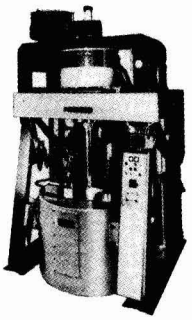
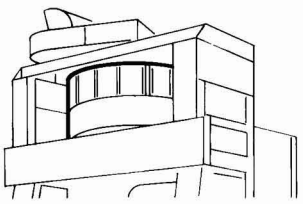
International Sugar Journal

JUNE 1977

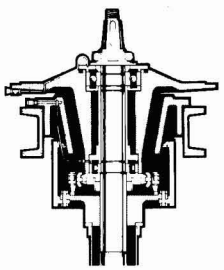


The Build Up

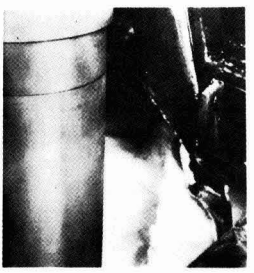


Motor

- Motor specially designed to meet end-users power requirements.
- Special Suspension assists in dampening effects of out-of-balance loads.
- Plough operation ensures free discharge and completely cleared basket: cycle time kept to a minimum since sugar discharges in same direction of rotation.
- Automatic Feed Valve and Limiting Sensor arrangement ensures constant feeding independently of variations in massecuite.
- High unimpeded output ensured by Special Discharge Valve.
- Automatic sequence controls programmed for step-by-step operation throughout cycle.



Suspension



Plough

Broadbent—
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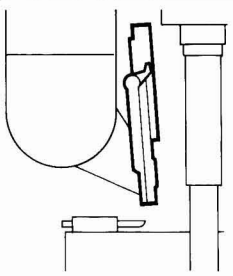
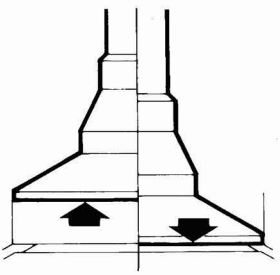
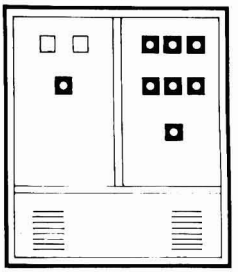
Write for details



Feed Valve



Discharge Valve



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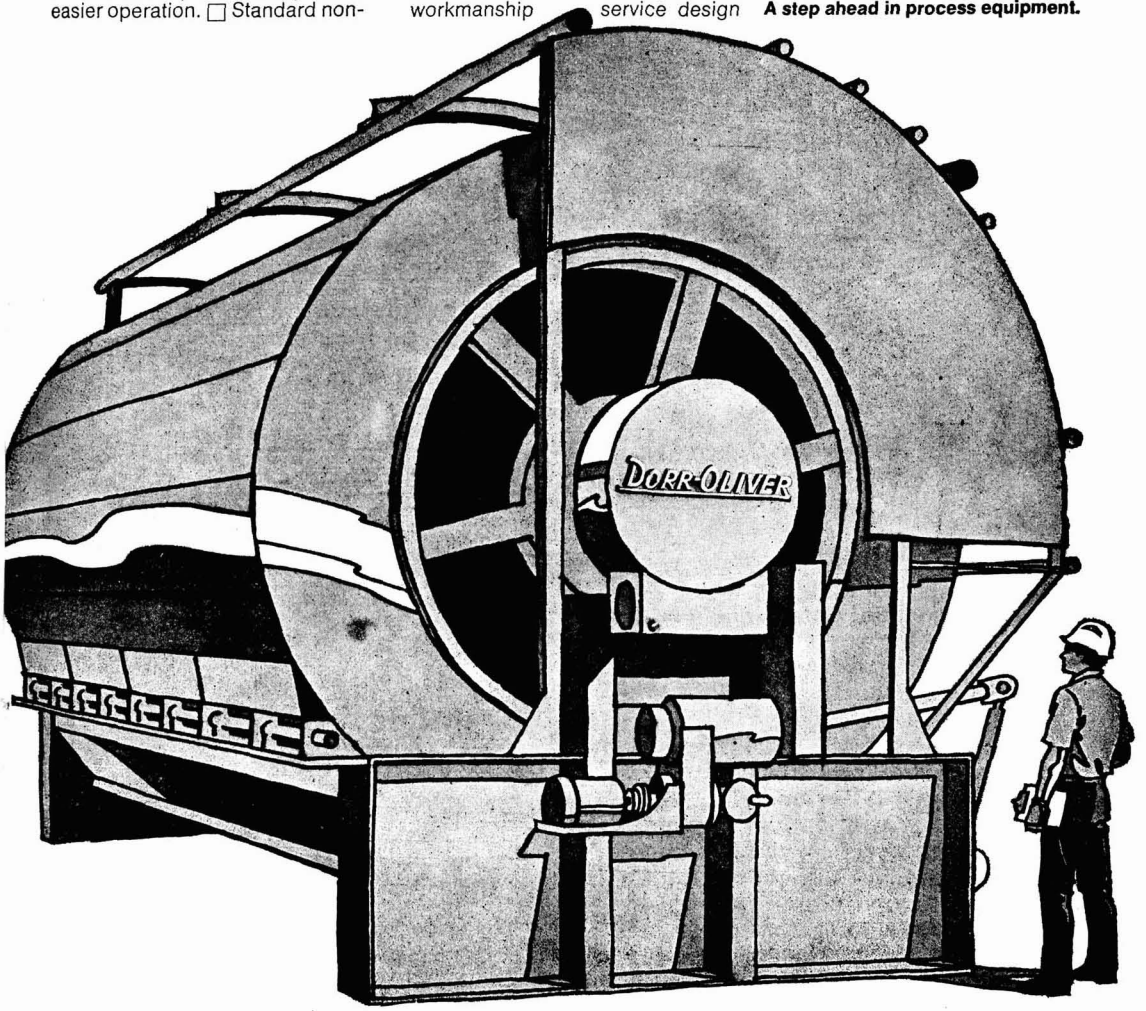

