal of the heads (although at the 6–8 leaf stage uprooting of the entire plant is preferable). However, while wild beet tend to seed early, it is pointed out that if the plant is cut too early it will have the opportunity to produce new stalks (which it does very quickly) carrying seeds which can ripen under favourable conditions; hence, there is an optimum date for such treatment, which in future is to be made known to growers each year by l'Institut de la Betterave in France.

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The fertilizer crunch and the sugar beet producer. L. S. ROBERTSON, E. C. DOLL and D. R. CHRISTENSON. *Sugar Beet J.*, 1974, **37,** (3), 4–5.—The soil P, K, Mg and Ca contents on Michigan beet farms are summarized on the basis of 343 samples submitted to the Central Soil Testing Laboratory in the period 1970–72. Recommendations are given on optimum fertilizer usage, including application of nitrogen, for which most soil testing laboratories in the area do not test because of lack of correlation between soil N and beet yield or quality response to the fertilizer. Most of the samples indicated, by their pH, the need for application of both Mn and B, preferably banded at the same time as N, P and K.

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What's buggin' you? R. A. FOGG. *Sugar Beet J.*, 1974, **37,** (3), 6–8.—Descriptions and some illustrations are given of major beet pests to be found in Michigan; information is given on the type of damage they cause and recommendations are given on chemical control. The pests discussed include white grubs, wireworms, flea beetles, cutworms, leaf miners, aphids and lygus bugs.

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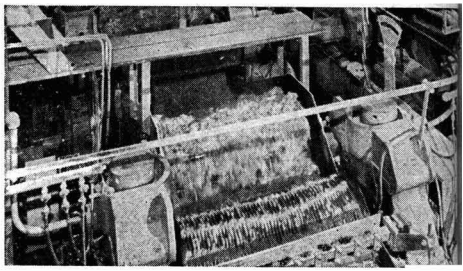
Tillage and soil compression. R. E. VASOLD. *Sugar Beet J.*, 1974, **37,** (3), 8–9.—The advantages of loose in contrast to compressed soil are briefly discussed and the adverse effects of deep tillage considered in association with increased use of mechanization. Careful soil management combined with minimum tillage is advocated.

Cane sugar manufacture



The reflux mill and the reflux milling process. T. M. HAMILL. *Proc. 15th Congr. ISSCT*, 1974, 1708–1718. Details are given of experimental work on reflux milling to extract juice from bagasse of a very high juice:fibre ratio, and descriptions are given of a full-scale mill, two of which were tested at Tower Hill sugar factory, Belize, in 1972. After preliminary difficulties, it was decided to continue the tests with only one mill, using the other as a feeder for it. Results showed that up to 95% of the bagasse pol (in the range 2·52–3·56) was extracted, representing some 27% reduction in milling losses, while two such mills would have reduced the losses by 40%, it is suggested.

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Simulation of mill yard operations by computer. R. G. HOEKSTRA. *Proc. 15th Congr. ISSCT*, 1974, 1736–1753.—Despite earlier findings that use of a spiller would be of advantage in reducing mill yard congestion[1], subsequent studies in which mill yard operations were simulated indicated that vehicle idle times in the mill yard would not be substantially reduced by a spiller, so that it was decided to concentrate on improving mill yard efficiency by increasing the proportion of cane which was sent immediately to the crusher. In order to reduce the stock levels of cane, closer coordination was arranged between the cane haulage and mill crushing programmes, which has contributed to a 35-minute reduction in mill yard residence time, considered by the transport company to be a big improvement. Full details are given of the computer programmes and simulation results.

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A simulation study of on-line imbibition control. J. H. GOUWS. *Proc. 15th Congr. ISSCT*, 1974, 1754–1770. Simulation of the performance of a 6-mill tandem using a dynamic model based on data collected by a computer system[2] was aimed at investigation of imbibition control possibilities based on cane input. It was shown that an improvement in extraction of 0·2–0·5% (absolute) could be expected by controlling the imbibition to the last mill, especially where the cane input rate varies considerably about the average for short periods (of a few minutes). The improvement in extraction would be more marked at lower average imbibition rates.

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Pilot studies on cane mud filtration. D. J. HALE, T. W. MEREDITH and E. WHAYMAN. *Proc. 41st Conf. Queensland Soc. Sugar Cane Tech.*, 1974, 269–278. Tests on a pilot-scale rotary filter at Farleigh sugar factory are reported, in which the effects of drum speed, flocculants, lime, bagacillo, water and pick-up vacuum were determined. While the results largely confirmed well-known or accepted aspects of filter operation, serious doubts were raised regarding present cane mud filter design. Further investigations are called for in order to verify if considerable increases in filter capacity and a reduction in the quantity of filtrate recycled are possible, as indicated in the tests.

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Bagasse stored in cylindrical silos. D. G. FRY. *Proc. 41st Conf. Queensland Soc. Sugar Cane Tech.*, 1974, 279–284.—The design and control of cylindrical bagasse silos are discussed and the rectangular and cylindrical types briefly compared.

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Problems encountered in the conversion of sulphitation sugar factories into double carbonatation sugar factories. T. C. ZINGAN. *Sugar News* (India), 1973, **5**, (8), 13–16.—See JHINGAN: *I.S.J.*, 1974, **76**, 373.

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Some important aspects of low-grade massecuite boiling. A. L. R. GOWDA and D. V. RAO. *Sugar News* (India), 1974, **5**, (9 & 10), 24–26.—In this discussion of low-grade boiling, attention is centred on seeding and seed slurry preparation, reference being made to the methods used at the authors' sugar factory.

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Instrumentation in the sugar industry. Application to steam generation and utilization. B. A. SREEKANTH and V. V. SUBBARAO. *Sugar News* (India), 1974, **5**, (9 & 10), 27–31.—Control of bagasse furnace parameters, boiler water feed and evaporator operation is discussed.

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Cane varieties and the consumption of supplementary fuel in the factories. V. ALEMÁN. *ATAC*, 1974, **33**, (1), 38–49.—A study was made of the effect of five cane varieties in respect of the bagasse produced from them and its adequacy for steam raising. Not only are the fibre and moisture contents of the bagasse controlling factors on its quality, but so is its density and granulometry, and all vary with the cane. The juice content of the cane also governs the amount of steam needed for processing and the characteristics of the cane variety are thus determining factors in the need to use supplementary fuel.

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Cane sugar factories can add to energy resources. A. C. CHATTERJEE. *Indian Sugar*, 1974, **23**, 801–804. The question of producing sufficient power to meet the requirements of cane processing and sell the surplus to other customers is discussed and the economics under Indian conditions are set out.

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[1] HOEKSTRA: *I.S.J.*, 1974, **76**, 181.
[2] GOUWS: *ibid.*, 213.

Test results of a rock removal pilot plant for cane dry-cleaning. D. LEWIS and B. MCELHOE. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 89–94.—Data obtained from tests with the dry-cleaner rock removal unit at Pioneer[1] indicated that with optimum settings (feed conveyor speed of 200 ft.min^{-1}, rock gap width of 48 in, air velocity of 180–200 ft.sec^{-1} and an air flow rate of 9000 ft^{3}min^{-1} per ft of conveyor width), 100% rock removal is possible at a total cane loss below 0·6% net cane, a fibrous trash reduction of 30% and a maximum throughput of 20 tons of cane per hr per ft of conveyor width.

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Wrap-up of cane dry-cleaning—what have we learned? W. GIBSON. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 95–96.—A résumé is presented of research on cane dry-cleaning in Hawaii, starting with the construction of a small, batch unit and ending with successful testing of a unit with rock removal and cane rinsing (where necessary) which is in operation at Papaikou, while another is being built for Pepeekeo factory. The possibility of washing dry-cleaned cane with juice is to be investigated.

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Proposed method of trash dewatering and incineration at Laupahoehoe Sugar Company. D. KENNY. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 97–98.—A brief account is given of the system of trash disposal which it is proposed to introduce at the author's sugar factory, whereby all the trash removed from the various stages in the cleaning plant is flumed to a screen conveyor in front of an old milling train. It is passed through a Ducasse shredder and then through a six-roller milling tandem for dewatering, after which it is fed via the bagasse conveyor to the furnace together with bagasse. Features of the new bagasse furnace under construction at the factory are described; it is expected to be able to burn all the bagasse and trash while still satisfying anti-pollution requirements.