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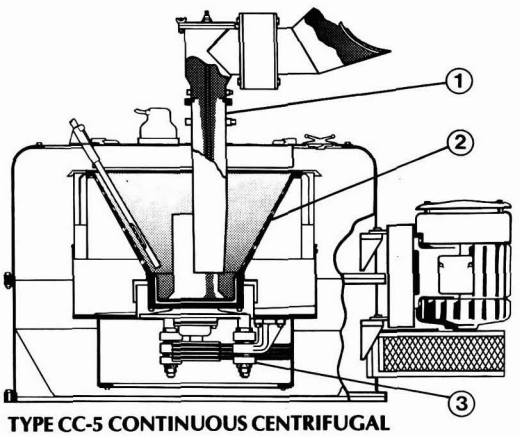

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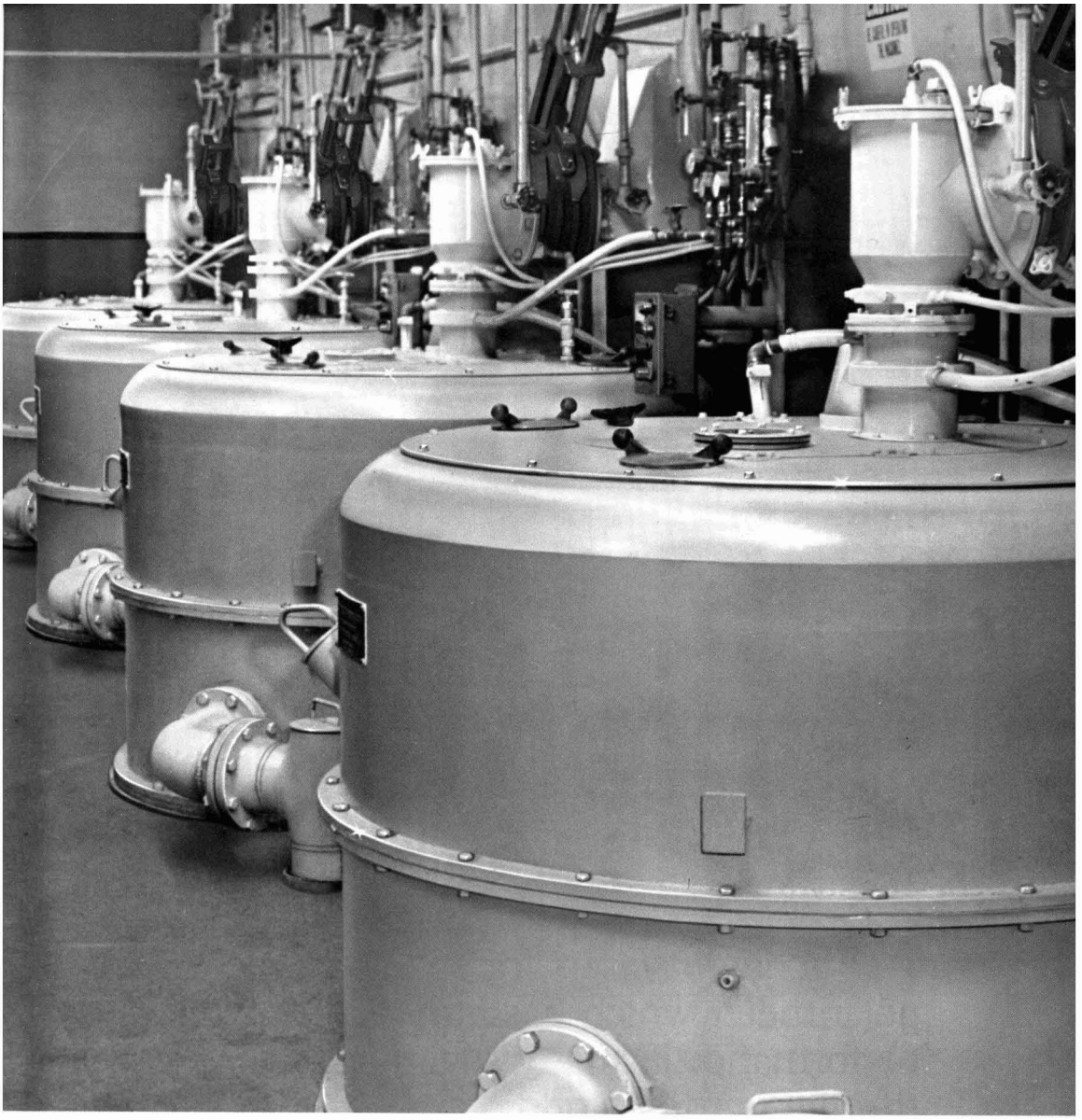
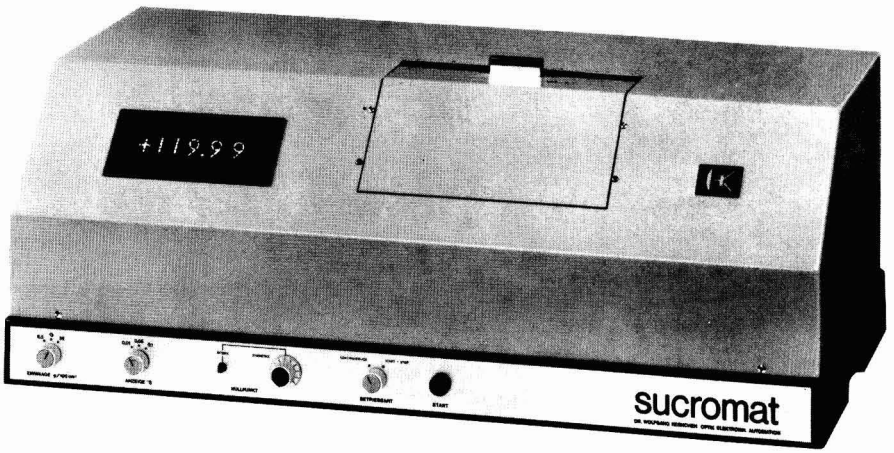


ty plus



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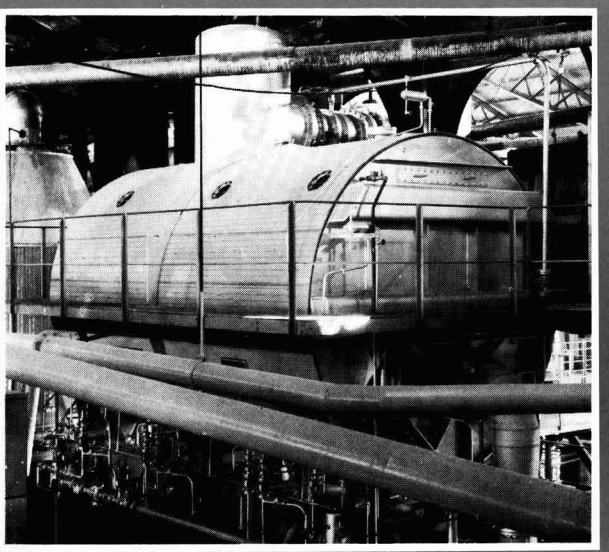
fcb continuous vacuum pan

Quartier Français Sugar Factory, Reunion.



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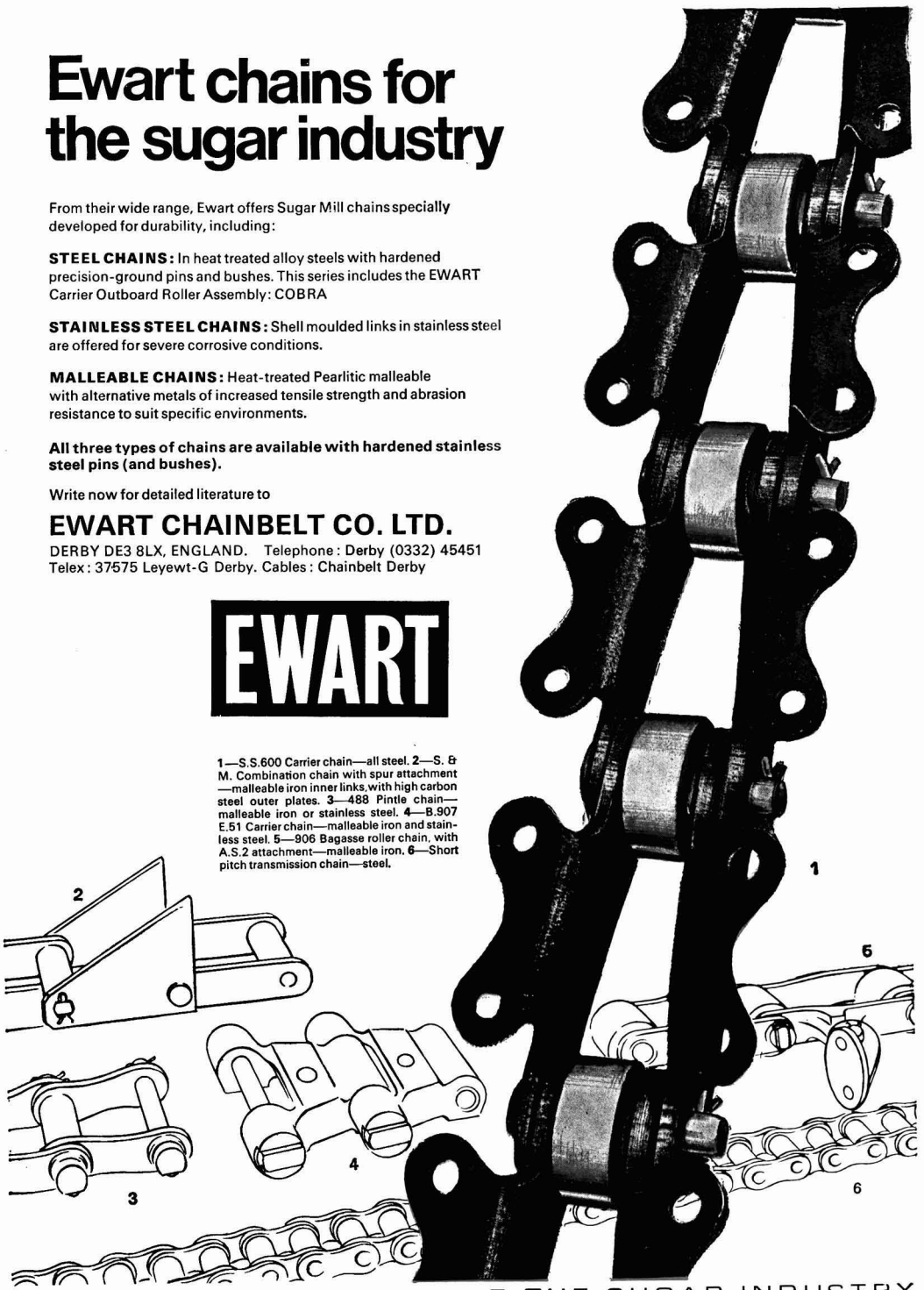