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Dust collection for bagasse-fired boilers. L. R. NEWTON and R. FERNANDEZ. *Rpts.* 1973 *Meeting Hawaiian Sugar Tech.*, 99–109.—The question of bagasse fly-ash collection is discussed and the technical and economic advantages of the "Multiclone" collector and "Turbulaire" scrubber as a combination are explained.

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Early history of the South African sugar industry. A. G. HAMMOND. *S. African Sugar J.*, 1974, **58**, 223–225. A brief survey is presented of the South African sugar industry from the mid-18th Century onwards.

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Sugar manufacture in South Africa. M. MATIC. *S. African Sugar J.*, 1974, **58**, 235–241.—A brief account is presented of the development in South African sugar manufacture, with indications of the improvements since 1925 in cane throughput and factory performances. The author deals separately with milling, clarification and filtration, evaporation and boiling, and describes the typical equipment and processes used.

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Bulk sugar terminal is showpiece of sugar industry. ANON. *S. African Sugar J.*, 1974, **58**, 259.—A brief description is given, with an illustration, of the bulk sugar terminal at Maydon Wharf, Durban, which has a total storage capacity of 520,000 metric tons and a high-speed plant for coating sugar with molasses. An automatic plant is also available for bagging of sugar if the overseas customer so desires. Completed in October 1973, the terminal is estimated to have already paid for itself in reducing the time taken to load ships.

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A report on the control of environmental pollution at TSC's factories. ANON. *Taiwan Sugar*, 1974, **21**, 42–51.—Results achieved at Taiwan Sugar Corporation factories (sugar factories and various other types of plant, including a bagasse board factory) in reducing atmospheric pollution by boiler stack emission are reported, and details given of the water spray method which has so far proved to be the most effective and most economical method of reducing bagasse furnace fly-ash. Briefer mention is made of the problems of treating effluent from various types of plant (see CHUANG & LAI: *I.S.J.*, 1975, **77**, 158).

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Qualitative study of sugar mills' effluents. ANON. *Taiwan Sugar*, 1974, **21**, 52–55.—Reference is made to the Taiwan official regulations on factory effluent treatment and disposal, and terms used in determining water quality are explained. Guidance is given on water analysis, and suggestions are made for the control of sugar factory effluent.

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Mumias Sugar Company Limited: a new project in Kenya. ANON. *Sugar y Azúcar*, 1974, **69**, (6), 41–43. A brief account is given of the Fletcher and Stewart-built cane sugar factory at Mumias and of the agricultural techniques and equipment used.

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"Presidente Benito Juarez". Another new sugar factory for Mexico. ANON. *Sugar y Azúcar*, 1974, **69**, (6), 93–94.—Information is given on this new 6000 t.c.d. factory which was intended for start-up in late 1974.

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Roles of pith and fibre in cane preparation and milling. G. K. CHETTY and Y. G. DAS. *Sugar News* (India), 1974, **5**, (12), 7–9.—The authors discuss the disadvantages of a high pith content with respect to cane preparation and milling; it is pointed out that when cane was fed whole into the mill, the problem did not arise, since the pith adhered firmly to the fibre, whereas with modern cane preparation the two components are separated and pith causes mill chokes.

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Molasses formation. S. NARAIN. *Sugar News* (India), 1974, **5**, (12), 11–13.—The effects of a number of cane and process variables on molasses formation are discussed and possible remedies indicated.

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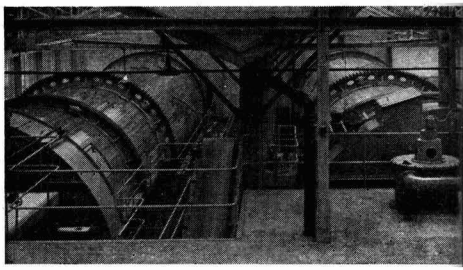
The influence of non-sugar in crusher juice on low-grade ratio. J. M. BINUEZA. *Sugar News* (Philippines), 1974, **50**, 57–62.—Derivation of a formula for calculating "low-grade ratio" (expressed as ft^3 of low-grade massecuite per ton of cane) is explained. While the ratio is affected by a number of variable factors, the greatest influence is exerted by the crusher juice non-sugars content, and the author discusses ways in which the non-sugars content can be reduced, with particular emphasis on the need for inversion control throughout the factory.

[1] *I.S.J.*, 1974, **76**, 245.

Beet sugar manufacture



Examination of anode materials for cathodic protection of metal in diffusers. V. V. SUPRUNCHUK, V. V. FESENKO, P. P. TUROV and A. L. SHOIKHET. *Izv. Vuzov, Pishch. Tekh.*, 1974, (2), 121–124.—Of 14 metals and alloys tested for their electrochemical durability, degree of passivation and mechanical strength, the most suitable for use in the manufacture of anodes for cathodic protection of diffuser metal against corrosion was found to be titanium. Subsequent tests showed that cathodic protection had no adverse effect on raw juice and subsequent products.

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Generalization of experimental data on heat transfer during massecuite boiling in a large vessel. V. T. GARYAZHA and V. R. KULINICHENKO. *Izv. Vuzov, Pishch. Tekh.*, 1974, (2), 142–145.—Equations are presented for calculation of heat transfer coefficients under conditions of convective heat transfer and ebullition.

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State of, and ways of improving, control and calculation of sugar production. A. YA. ZAGORUL'KO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 5–11.—Information is given on the state of chemical control in the Soviet sugar industry and instruments developed for it in recent years, and four major lines of development for future work in this field (covering determination of the major process parameters in both factory and refinery) are set out.

* * *

Means of reducing sugar losses in beet during reception, storage and feeding to process. A. YA. ZAGORUL'KO *et al. Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 37–49.—Ways in which losses can be reduced at reception, during storage and in fluming are examined. The methods are particularly applicable to conditions in the USSR, where beet are stored for a long period, often during sharp frosts, and where a proportion of the beet is transported by rail. To reduce fluming losses, the authors advocate installing large hoppers above the beet knives, capable of holding enough beet for 45 minutes' processing, widening of flumes and elimination of any control devices which might prevent flow of beet. Implementation of these methods would also considerably reduced the fluming time.

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Mathematical definition of calculated sugar losses in filtration. A. YA. ZAGORUL'KO and A. A. PONOMARENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 61–70.—Differential equations are developed from which is derived an equation for calculation of sugar losses in filter cake. Mathematical analysis shows that the amount of sweetening-off water used has little effect on the losses unless the quantity of water is extremely high or low. The losses can be reduced, it is suggested, by raising the temperature of the water, increasing the sweetening-off time, reducing the initial mud sugar content and by raising the value of the Biot number (given by $R\frac{\beta_f}{D_f}$, where R = mud particle radius, β_f = mass transfer coefficient and D_f = coefficient of sugar diffusion in the pores of the mud particle).

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Causes of above-standard molasses sugar content and measures for reducing it. A. YA. ZAGORUL'KO *et al. Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 71–77.—Major causes of molasses sugar losses which were above the norms at a number of Soviet sugar factories were found to be: inadequate exhaustion of low-grade massecuite and formation of excessive quantities of reducing and colouring matter as well as lactic and acetic acid as sucrose decomposition products. Advice on how to reduce the losses concerns all stages from beet reception to massecuite crystallization.

* * *

Method of reducing sugar losses in beet sugar manufacture. A. YA. ZAGORUL'KO, E. T. KOVAL', S. A. BOGDANOV and V. P. LYSIKOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 96–109. Methods of reducing losses include: recycling press water to diffusion, carrying out diffusion under vibratory conditions (this cut losses from 3·29% to 2·28% on weight of beet), using a single-scroll sloping trough diffuser, and modifying the pan station. To reduce undetermined losses, it is recommended to ensure that reducing sugar formation is minimal in storage and diffusion, to treat the stored beet with chloride-of-lime, maintain thick juice and massecuite pH at optimum levels, etc. The use of statistical and digital computer methods for optimization and loss evaluation is also advocated.

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Precise chemico-technical control and calculation of beet reception, storage and transfer to processing at Gaisin, "Oktyabr" and Drokiya sugar factories in 1964-69. A. YA. ZAGORUL'KO *et al. Trudy Vsesoyuz. Nauch-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 127–144. From an examination of the materials and loss balances at these three Soviet factories, which represent different approaches to beet storage, recommendations are given on suitable ways of reducing losses, and loss standards are set.