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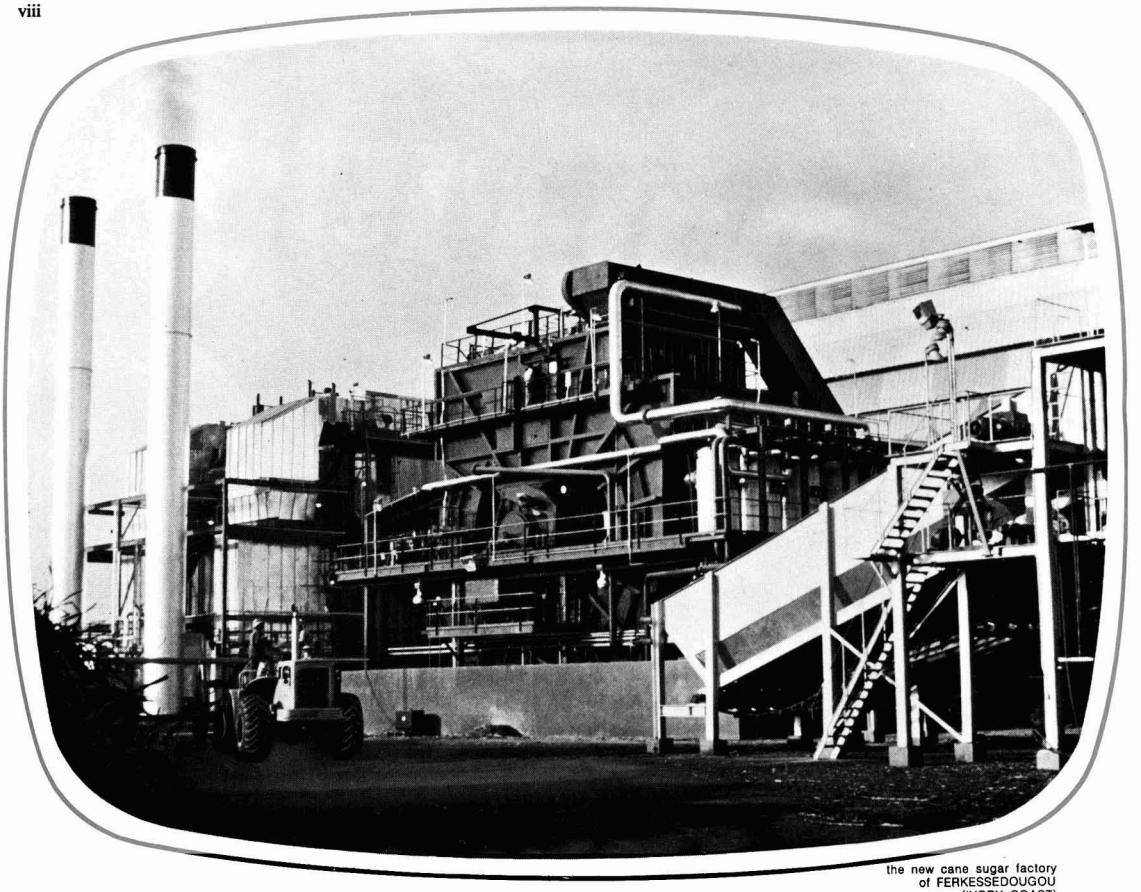

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Week N°	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Final
Tons cane crushed per hour...	112.3	109.6	111.0	110.2	110.9	108.3	109.0	108.0	97.0	105.0	102.2	103.7	103.6	100.1	100.2	107.0
Sucrose % cane.....	12.45	12.45	12.44	12.17	12.14	12.26	12.47	12.83	13.41	13.46	13.47	13.04	13.43	13.99	13.02	12.52
Fibre % cane.....	15.18	13.56	14.41	14.61	14.19	14.23	15.02	14.95	15.70	16.58	16.31	16.67	15.86	16.41	16.48	14.81
Mixed Juice % cane	107.5	108.4	107.7	108.5	108.2	109.2	108.3	110.0	115.0	112.0	113.5	114.6	112.3	115.4	110.1	109.1
Purity 1st extraction juice.....	86.2	87.0	85.9	87.0	85.8	86.1	85.7	86.9	85.8	85.3	84.7	84.8	84.6	85.1	85.3	85.6
Purity mixed juice.....	85.3	86.6	85.4	86.1	85.3	85.1	84.8	85.7	85.1	84.3	83.3	83.5	83.9	84.1	84.1	84.8
Pol % bagasse.....	1.44	1.37	1.43	1.36	1.27	1.22	1.15	1.20	1.24	1.25	1.25	1.18	1.28	1.28	1.20	1.36
Moisture % bagasse	51.78	51.54	51.65	50.71	51.02	50.61	50.46	49.37	49.01	49.74	49.63	49.58	50.34	49.49	49.04	50.83
Extraction.....	96.21	96.80	96.43	96.56	96.84	97.04	97.11	97.15	97.04	96.83	96.89	96.92	96.84	96.97	96.91	96.59
Reduced extraction.....	96.97	97.09	96.97	97.13	97.27	97.45	97.66	97.68	97.73	97.72	97.72	97.80	97.60	97.80	97.76	97.20
Overall Recovery.....	84.51	86.28	85.82	86.57	85.37	86.23	85.02	85.81	85.45	82.97	82.35	82.94	84.15	84.59	82.14	84.31
Pol of sugars	99.14	99.16	98.81	99.12	98.98	98.93	99.09	98.98	98.96	98.93	98.90	98.99	99.06	98.61	98.33	98.98
Losses in bagasse % cane.....	0.47	0.40	0.44	0.42	0.38	0.36	0.36	0.37	0.40	0.43	0.42	0.40	0.42	0.42	0.40	0.43
Losses in filter cake % cane...	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Losses in molasses % cane....	1.26	1.20	1.17	1.16	1.35	1.23	1.23	1.39	1.33	1.50	1.44	1.37	1.42	1.59	1.29	1.30
Undetermined losses % cane..	0.19	0.10	0.14	0.05	0.04	0.09	0.27	0.05	0.21	0.36	0.51	0.44	0.28	0.13	0.63	0.23
Total losses % cane	1.93	1.71	1.76	1.64	1.78	1.69	1.87	1.82	1.95	2.30	2.38	2.22	2.13	2.15	2.33	1.97

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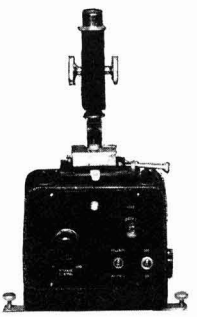

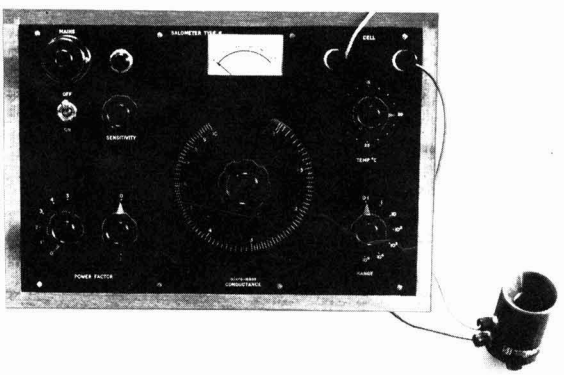

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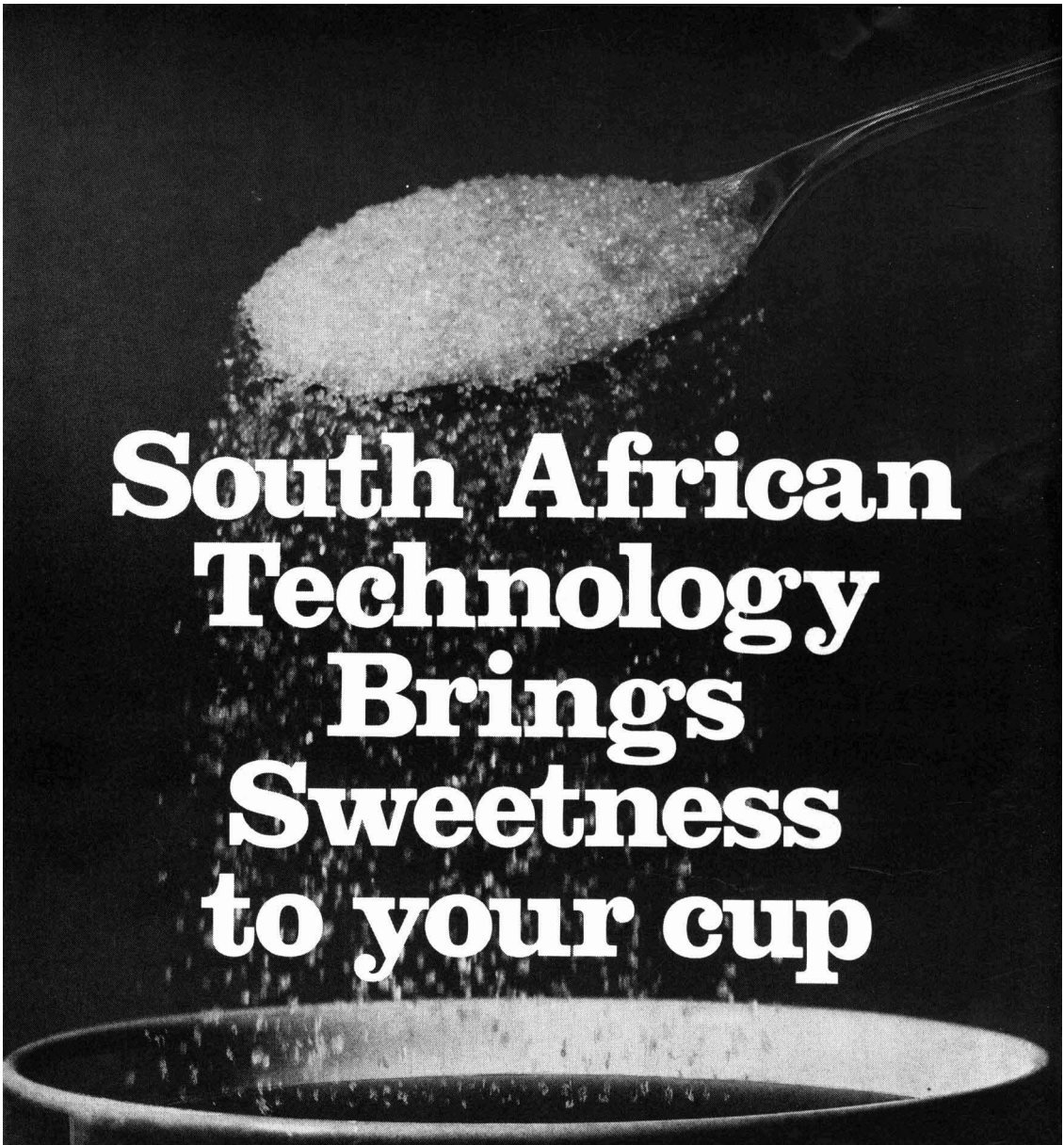

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SOMMARES : ZUSAMMENFASSUNGEN : SUMARIOS