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Fundamentals of conductimetric control of massecuite boiling. III. Dependence of electrical conductivity on the supersaturation coefficient. V. VALTER. *Listy Cukr.*, 1974, **90,** 111–117.—The relationship between conductivity κ and supersaturation Kp is described by the equation $\log \kappa = \alpha - \beta \log Kp$, where α and β are dependent on non-sugars composition and concentration, β having a value which is reasonably constant at 2·8.

Synthetic surface-active substances in the sugar industry. II. K. Číž, Q. Mann and V. Čejková. *Listy Cukr.*, 1974, **90**, 127–130.—Tests with Hodag CB-6 and "Intrasol FK" surface-active agents are reported. While both caused a sharp reduction (of nearly 50%) in sugar solution surface tension when added at 0·05% by weight, when added to 80°Bx molasses solutions at up to 0·3% by weight they caused only slight change in viscosity at temperatures in the range 40–80°C. Hodag CB-6 added at the rate of 0·01–0·05% to 86–88°Bx molasses solution caused only slight fall in purity. Addition of 0·05% "Intrasol FK" to middle-product and low-grade massecuite caused little change in surface tension and purity; the surface-active agent had less influence than did non-sugars on surface tension.

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The 1973 campaign (in West Germany). E. Reinefeld. *Zucker*, 1974, **27**, 349–358.—An account is given of the 1973/74 beet campaign in West Germany, covering both agricultural and factory processing aspects and indicating some general problems as well as difficulties encountered at specific sugar factories, or with specific pieces of equipment. Particular mention is made of BMA tower diffusers; apart from the question of side screen effectiveness (investigations have shown that they *are* effective and should be retained), attention has also been focused on cossette transport, systematic examination of which is difficult and for which no satisfactory theory has been provided. Some drive problems have been encountered with large tower diffusers. While an Enviro-Clear rapid settler has given very good results, yielding a clear juice containing no "harmful colloids", the question is whether to use filter-thickeners or settlers and, if the latter are used, whether secondary filtration of the clear juice can be omitted. Tests on Putsch frame filters (batch filter-thickeners) and plate filters (for thick juice fine filtration) have demonstrated their high efficiency. Other subjects discussed include boiling (both batch and continuous), with a brief mention of a Buckau-Wolf massecuite stirrer driven by a motor located below the pan, and tests on BMA centrifugals. The question of thick juice storage (so far not practised in West Germany) is briefly discussed, as is the issue of energy supply and costs of fuel oil. In an examination of effluent treatment, the relationship between BOD_5 and COD as indicators of organic load is discussed and ways of improving the performance of waste water plant considered, with references to results achieved outside West Germany. The costs of effluent treatment are also briefly discussed.

* * *

The energy situation in a sugar factory with particular reference to conditions at Ochsenfurt. G. Witte. *Zucker*, 1974, **27**, 358–363.—Considering each individual process in turn, the author shows how it is possible to reduce steam consumption throughout a beet sugar factory slicing 7600 tons of beet daily by 25%. About half of such a saving is shown to be possible in the sugar house, although this would entail marked changes to the boiling scheme.

* * *

Possibilities and problems in water and effluent treatment in the sugar industry. J. Reuter. *Zucker*, 1974, **27**, 363–367.—After a brief general appraisal of the water situation in a beet sugar factory, the author examines those areas where the use of organic synthetic polyelectrolytes can be of benefit, e.g. in treatment of raw feed water and flume water, secondary treatment of biologically treated effluent and in dewatering mud from biological treatment of waste water.

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Heat energy demand in continuous diffusion. E. Waleriańczyk. *Gaz. Cukr.*, 1974, **82**, 137–141. Heat and steam balances are presented for a trough-type continuous beet diffuser, showing how the steam demand increases considerably when the temperature of the cossettes falls below +10°C; at a cossette temperature below −4°C the cell juice undergoes partial freezing.

* * *

Use of a minicomputer for calculations of mass flow in a sugar factory. A. Kubasiewicz and W. Lekawski. *Gaz. Cukr.*, 1974, **82**, 144–146.—Application of a 425G Compucorp computer to simulation of beet sugar processes in order to calculate the sugar balance (to within 0·001% on beet) is described with the aid of a block programme.

* * *

Development of techniques and basic trends in intensification of massecuite boiling, crystallization and centrifugalling. Yu. D. Kot. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 3–14. Means of intensifying sugar house operations are analysed on the basis of research conducted in recent years. Particular attention is focused on the use of continuous processes.

* * *

Simulation of industrial massecuite crystallization processes. Yu. D. Kot. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 15–36.—Mathematical expressions are derived which define boiling parameters and which can be applied to process and steam calculations for multi-sectioned vacuum pans, and for automatic boiling control. A number of idealized models are examined from which it is concluded that a maximum crystal growth rate can be obtained in either a batch pan or a direct-flow continuous pan based on ideal displacement.

* * *

Run-off of viscous fluids from the surface of crystals during centrifugalling. B. N. Tereshin. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 36–43.—Equations are presented which describe the mechanism of syrup removal from the crystal surface during centrifugalling under non-steady conditions. Use of the expressions to simulate the process and permit calculation of the mass transfer coefficient is demonstrated.

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Throughput of a crystal generator under continuous conditions. L. G. Belostotskii, A. K. Sushchenko and G. G. Mikhail'chuk. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 43–46.—In a continuous system consisting of a concentrator, crystal generator and a crystal growth chamber, the processes in the last two sections can be related mathematically by the ratio between the crystal content in the suspension leaving the crystal generator and that in the massecuite after the crystal growth chamber, given the crystal sizes in both suspension and massecuite. A

formula is presented which is based on this assumption, and calculated results are presented for a continuous system tested at Yagotin experimental factory.

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Use of Hodag CB-6 preparation to improve sugar crystallization. YA. G. ROPOTENKO, YU. D. KOT, Z. I. BEREGOVAYA, L. V. EREMENKO and ZH. I. KATROKHA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 47–52.—In tests at Yagotin, Hodag CB-6 surface-active agent added to 1st and 2nd massecuite at 0·001–0·05% by weight caused a slight reduction in boiling time; in the case of 1st massecuite it also gave a slight increase in purity and crystal content, and particularly improved the white sugar granulometry, while with 2nd massecuite it was effective in increasing molasses exhaustion. Optimum dosage was 0·01% by weight.

* * *

Determination of optimum crystal size in boiling and centrifugalling. L. F. UROVSKII. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 58–64. A method is presented for calculation of boiling and centrifugalling parameters to yield a crystal of optimum size from the point of view of process economics.

* * *

Low-grade massecuite boiling and crystallization. A. L. SOKOLOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 65–69.—From a study of the effect of massecuite crystal content and crystal size on crystal growth during boiling and crystallization, it is concluded that sugar yield can be increased by boiling low-grade massecuite on a footing of sufficient crystal content to maintain an optimum ratio between the solids and mother-liquor. Molasses addition to the massecuite reduces the solids proportion, while dilution water reduces crystal yield and molasses exhaustion. Intermediate centrifugalling of massecuite helps improve molasses exhaustion by reducing the crystal content and viscosity, but extra equipment is required and personnel have to maintain optimum conditions throughout the process.

* * *

Experience in the use of the VNIISP crystallization scheme for lower purity products. YU. D. KOT, A. K. SUSHCHENKO, B. N. TERESHIN and G. G. MIKHAIL'CHUK. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 78–80.—A brief account is given of experience with the VNIISP 3-product scheme in which part of the 2nd massecuite is used as footing for low-grade strikes, thus permitting improvement in molasses exhaustion, better massecuite centrifugalling and greater yield of sugar, while white sugar colour is reduced. Advice is given on regulation of low-grade massecuite purity and crystal size.

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Operating conditions for new types of centrifugals. B. N. TERESHIN and N. F. SHURBOVANYI. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 80–85.—Advice is given on correct operation of a number of centrifugals newly introduced in the USSR, including the Hein, Lehmann "Konti-8", BMA K-750 and Sangerhausen FKV-630 conical-basket continuous centrifugals, Bosco B-7, Polimex-Cekop and Sangerhausen fully-automatic centrifugals, and Soviet continuous and fully-automatic machines.