La détermination absolue du saccharose dans les produits de sucrerie et de raffinerie par dilution isotopique. 1ère partie. Isolement et épuration du saccharose en vue du comptage. N. R. PIPER. *p.* 153–156

Quoique la technique de dilution isotopique offre le plus de possibilités pour la détermination isotopique du saccharose, il est nécessaire d'éliminer au préalable, ou de ramener à des niveaux acceptables, les sources d'erreur qui pourraient affecter le résultat. L'auteur examine brièvement les diverses sources d'erreur et décrit ensuite un mode opératoire recommandé pour l'isolement et l'épuration du saccharose radioactif, dans laquelle le mélange de l'échantillon et de saccharose marqué ^{14}C est clarifiée à l'acétate basique de plomb, traité ensuite à l'hydroxyde de barium pour précipiter le saccharate comme saccharate de barium, puis carbonaté; le traitement sur résine échangeuse d'ions et charbon actif est suivi par l'évaporation et la double cristallisation du saccharose dans l'alcool. La précision de cette méthode est examinée à l'aide de résultats obtenus sur mélasses de canne et sirop d'or, ainsi que par comparaison des résultats expérimentaux basés sur la teneur en saccharose des échantillons originaux et de quantités connues de saccharose ajouté.

* * *

La stérilité du diffuseur et le pressage des pulpes. 2ème partie. J. F. T. OLDFIELD, M. SHORE et N. W. BROUGHTON. *p.* 157–162

On rapporte les recherches de laboratoire au sujet de la relation entre le pH dans la diffusion et les paramètres de pressage des pulpes, qui ont démontré l'effet adverse sur le pressage de l'accroissement du pH de diffusion. Il a été décidé que, si l'éliminatiou des fermentations est souhaitable (voir 1ère partie de l'article), il est important, pour un pressage optimal, de maintenir l'acidité dans le diffuseur. On a essayé l'addition d'acide sulfurique et on a constaté que 0,015% d'acide (poids/poids de betteraves) maintient une allure de pH adéquate sous les conditions stériles obtenues par addition de formol. La procédure optimale d'addition d'acide était en dilution à 5% à un point situé à mi-longueur ou à un tiers de la longueur du tambour de diffusion en partant de la tête. On ne trouva pas de différences détectables en formation d'inverti ou en corrosion de l'acier doux entre le traitement à l'acide sulfurique et celui à l'acide lactique; l'addition d'acide sulfurique donna en outre une méthode de régulation de pH plus fiable et plus aisée à régler que la fermentation "contrôlée". L'examen économique révèle que le coût de l'addition d'acide est relativement faible et permet une économie nette en diminution de la quantité de sucre-mélasse sans dépenses supplémentaires pour le chauffage.

Die Absolutbestimmung von Saccharose in Rohrzuckerfabriks- und Raffinerieprodukten mit Hilfe der Isotopenverdünnungstechnik. Teil I. Isolierung und Reinigung von Saccharose zur Szintillationsmessung. N. R. PIPER. *S.* 153–156

Wenn auch die Isotopenverdünnungstechnik die beste Methode für die Absolutbestimmung der Saccharose darstellt, ist es zuerst erforderlich, Fehlerquellen, welche das Ergebnis beeinflussen könnten, auszuschalten oder die Fehler auf annehmbare Werte zu beschränken. Der Autor zählt kurz die verschiedenen Fehlerquellen auf und beschreibt dann einen Verfahrensvorschlag zur Isolierung und Reinigung von radioaktiver Saccharose, bei welchem eine Mischung der Probe mit durch ^{14}C markierter Saccharose mit basischem Bleiacetat geklärt wird. Dann wird Bariumhydroxid zugegeben, um die Saccharose als Bariumsaccharat zu fällen, das anschliessend mit Kohlendioxid versetzt wird. Einer Behandlung mit Ionenaustauschern und mit Aktivkohle schliesst sich das Eindampfen und die doppelte Kristallisation der Saccharose aus Alkohol an. Die Genauigkeit der Methode wird an Hand der mit Rohrmelasse und "Golden Syrup" erzielten Ergebnisse und durch Vergleich der Versuchsergebnisse mit den nach dem Saccharosegehalt der Ausgangsprobe und einem Zusatz bekannter Saccharosemengen erwarteten Resultaten diskutiert.

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Sterilität der Saftgewinnung und Abpressbarkeit der Schnitzel. Teil II. J. F. T. OLDFIELD, M. SHORE und N. W. BROUGHTON. *S.* 157–162

Es wird über Laboratoriumsversuche zur Ermittlung der Beziehungen zwischen dem pH-Wert in der Saftgewinnung und den Parametern der Schnitzelabpressung berichtet, aus denen der negative Einfluss des pH-Wertes in der Saftgewinnung auf die Abpressbarkeit hervorgeht. Obwohl eine Unterbindung der Gärungsvorgänge wünschenswert ist (siehe Teil I), entschied man sich für ein saures Milieu in der Saftgewinnung, um eine optimale Abpressung zu erreichen. Die Verfasser haben die Zugabe von Schwefelsäure untersucht. Um unter durch Formalinzugabe eingestellten sterilen Bedingungen ein annehmbares pH-Profil zu erhalten, sollte man 0,015 Gew.-% Säure auf Rübe verwenden. Als optimal wurde die Zugabe der Säure in 5 %iger Verdünnung an einer Stelle der Extraktionstrommel ermittelt, die um die Hälfte bis ein Drittel der Trommellänge vom Saftende entfernt liegt. Bei einem Vergleich eines Schwefelsäure- und eines Milchsäurezusatzes wurden keine merklichen Unterschiede hinsichtlich der Invertzuckerbildung und einer geringen Stahlkorrosion festgestellt. Die Schwefelsäurezugabe ist eine zuverlässigere und leichter kontrollierbare Methode der pH-Regelung als die "kontrollierte" Gärung. Eine Untersuchung der Wirtschaftlichkeit ergab, dass die Kosten für die Säurezugabe relativ gering sind und einen echten Gewinn in Gestalt einer niedrigeren Melassezuckermenge ohne zusätzliche Aufwendungen für das Trocknen bringen.