Sulphitation of viscous products in beet sugar manufacture. V. Z. SEMENENKO, YU. D. GOLOVNYAK, YU. V. ANIKEEV, L. D. BOBROVNIK and A. R. SAPRONOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 86–96.—Investigations have shown that the concentration of SO_2 necessary for syrup sulphitation, whereby further colour formation is prevented in sugar house products obtained from the syrup, is determined by the amount of free SO_2 present (the greater the quantity the less colour formed) and is governed by the syrup composition and pH. For practical purposes, formation of colouring matter will not occur in the presence of 0·5 mol SO_2 per mol of newly formed reducing matter. In tests, sodium sulphite added to massecuite in the pan station inhibited colour formation and stabilized pH, thus reducing sugar losses. High quality sugar was produced even when beet quality was poor.

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Continuous unit for massecuite production. A. K. SUSHCHENKO *et al. Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 96–103.—Tests are reported on 1st massecuite boiling in a continuous vacuum pan. While massecuite Brix and colour as well as molasses exhaustion were as good as with batch boiling, sugar crystal uniformity was not as good.

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Intensification of massecuite boiling with use of forced circulation and feeding of reheat steam. L. G. BELOSTOTSKII, A. K. SUSHCHENKO, A. I. SAVICH, A. V. VLASENKO and G. I. ZAZIMKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 103–107. Investigations showed that use of a massecuite stirrer and feeding of reheat steam from a concentrator for 1st massecuite boiling considerably increased heat transfer and reduced boiling time, inhibited colour formation, and reduced the moisture and ash contents of the final dried sugar, the granulometry of which was also improved compared with boiling without reheat steam.

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The continuous saccharate plant at Origny Sainte-Benoite. C. OF and P. CREDOZ. *Sugar y Azúcar*, 1974, **69**, (6), 97–99.—See *I.S.J.*, 1974, **76**, 279.

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Development of the sugar industry in Iran. M. MONAZAHIAN. *Zeitsch. Zuckerind.*, 1974, **99**, 347–350.—A survey is presented of the sugar industry in Iran, which includes 32 beet sugar factories, 1 cane sugar factory, 1 refinery and 2 combined sugar factories and refineries. A map showing locations of the factories is presented, and future developments aimed at making the country self-sufficient in sugar are mentioned.

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Production of liquid sugar in West Germany. F. PITTALUGA. *Ind. Sacc. Ital.*, 1974, **67**, 61–62.—A survey of liquid sugar production in West Germany, now up to 340,000 metric tons per year, is described on the basis of a visit made by the author.

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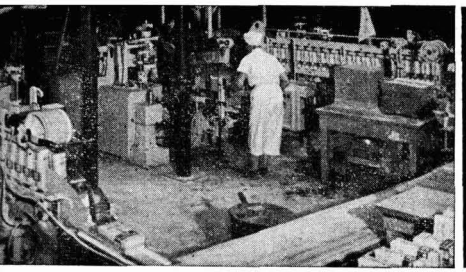
Sugar research in Morocco. M. DEBBARH. *Sucr. Maghrébine*, 1974, (11), 5–7.—For the non-sugar technologist, the author explains the various sugar loss components which make up the total loss balance of a beet sugar factory.



Sugar refining

A new automatic defecation-decolorization station using the "Talofloc" process. J. T. RUNDELL, C. V. RICH and A. E. NORCOTT. *Proc. 32nd Meeting Sugar Ind. Tech.*, 1973, 58–70.—A brief description is given of the design, construction and start-up of a new plant for phospho-defecation and decolorization of sugar liquor by the "Talofloc" process[1] which has an hourly capacity of 40 tons, with fully-automatic control of pH, liquor flow and addition of the chemicals ("Talofloc" and the phosphatation reagents being added before the pump delivering to the clarifier, and "Taloflote" between the pump and the clarifier). The clarifier mud treatment is in two stages, permitting elimination of mud presses and direct disposal of the mud. Details are given of problems encountered in the initial stages and their remedies, and capital and processing costs are discussed. Advantages of the system include a considerable reduction in operating costs compared with the previous phosphatation-filtration system using carbon.

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Automation of a white sugar pan. L. A. ANHAISER. *Proc. 32nd Meeting Sugar Ind. Tech.*, 1973, 102–107. Information is given on automatic control of a white sugar pan at Sugar Land, Texas. The Honeywell system used is based on refractometric measurements for seeding, the massecuite stirrer as mobility sensor for pan feed control, and a cam for absolute pressure control. The sequence of operations is described from charging to discharge and steaming-out; the possibility of reversion to manual control is provided.

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Study of continuous crystallization in the refinery. P. H. PETRI and R. C. BENNETT. *Proc. 32nd Meeting Sugar Ind. Tech.*, 1973, 108–138.—Tests with a pilot-scale version of the continuous boiling system developed by the Swenson Division of Whiting Corporation[1] are reported, in which hourly operating conditions on refinery liquor and syrup were recorded as well as product analyses. The crystal slurry was continuously cooled in a crystallizer and cured in a centrifugal as usual. Results showed that the crystal sugar was of higher purity with fewer conglomerates than in batch boiling. Re-crystallization of melted raw gave excellent results, but the system is unsuitable for remelt or recovery operations. It was concluded that relatively long retention times are necessary to allow the self-generated seed to reach the target size; because of the low growth rate of small crystals, seeding was not effective at below a seed crystal size of 200μ.

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Environmental water quality standards in the cane sugar refining industry. T. W. BAKER. *Proc. 32nd Meeting Sugar Ind. Tech.*, 1973, 139–159.—Guidelines in the Federal Water Pollution Control Act of interest to cane sugar refiners concern effluent limitations and pre-treatment of effluent. The discharge potential and performance of a refinery were compared, showing that if control measures had not been practised, a total theoretical daily load of 20,846 lb BOD_5 would have been discharged, whereas an actual 4,250 lb BOD_5, representing 20% of the potential, was estimated. Statistical analysis of the various factors involved showed that, despite the excellent reduction in BOD_5 attained, particularly with use of a joint municipal treatment scheme, the compliance with the limitations set by legislation is *apparently* only marginal, but that, in fact, the BOD_5 levels are about half of the guideline limitation, almost complete reduction in discharge potential being achieved. The error is due to unsuitability of the statistical method used for evaluation.

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Pollution control symposium. (*A*) A. M. BARTOLO. *Proc. 32nd Meeting Sugar Ind. Tech.*, 1973, 173–176. (*B*) R. J. HERRING. *ibid.*, 177–178.

(*A*) The Federal Water Pollution Control Act and its effect on sugar refining in the USA are discussed and measures to permit a reduction in the BOD levels briefly listed. The question of air contamination is also examined and the quantities given of various pollutants that a medium-size refinery can expect to emit each year.

(*B*) The author briefly indicates how Savannah refinery has been able to comply with regulations covering discharge of effluent into the local river.

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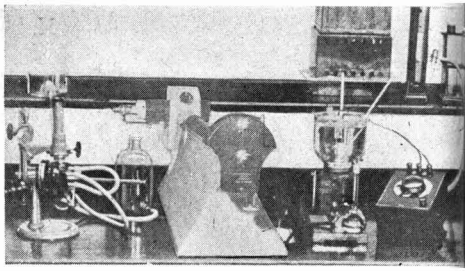
Production of amorphous refined sugar in Brazil. F. M. D. LEAO. *Proc. 15th Congr. ISSCT*, 1974, 1246–1254.—The processes used in the production of amorphous refined sugar, a finely powdered, quick-dissolving sugar, as practised at plants owned by Cia. União des Refinadores, are described and future prospects discussed. White raw sugar liquor is filtered, run twice through bone char cisterns and concentrated by rapid evaporation (7–9 minutes per strike of 700–800 kg of sugar) in open pans where steam coils raise the temperature of the charge to 120–122°C to form a highly concentrated magma of about 93°Bx. The magma is then treated for 4–7 minutes in beaters where instant crystallization takes place on cooling; the sugar, of about 2% moisture content and a temperature above 90°C, is fed to cooler/dryers, screened and packaged. Grade 1 amorphous sugar has a maximum moisture content of 0·30%, a minimum pol of 99·0, a maximum colour of 20 ICUMSA units (at 560 nm) and a maximum ash content of 0·20%; Grade 2 amorphous sugar has corresponding values of 0·40%, 98·5, 30 units and 0·20%. The major problem affecting amorphous sugar quality is the invert sugar content. Although clarification is not used at present, it is to be used in the future.

[1] BENNETT *et al.*: *I.S.J.*, 1972, **74**, 313.
[1] BENNETT & CALDWELL: *ibid.*, 1971, **73**, 316.

Laboratory methods & Chemical reports



Estimating the yield of sugar cane and the division of sugar monies. W. F. ALLISON. *Proc. 15th Congr. ISSCT*, 1974, 1437–1445.—The significance of sugar yield estimation in assessing farm and factory efficiency is discussed and formulae for cane quality determination examined. It is considered that determination of cane fibre and extraneous matter is just as important as pol and Brix measurement, and elimination of the F-factor (error of estimate) from the formula used is regarded as desirable. For 96° sugar the author recommends the following formula:

$$R = 1{\cdot}0417 \times \left[\left(\frac{102{\cdot}5 - 0{\cdot}85\,fc}{100}\right)\left(S - \frac{B - S}{2}\right) - \frac{3{\cdot}26\,fc}{102{\cdot}5 - 0{\cdot}85\,fc}\right],$$

where R = rendement, S = pol % cane, B = Brix and fc = fibre % cane + extraneous matter % cane. He also recommends penalties based on the system used in Australia so as to encourage efficient cane farming and processing, and give a fair distribution of monetary returns.

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Micro-structure of sugar cane tissue for solid-liquid extraction. H. J. DELAVIER and R. SHOKRANI. *Proc. 15th Congr. ISSCT*, 1974, 1475–1485.—Electron microscopy was applied to a study of cane tissue under the effects of pressure or thermal denaturing. Photomicrographs show how circular pores in the cell wall in intact tissue become oval with treatment and form canals within the tissue through which the contents of the cell might be expelled during diffusion. This demonstrates that sugar extraction may be more a flow mechanism than molecular diffusion. The techniques used in the study are explained.

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Effect of the carbohydrate complex in beet on determination of beet sugar content by polarimetric methods. A. YA ZAGORUL'KO and A. A. PONOMARENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 12–28.—Investigations are reported in which paper and thin-layer chromatography as well as microchemical methods were applied to analysis of beets of varying quality. Chromatograms are reproduced, showing the various sugars identified; thin-layer chromatography also revealed the presence of dextran and levan. It was found that the content of optically active substances decomposing under the effect of lime during heating could be calculated, within limits of normal experimental error, from the amount of reducing sugars (fructose, glucose, maltose and *iso*-maltose) and their specific rotation relative to that of sucrose. The difference between the polarimeter reading after hot water digestion and after alcoholic extraction was calculable from the contents of dextran and levan, their specific rotation relative to sucrose and from the change in polarization resulting from alteration in the value of the "juice coefficient" (beet sugar content divided by pressed juice sugar content found by direct polarization).

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Differences between digestion of beet, submitted for processing, and digestion of a beet cossette. A. YA. ZAGORUL'KO, T. P. KHVALKOVSKII, S. A. BOGDANOV and L. A. KOROBEINIKOVA. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 29–36.—A mathematical method of calculating the difference between beet sugar content and cossette sugar content is described, which permits either to be found when the other is known. Calculated and experimental values agreed satisfactorily.

* * *

A gravimetric method of determining the sucrose content in beet and other sugar factory products. A. YA. ZAGORUL'KO and A. A. PONOMARENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 50–60.—Details are given of a method in which the sucrose is precipitated with barium hydroxide from an alcohol extract of beet brei (or a juice or sugar solution sample), the suspension filtered, the barium saccharate treated with CO_2, the aqueous sucrose solution then demineralized in a mixed bed ion exchange column, and an aliquot evaporated to yield a final powdered sucrose, which is then weighed. A preliminary run with standard samples is advocated before a series of routine determinations.

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Comparative evaluation of methods for determining sugar losses in pulp, diffusion water, filter mud and molasses. A. YA. ZAGORUL'KO *et al. Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20,** 78–95. Comparison of a number of methods for determination of sugar in the beet sugar factory products mentioned in the title showed that direct polarization after hot water digestion gave the most accurate results for pressed pulp (although cold water digestion, alcohol extraction and a gravimetric method were also considered sufficiently accurate for routine determination of sugar in exhausted cossettes). For determination of sugar in diffusion water, polarimetric measurement was better than a combined alcohol extraction-gravimetric method as was the case with filter cake. For molasses sugar determination, six different methods were tested; none determined the true sucrose content, although a combined gravimetric-polarimetric method was the most accurate. While this gave the combined sucrose-raffinose-kestose content, raffinose and kestose were found not to have any effect on the sucrose balance not did they distort the undetermined loss figure.

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Examination and evaluation of factory control methods for lime and milk-of-lime. A. YA. ZAGORUL'KO, T. P. KHVALKOVSKII, L. A. KOROBEINIKOVA and A. A. PONOMARENKO. *Trudy Vsesuyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20**, 110–120.—Methods were compared for determination of total and free CaO in lime, milk-of-lime, limed and carbonatated juice and for milk-of-lime density determination. Values obtained are tabulated and merits and demerits of specific techniques are discussed. A formula developed by SKORBILIN is found to give CaO contents in juices which are lower than the true values by a small percentage in the first half of the campaign and by a much larger percentage in the second half. A method is described which bases the total CaO content in limed and carbonatated juice on raw juice organic and inorganic acid contents.

* * *

Semi-automatic line for determination of the sugar content in beet at reception. A. YA. ZAGORUL'KO *et al. Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1973, **20**, 121–126.—A description is given of a Soviet-designed semi-automatic line for beet sugar determination in the tarehouse laboratory.

* * *

Sucrose crystallization in pure aqueous solutions. Mechanism of fines or false grain formation. –. GIORGI, –. HONORÉ and –. DUFRENNE. *Sucr. Franç.*, 1974, **115**, 305–310.—It was found that during continuous boiling the linear rate of crystal growth was identical in all compartments of the Five-Cail Babcock pan while at any one time supersaturation varied between compartments; modifications to process control to maintain a supersaturation which was identical in all compartments led to formation of false grain and centrifugalling difficulties. Laboratory experiments were carried out to determine the relationship between crystal growth rate and false graining. At a supersaturation in the range 1·01–1·10, a temperature of 76°C and in the presence of a sugar crystal, false grain formed in the pure sugar solution at a clearly defined crystal growth rate (obtained either by stirring the solution or by adjustment of the supersaturation, or by both). The presence of a marked quantity of false grain was indicated by "milkiness" of the solution. The formation of false grain is attributed to the greater effect of diffusion rate of sugar in the mother-liquor on the kinetics of crystallization than of the surface reaction rate, although the diffusion rate is the slower. Under factory conditions, stirring is intended to homogenize the mass and reduce boiling time while improving crystal quality; but when the maximum crystal growth rate is achieved, further increase in stirring of the massecuite does not bring any further reduction in time, although it does permit a reduction in supersaturation at constant growth rate to give better exhaustion. However, under the effect of thermal agitation, packets of molecules emitted by the crystal are more soluble than the crystal itself, and grow or are dissolved according to the sugar concentration in the vicinity of the crystal.

* * *

Studies on the refining quality of Taiwan raw sugar. The filtrability of carbonatated slurry under addition of different quantities of CaO. Y. C. CHENG, C. H. CHEN and S. A. LU. *Rpt. Taiwan Sugar Research Inst.*, 1973, (61), 59–67.—Raw sugar samples from Taiwan sugar factories were affined and melted and the resultant liquor subjected to continuous laboratory carbonatation at 80°C with addition of 0·2–1·5% CaO (on solids) to a final pH of 8·2. The filtrability was then determined with the NICHOLSON & HORSLEY system at 50 psig and 70°C; the starch and gum-pectin contents in both raw and affined sugars were also determined. Results indicated that, under Taiwan conditions, addition of 0·6% CaO will give best filtrability; while correlation was found between filtrability and starch and gum-pectin contents of the affined sugar and between filtrability and raw sugar starch content, no relationship was found between filtrability and raw sugar gum-pectin content.

* * *

Determination of massecuite viscosity. E. M. GLYGALO and A. V. VLASENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 52–57.—The rheological properties of massecuite were investigated with a rotary viscometer. A method described for processing the results permitted the behaviour of massecuite during mixing to be explained; pseudo-plasticity, increasing with crystal content, was observed. The RV-8 rotary viscometer used in the investigations is applicable at crystal contents up to 48%.