La determinación absoluta por dilución isotópica de sacarosa en produtos de la fábrica azucarera y de la refinería. Parte I. Aislamiento y purificación de sacarosa para contar. N. R. PIPER. *Pág.* 153–156

Mientras que la técnica de dilución isotópica ofrece la más grande oportunidad para determinación absoluta de sacarosa, es necesario, como primer etapa, eliminar o reducir a niveles aceptables fuentes de error que podrían afectar la resulta. El autor examina brevemente los varios fuentes de error y describe un procedimiento recomendado para aislar y purificar la sacarosa radioáctiva, en que la mezcla de muestra y sacarosa apodado con ^{14}C se clarifica con acetato básico de plomo, y entonces es tratado con hidróxido de bario para precipitar la sacarosa como sacarata de bario. Esta es carbonatado, el licor tratado con résina cambiador de iones y con carbón áctivo, y la sacarosa obtenido por evaporación y cristalización dos veces de alcohol acuoso. La precisión del método se discute con el ayudo de resultas obtenido para melaza de caña y "golden syrup" (una sirope que contiene sacarosa y azúcar invertido) y, por comparación de resultas experimentales y resultas calculadas sobre un base del contenido original de sacarosa de las muestras y cantidades conocidas de sacarosa añadido a ellas.

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Esterilidad en el difusor y prensamiento de la pulpa. Parte II. J. F. T. OLDFIELD, M. SHORE y N. W. BROUGHTON. *Pág.* 157–162

Se hace un informe sobre investigaciones en el laboratorio de la relación entre pH en difusión y parametros del prensamiento de pulpa, en que el efecto adverso de un subida de pH de la difusión sobre prensamiento se demuestra. Mientras que eliminación de fermentación es deseable (ver Parte I de este artículo) los autores han decidido que es importante (para procesamiento óptimo) mantener condiciones ácidas en difusión. Adición de ácido sulfúrico se ha examinado, y se ha averiguado que 0,015% de acido sobre peso de remolacha mantuvo una perfila conveniente de pH sobre condiciones esterilas obtenido por tratamiento con formalina. Adición óptima del ácido estuvo en la forma de una dilución a 5%, a una locación acerca de una mitad o una tercio del largo de la salida para jugo del tambor del difusor. No ha descubrido ninguna diferencia perceptible de formación de azúcar invertido o de corrosión de acero dulce entre adición de ácido sulfúrico y de ácido láctico, y adición de ácido sulfúrico dió un método más confiable y más facil para regulación de pH que "fermentación controlada". Examinación de la economía demuestra que el costo de adición de ácido estuvo relativamente pequeño y prmitió un ahorro neto en la forma de menos azúcar en melaza con ningun costo adicional de secado.

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Notes & Comments

World sugar prices

The London Daily Price of raw sugar rose slightly from £131 to £135 per ton during the first week of April but improved markedly following publication by the U.S.D.A. of a statement that frost damage and losses through poor storage and processing had adversely affected Soviet sugar production which the Department estimated at 7·5 million metric tons, raw value, against their earlier estimate of 9·2 million tons. Perhaps an air of optimism over the start of the International Sugar Conference in Geneva also contributed to the increase which took the price to £150 by the 20th April, at about which level it stayed for several days before commencing a fall on the 27th April which took it to £140 by the end of the month.

There was very much less movement in white sugar values, the LDP(W) rising from £139 at the beginning of the month by a smaller amount so that from the 14th to 17th April it was lower than the price of raw sugar. A maximum of £147 per ton was reached on the 25th April and the level subsequently declined, as with the L.D.P. but less steeply, to reach £140 at the end of the month.

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International Sugar Conference

The ninth International Sugar Conference of the past 25 years opened in Geneva on the 18th April. It was convened by the Secretary-General of UNCTAD and is intended to negotiate a new International Sugar Agreement to replace that of 1973. During the period since 1951 sugar production has more than doubled, from some 33 to 85 million tons. Of this figure in 1976 about 22 million tons entered into world trade, including 5 million tons covered by special arrangements and 17 million tons on the free market.

While sugar agreements have been inoperative the sugar price has fluctuated widely, from less than 2 to 65 cents/lb, and there will be a sincere desire on the part of negotiators to achieve stable conditions for international trade in sugar with achievement of price levels which will be fair to both producers and consumers.

The Conference has before it a draft text prepared by the secretariat of the International Sugar Organization which serves as a working document, including provisions for the determination of basic export tonnages, minimum and maximum prices, mechanism for the adjustment of export quotas in the light of movements in the free market price, minimum stocks and reciprocal supply and purchase commitments. The Conference is set to continue to 27th May if necessary.

Obviously, participating Governments have very differing views which will need to be reconciled, particularly whether or not buffer stock arrangements should be used instead of variable quotas to regulate prices. This is the system operating in the EEC under the Common Agricultural Policy and is favoured by a number of member countries although France and Belgium have been reported as not wanting to be tied to an inflexible common policy for the Community. With imports from ACP countries guaranteed access under the Lomé Agreement, the EEC is an exporter of appreciable quantities of excess sugar and will thus resist moves to restrict sales to developing countries.

One of the most hopeful aspects of the Conference is the participation of the USA, not a member of previous Agreements. A representative from this country has been elected Chairman of the Statistical Committee, and the importance attached by the CARTER Administration to the success of the Conference has been emphasized by the Secretary of Agriculture.