* * *

Determination of molasses ability to resist tensile stress during massecuite centrifugalling. B. N. TERESHIN. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1974, **21**, 70–78.—The Weissenberg phenomenon, whereby a viscous fluid climbs up a smooth vertical tube rotated in it, is related to molasses and the forces which cause it to maintain its adhesion to the sugar crystal. A method is described which permits molasses adhesion to be determined experimentally and hence the quality of cured sugar to be predicted.

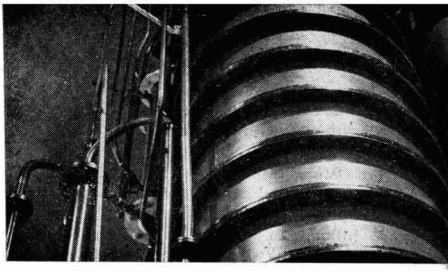
* * *

Rapid method for determination of reducing matter in sugar beet. D. SCHOLZE. *Die Lebensmittelind.*, 1974, **21**, 255–259.—Details are given of two methods for determining reducing matter in beet : (1) with use of 2,3,5-triphenyltetrazolium chloride as reagent, and (2) with 3,5-dinitrosalicylic acid (DNSA) as reagent. Because of certain difficulties with (1), the use of method (2) is preferred; this is based on reaction between the reducing matter and a nitro-group in the DNSA which is reduced to an amino-group. The reaction product is yellowish-brown to brown according to the reducing matter concentration. The nitramine compound is water-soluble and can be determined spectrophotometrically. Full details are given of the procedure used. Results indicated a greater accuracy than with method (1), with reducing matter contents of <0·1% being determinable in 25 g beet brei samples.

* * *

Automatic waste water sampler. M. HAVELKA and J. HERČIK. *Listy Cukr.*, 1974, **90**, 164–166.—Details are given of an automatic device designed to sample sugar factory effluent once an hour; 0·8 litre samples are fed into each of 24 bottles placed on a turntable so that at the appropriate sampling time an empty bottle is ready to receive its sample, a 5-litre bottle also being used for a composite 24-hour sample. The bottles are housed in a weather-proof container and the contents are analysed daily.

By-products



Effects of methods of pulping, bleaching and blending on the physico-chemical properties of sugar cane bagasse for newsprint. R. SAMANIEGO, H. A. NAQVI and J. O. ESCOLANO. *Proc. 15th Congr. ISSCT*, 1974, 1821–1839.—See NAQVI *et al.: I.S.J.*, 1974, **76**, 317.

* * *

A study of changes in bagasse during storage and the effect on the quality of bagasse particle boards. H. C. HUANG. *Proc. 15th Congr. ISSCT*, 1974, 1840–1850. The constituents and properties of bagasse samples were determined at given intervals by chemical analysis, infra-red spectroscopy and X-ray diffraction, and the fibre size determined by sieve analysis. Of the changes noted, the most remarkable were in moisture content and brightness. Moisture affected the biological activity of the bagasse and board quality and should be no more than 22–32% before the bagasse is shredded. Deterioration of aged bagasse was found from sieve analysis, which indicated a greater fines content than in fresh bagasse. The degree of crystallinity estimated by X-ray diffraction was greater in fresh bagasse (about 43%) than in bagasse stored for up to 10 months without protection (35%). While board produced from fresh bagasse had greater strength and was lighter in colour, its water-resistance properties were not as good as those of board produced from aged bagasse.

* * *

Present status and future potential for utilization of bagasse in the pulp, paper and paperboard industry—a world-wide review. J. E. ATCHISON. *Proc. 15th Congr. ISSCT*, 1974, 1851–1863.—The present and potential use of bagasse pulp is discussed and a list given of known bagasse pulp mills (with their production capacitities) in the world. Prospects for production of bagasse newsprint and dissolving pulp are examined and reference made to work being conducted in Cuba in this field. While bagasse leads all other non-wood plant fibres in yield per acre, as indicated by a table, the author suggests the possibility of incorporating other fibres, many of which grow in cane areas, with bagasse for paper and board production.

* * *

Prospects for the industrial utilization of sugar. F. K. E. IMRIE and K. J. PARKER. *Proc. 15th Congr. ISSCT*, 1974, 1864–1876.—A survey is presented, with 50 references to the literature, of chemical and microbiological transformation reactions involving sucrose and the applications of the reaction products. Brief mention is also made of protein production from sugar for use as animal feed.

* * *

Microbial gum: a potential new product from sucrose. W. P. CHEN and C. H. TSOU. *Proc. 15th Congr. ISSCT*, 1974, 1877–1881.—Experiments are reported on gum production from a medium containing sucrose, peptone and dipotassium hydrogen phosphate to which an isolate of *Xanthomonas manihotis* was added. The viscosity of the resultant gum rose with addition of sodium chloride and with increase in temperature, but was unaffected by pH in the range 3–11, and fell at high shear stress. The possible use of the gum as an oil well drilling agent is suggested.

* * *

Treatment of the waste stream from a yeast plant. Y. T. CHUANG and C. L. LAI. *Proc. 15th Congr. ISSCT*, 1974, 1882–1886.—Studies showed that a proportion of the effluent from a yeast plant could be recycled to replace some of the water used for preparation of yeast culture broth without any adverse effects on yeast growth and quality. While this halved the effluent volume, the BOD content of the effluent from the recycle system was doubled. However, since anaerobic fermentation was more effective at the higher BOD level, the total removal was such as to give a BOD (after activated sludge treatment) which met official requirements for industrial waste (maximum permissible BOD of 150 ppm) without the need for dilution water.

* * *

The effect of steam treatment on cane bagasse in relation to its digestibility and furfural production. Y. WONG YOU-CHEONG, J. T. D'ESPAIGNET, P. J. DEVILLE, R. SANSOUCY and T. R. PRESTON. *Proc. 15th Congr. ISSCT*, 1974, 1887–1894—Details are given of tests in which the digestibility of bagasse for use as animal fodder or for furfural production was found to be increased by treatment with steam for 10 minutes at a pressure of 14–15 bar. The total acids content and furfural yield increased with steam pressure and duration of treatment; even after 30 minutes, furfural production seemed to be increasing so steadily that much greater yields could be expected with longer periods of treatment, while yields of about 3% on dry bagasse were obtained after only 10 minutes. The digestibility of the water-insoluble fraction was not increased by steam treatment.

* * *

Extraction of hemicellulose from bagasse pith. W. C. HSIEH and S. L. CHENG. *Rpt. Taiwan Sugar Research Inst.*, 1973, (61), 101–110.—Comparison of various methods of bagasse treatment before hemicellulose precipitation with ethanol showed that 4% NaOH solution gave the maximum hemicellulose yield. The other extractants tested were: lime, lime + NaOH, sodium xylene sulphonate + NaOH and dimethyl sulphoxide + NaOH. Under ideal conditions, 3·1 tons of NaOH yielded 1 ton of hemicellulose, which contained a maximum of 87% pentosan and 5% lignin.

Norway sugar imports[1]

	1974	1973	1972
	(metric tons, white value)		
Belgium-Luxembourg	1,750	234	417
Czechoslovakia	8,997	13,844	11,099
Denmark	41,949	57,360	61,198
Finland	12,735	18,197	14,605
France	20	10	50
Germany, East	783	0	39
Germany, West	2,713	2,745	7,090
Holland	1,624	3,722	2,807
Poland	9,576	10,542	12,964
Sweden	434	860	1,811
UK	44,942	47,525	58,685
Other countries	384	2	45
Total	125,907	155,041	170,810
Total, raw value	139,897	172,267	189,790

CSR Ltd. acquisition of Australian Estates Ltd.—An initial bid by CSR Ltd. for the three sugar mills of Australian Estates Ltd. was rejected in 1973 by Sir DENYS LOWSON, then the majority shareholder. After his retirement in 1974 further approaches was made to the merchant bankers Hill, Samuel & Co. Ltd. who were reorganizing the Lowson family trusts. They also rejected the offers made for their controlling shares, but on the 6th March, after a series of improved bids by CSR and a proposed offer by a group of some 650 cane growers intending to form a cooperative, Hill, Samuel accepted an offer of 240p for each ordinary share and 205p for the "A" non-voting shares held by the trust, so yielding control to CSR Ltd.

* * *

Association of Official Analytical Chemists.—The 89th Annual Meeting of the AOAC will be held during the 13th–16th October 1975 at the Marriott Hotel, Twin Bridges, Washington, D.C., USA. The latest developments in analytical methods for many commodities and materials important to agriculture and public health will be presented and discussed with about 240 papers on new techniques, methods and instrumentation for analysis of drugs, feeds, fertilizers, foods, etc. Evening workshops are planned on automated analysis and thin-layer chromatography, while nearly 40 firms will exhibit their latest laboratory equipment and supplies. Further information is available from Mr. LUTHER G. ENSMINGER, AOAC, Box 540, Benjamin Franklin Station, Washington, D.C., 20044 USA.

* * *

Australia sugar production expansion[2].—The Australian Minister for Primary Industries has referred a proposal for a modest expansion of sugar production by approximately 300,000 metric tons to the Central Sugar Cane Prices Board for implementation. The increased cane assignments will be distributed among those producers able to fulfil the obligations involved and willing to accept the risks. The expansion will be about 10% above the current normal production level of 2·75 million tons and will require some 26,000 hectares of additional cane land.

* * *

Mauritius sugar crop, 1974[3].—The 1974 sugar cane harvest began on the 7th June and ended on the 20th December. The 21 mills crushed 5,869,739 long tons of cane and produced 685,813 tons of sugar, the second highest output achieved in Mauritius. Cane yield was 29·7 tons/acre as against 30·7 tons in 1973 while average sugar extraction was 11·68%, giving 3·47 tons of sugar per acre as against 3·54 tons in 1973.

* * *

Ghana trial cane farm[4].—Tate & Lyle Enterprises Ltd. and Taylor Woodrow International Ltd. have been commissioned by the Government of Ghana to establish a trial sugar cane farm at Havi in the Volta Region. The intention is to prepare, by the end of 1976, a feasibility study based upon experiences with the trial farm, with the object of determining whether or not an integrated sugar project can be established in that region. Taylor Woodrow is to give advice on the irrigation works whilst Tate & Lyle Enterprises will maintain a representative to oversee the technical aspects of the cultivation of the cane.

Japan sugar imports[5]

	1974	1973	1972
	(metric tons, tel quel)		
Australia	290,490	621,711	653,599
Brazil	181,472	97,133	111,348
Colombia	0	24,270	59,143
Cuba	1,176,758	907,200	855,174
Dominican Republic	20,807	25,940	200,032
Fiji	10,134	17,358	21,179
Jamaica	10,904	0	0
Mozambique	9,688	0	0
Philippines	127,807	28,482	0
Salvador	58,957	0	21,769
South Africa	491,454	519,453	566,850
Taiwan	159,843	130,135	135,062
Thailand	220,939*	0	34,849
Trinidad & Tobago	10,959	0	0
Other countries	1,013†	234	2,753
Total	2,771,225	2,371,916	2,661,758

* Includes 443 tons refined sugar and 100 tons non-centrifugal sugar.
† Refined sugar.

Canadian Cane Equipment Ltd.—This Canadian company, set up to exploit the "Comfith" process[6] of separation of cane into fibre and pith with extraction of sugar and utilization of the residues for animal fodder and paper or board manufacture, has been put into liquidation. The financial arrangements were rather complicated, with a number of investors, many of whom have lost considerable sums, including over £250,000 by St. Kitts (London) Sugar Factory Ltd. The patents taken out by the Company are now held by the Canadian Government as security against loans advanced for the development of the process, and a number of organizations have shown interest in acquiring the business which was reputed to have been on the brink of achieving commercial success, but hampered by lack of liquid funds.

* * *

St. Kitts (London) Sugar Factory Ltd., 1974 report.—Production of sugar amounted to 25,470 tons, equivalent to 26,102 tons 96° pol. Although better than in 1973 the output was only half of that of which the factory is capable. The tons cane:tons sugar ratio was outstandingly good but there was inadequate cane supply, and drought hampered cane growth. As a result of the higher price obtained for sugar under the Commonwealth Sugar Agreement, earnings were much improved; however, a St. Kitts Government levy was introduced which reduced profits by £966,414 to £302,390. Unfavourable weather in 1974 indicates a 1975 crop unlikely to exceed 25,000 tons. Experiments in irrigation are to be carried out with British Government aid.

* * *

Jamaica sugar factory closure.—A new company, Clarendon Sugar Co. Ltd., has been formed following a merger between West Indies Sugar Co. Ltd.'s Monymusk factory and Sevens Ltd. Closure of the Sevens factory in 1975 will release cane to keep Monymusk working at full capacity. West Indies Sugar Co. Ltd. will continue to operate the Frome factory independently; all the company's former cane lands are now owned by the Government or local farmers.

* * *

Hawaii sugar factory closure[7].—McBryde Sugar Co., located on the island of Kauai, recently closed its 73-year-old mill at Wahiawa. Cane is now being processed at the former Grove Farm factory at Koloa. McBryde leased the Koloa mill and 7200 acres of cane land from Grove Farm and the Knudsen estate in January, bringing the McBryde cane area to more than 13,000 acres.

* * *

Zaire sugar crop, 1974[8].—Sugar production by the Kwilu-Ngongo and Kiliba factories in Zaire amounted to 65,000 tons in 1974, some 25,000 tons short of present annual consumption.

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[1] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (5), vi–vii.
[2] *Australian Sugar J.*, 1974, **66**, 379, 381.
[3] *Mauritius Sugar News Bull.*, 1974, (12).
[4] *Standard & Chartered Review*, March 1975, 39.
[5] C. Czarnikow Ltd., *Sugar Review*, 1975, (1219), 34.
[6] *I.S.J.*, 1972, **74**, 123–124; 1974, **76**, 318.
[7] *Sugar y Azúcar*, 1975, **76**, (1), 11.
[8] *Standard and Chartered Review*, February 1975, 7.

Switzerland sugar imports[1]

	1974	1973
	—*metric tons, tel quel*—	
Belgium/Luxembourg	738	654
Colombia	1,370	0
Cuba	3,145	1,119
Czechoslovakia	15,062	11,671
France	107,314	118,276
Germany, West	13,446	12,144
Holland	15,936	2,819
Portugal	4,127	0
UK	53,044	59,016
Other countries	2,353	932
Total	216,535	206,631

Guyana sugar factory nationalization plans[2].—The Prime Minister of Guyana, Mr. FORBES BURNHAM, announced that all the holdings of the Demerara Co. Ltd. are to be nationalized. He did not specify the amount of compensation to be paid to the British owners of the company but said that discussions would take place shortly between the government and the company. He also announced that a nationally-owned sugar refinery is to be installed and Guyanese trained in international marketing of sugar.

* * *

West Germany 1974/75 campaign results[3].—A total of 16,757,601 metric tons of beet were processed in West Germany during the 1974/75 campaign, as against 16,338,480 tons in the previous campaign. The beet area was 377,472 hectares as against 356,467 hectares in 1973/74. Total sugar production was 2,221,940 tons, tel quel, and included 1,953,082 tons of white sugar, 268,845 tons of raw sugar and 13 tons of syrup. In the previous campaign, the sugar output totalled 2,234,542 tons and included 1,980,188 tons of white sugar, 254,349 tons of raw sugar and 5 tons of syrup.

* * *

Honduras sugar industry expansion[4].—Public and private sector interests are to invest a total of $37,500,000 (equivalent) in the setting up of three sugar factories to increase export production.

* * *

Italy beet sugar production[5].—The beet area for the 1974/75 campaign was 190,000 hectares or 15·93% less than the 226,000 ha of 1973/74. The yield was 2·55% less and beet production 18·09% lower in consequence, at 7,400,000 metric tons as against 9,033,960 tons. The sugar content was 3·18% higher, however, so that sugar output was 16·48% lower at 870,000 tons in 1974/75, compared with 1,041,624 tons in the previous campaign. An interesting point is that the 1973/74 figure included 4774 tons of sugar recovered from molasses, a figure less than 10% of previously, and that no sugar at all was recovered from molasses in 1974/75.

* * *

Hungary sugar expansion[6].—Hungary is to aim at a sugar beet harvest of 4,320,000 metric tons this year, in an effort to become self-sufficient, according to the official news agency NTI. The target is 460,000 tons of sugar, which compares with a domestic consumption of 470,000 tons in 1974. The beet area is to be expanded from 98,000 hectares in 1974 to 125,000 ha this year. The 1974 beet harvest was a record at 3,650,000 tons, but the sucrose content was low and produced only 315,000 tons of sugar.

* * *

Colombia sugar crop, 1974[7].—It is estimated that the 1974 sugar crop was 908,000 tons, an increase of 11% over 1973. It is estimated that the 1975 crop will exceed one million tons.

* * *

New Tanzanian sugar factories[8].—During the second half of 1975, Cuban experts will start to establish a sugar cane plantation with an overall area of 15,000 acres near Kilosa in the Morogoro region of Tanzania, as part of an economic agreement between the two countries[9]. The project will have an initial production capacity of 50,000 tons of sugar per year while, in a second phase, the cane area is to be extended and sugar production capacity raised to 100–150,000 tons/year. Operations are to begin in 1977. Construction of another new factory at Kagera, west of Lake Victoria, is to start this year[2]. The plant, which will have a capacity of some 100,000 tons per year, is to begin operations at the end of 1977.

Hong Kong sugar statistics[10]

	1974	1973
	—*long tons, tel quel*—	
Imports		
China	23,988	25,640
Japan	14,267	31,273
Korea, South	18,067	11,085
Malaysia	10,663	98
Singapore	1,314	831
South Africa	400	3,192
Taiwan	1,080	1,477
Thailand	2,887	0
Vietnam, North	6,506	3,453
Other countries	1,468	138
Total imports	80,640	77,187
Exports and re-exports		
Japan	789	3
Kenya	52	344
Laos	0	140
Macao	646	841
Malaysia and Brunei	211	810
Qatar	492	0
Saudi Arabia	52	194
Singapore	88	207
USA	106	157
US Oceania	80	475
Other countries	289	367
Total exports and re-exports	2,805	3,538

Poland sugar production, 1974/75[11].—The Polish beet sugar campaign ended on the 27th January by which date a total of 12,470,000 metric tons of beets had been sliced and 1,430,000 tons of sugar, white value, had been produced.

* * *

Paraguay sugar project[12].—The Paraguay Ministry of Agriculture has stated that the equivalent of US$50,000,000 is to be invested by Brazilian and Paraguayan interests in a factory near San Estanislao to produce 60,000 tons of sugar a year.

* * *

New Ethiopia sugar factory[13].—The foundation stone has been laid of a new sugar factory at Hajar Asalaya. The plant, which will have an annual capacity of 110,000 tons, will process sugar cane from an area of 30,000 feddans.

* * *

Canada beet sugar campaign results[14].—A total of 67,578 acres was harvested in the three beet growing provinces of Alberta, Manitoba and Quebec for the 1974/75 crop, and a total of 91,550 long tons of sugar was produced. This compares with 105,674 tons of sugar produced in 1973/74 from 68,640 acres.

* * *

Greece sugar expansion[15].—It is intended to erect two sugar factories in the north of Greece each of 5000 metric tons daily slice, in order to increase the country's production. In addition, the capacity of the factories at Larissa, Platy, Serrae and Xanthi is also to be increased, and output thereby raised to 230,000 tons per year. In the 1974 campaign, 1,416,600 tons of beet were sliced and yielded 171,880 tons of sugar[16]. Sugar consumption in Greece reached 225,000 tons in 1974, corresponding to a per caput consumption of 25 kg.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1975, (1219), 35.
[2] *The Times*, 25th February 1975.
[3] C. Czarnikow Ltd., *Sugar Review*, 1975, (1219), 34.
[4] *Bank of London & S. America Review*, 1975, **9**, 93.
[5] *Zeitsch. Zuckerind.*, 1975, **100**, 106.
[6] *Public Ledger*, 1st Mrch 1975.
[7] *Bank of London & S. America Review*, 1975, **9**, 100.
[8] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (4), 8.
[9] *ibid.*, (5), ix.
[10] C. Czarnikow Ltd., *Sugar Review*, 1975, (1220), 38.
[11] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (5), 9.
[12] *Bank of London & S. America Review*, 1975, **9**, 108.
[13] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (5), 10.
[14] C. Czarnikow Ltd., *Sugar Review*, 1975, (1218), 28.
[15] F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (4), 6.
[16] *Zeitsch. Zuckerind.*, 1975, **100**, 106.

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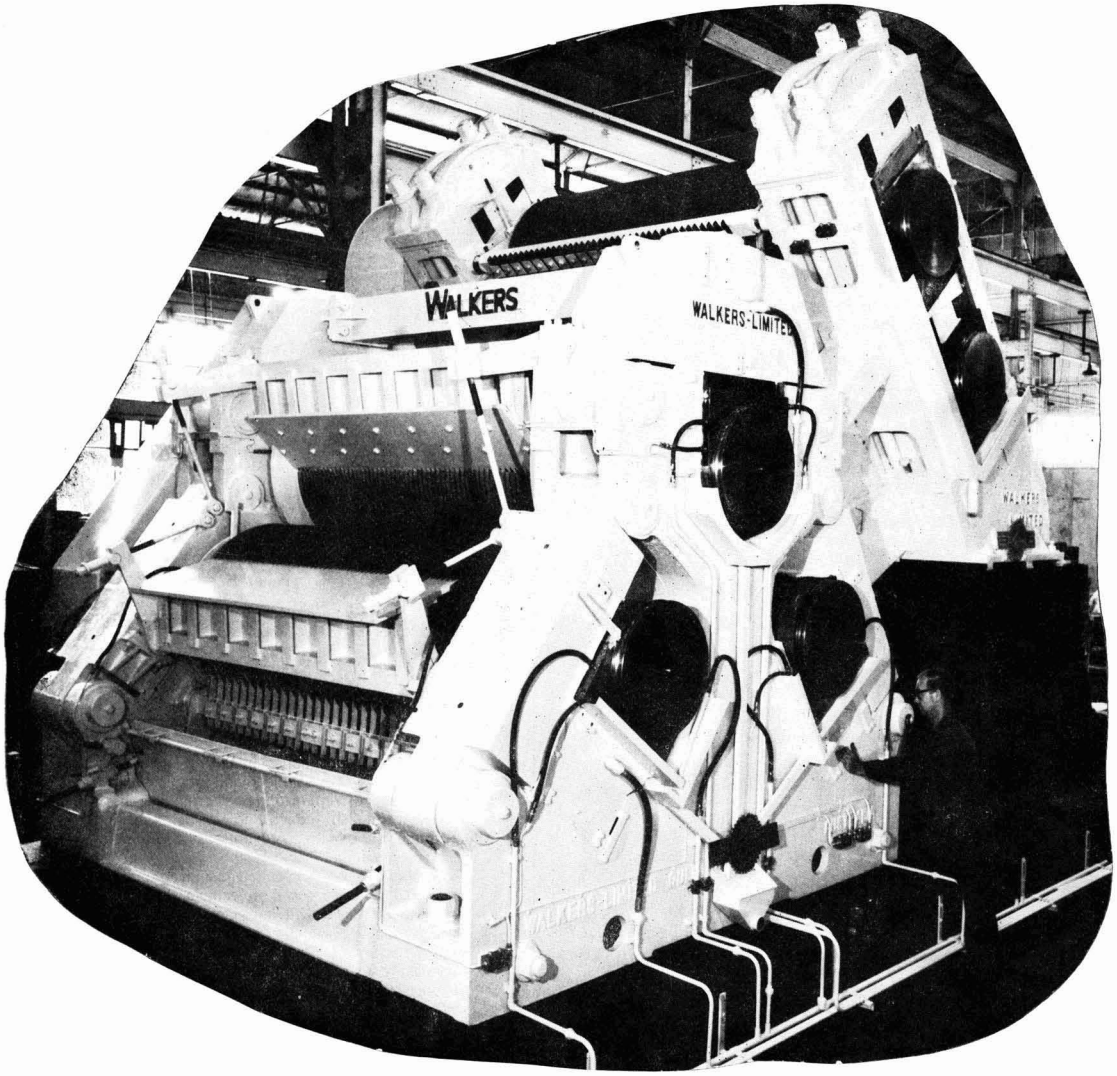

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