The US position has been outlined in a declaration to the Conference[1] that the US was looking for an agreement which was "technically sound" and which would utilize "established trade channels and practices". The US favours a system of internationally coordinated stocks accumulated in times of surplus in order to minimize high prices to consumers, and believes that export quotas could provide immediate and effective protection against excessively low prices, and would be a necessary mechanism to defend the lower end of any price range negotiated in the agreement

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World sugar production estimates 1976/77

F. O. Licht KG. have recently produced their third estimates of world sugar production for the current crop year September 1976—August 1977[2]. With more information available in the three months since the previous estimate, total production is set some 400,000 tons lower at 87,753,000 metric tons, raw value, as against 81,705,000 tons for the 1975/76 crop. This rise of 6 million tons, or 7·4%, is clearly larger than any likely rise in consumption during the period, although consumption certainly is growing, and a surplus of 2,000,000 tons or more must be anticipated.

There are areas of uncertainty in Licht's estimates, particularly in relation to East Europe; contradictory data, confusing calendar and crop year figures, and

[1] *Public Ledger*, 23rd April 1977.
[2] *International Sugar Rpt.*, 1977, **109**, (9), 1–7.

combined beet sugar and raw cane sugar tonnages all make it difficult to ascertain true production levels for the USSR and since the figures are so large this entails an unsatisfactory degree of uncertainty in global estimates.

Similarly, estimates for China have to be educated guesses and can result in unknown shortfalls producing unforeseen large demands from the world market, as have occurred in recent weeks, although Licht attributes these to stock-rebuilding and expanded consumption. In Cuba there are indications of difficulties in bringing in the cane harvest owing to rain and some factories have interrupted processing.

Details of the estimates appear elsewhere in this issue.

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European sugar beet area, 1977

Only a month after their first estimate[1], F. O. Licht KG have published revised figures. In most cases the estimated areas are unchanged but actual figures have become available for countries where sowing is carried out early and revisions have been made in others. In Western Europe the major change is an upward revision for Turkey of some 35,000 hectares to 260,721 ha, although the figure for Spain is 30,000 ha lower at 220,000 ha. France also is expected to sow 21,000 ha less, at 549,000 ha, while the figure for West Germany is reduced from 445,000 at 435,000 ha.

The East European figures were plan figures and are virtually unchanged, although that for Poland is raised by 30,000 to 600,000 ha, and that of the USSR reduced by the same amount to 3,770,000 ha. The total European area is now set at 7,974,398 ha against the first estimate of 7,998,100 ha and the revised 1976 area of 7,941,252 ha.

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Booker McConnell 1976

Last year marked a watershed in the activities of the Booker Group in that they are the first to cover the period since operation of most of the Guyana sugar industry passed from the company's hands. Now, instead of sugar manufacture providing 40% of group profits, Bookers have diversified even wider into food and drink wholesaling and retailing, in the UK and abroad, although sugar is still a factor in the business, with Booker Agriculture International providing world-wide consultancy services. Engineering facilities include the Sigmund and Plenty divisions providing equipment for sugar, while the Fletcher and Stewart Division lost money in 1976 owing to the effects of inflation on a fixed-price Sudanese sugar factory contract.

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Western Australia sugar industry

Proposals have been made over the years for establishment of a cane sugar industry in the Ord River area of Western Australia but have never come to anything. A feasibility study was made recently by CSR Ltd. for the W.A. Government and their report has been presented to the State Prime Minister, the Premier of Queensland, and to farmers' representatives for consideration.

In the summary of the report[3] it is suggested that the best proposition would be establishment of a mill with an initial capacity of 120,000 tons of raw sugar per year, expanding over 3–5 years to 220,000 tons. A period of commercial pilot-scale cane farming is essential for proper evaluation of the region to get better data on costs, yields, cultivation methods, etc., while there are no known pests which could harm the crop. Investments would be needed in farms, harvesting and transport equipment, processing facilities, bulk storage and port facilities, etc. and for 220,000 tons p.a. are estimated at $Aust. 231 million at 1975 prices. About 30,000 hectares of land would be needed, whereas some 70,000 ha is potentially available. If all available land were irrigated and developed a 500,000-tons industry could be established in the Ord region. Construction of a mill is envisaged at 26 miles towards the coast from the town of Kununurra, with a new sugar port to be established at Cape Domett, about 70 miles from the mill.

* * *

GEPLACEA views on sugar prices

The sixth meeting of GEPLACEA, the Group of Latin American and Caribbean Sugar Exporting Countries, which took place in Havana in March, was successful in producing a concensus as regards an appropriate price target to aim for in the negotiations for the International Sugar Agreement which started in mid-April. The group, which represents the producers of about 60% of the world's sugar exports, agreed that the lowest acceptable floor price would be 15 cents per pound, with a maximum of 50–100% above this level. They also decided they would favour a new agreement which would incorporate export quotas for only the first three years, such quotas then to be subject to new negotiation to take into account development plans for the industries of the exporting countries. It was also recommended that sales should not be made to dealers if the name of the final destination was unknown, to prevent speculation, and it was suggested that the GEPLACEA secretariat or other central organization handle sales information to avoid simultaneous selling tenders.

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ACP sugar supplies to the EEC

At meetings in April held between representatives of the EEC and sugar supplying countries under the Lomé Agreement, it was decided to restore sugar quotas in full for all members for 1976/77. It had previously been decided to reduce or eliminate the entitlements for the Congo Republic, Uganda and Surinam but these have now been restored to 10,000 tons, 500 tons and 4000 tons, respectively[4].

On the 28th April, at the start of negotiations for the 1977/78 period the ACP countries called for a higher price than the 272·5 units of account (about £190) per metric ton, raw value, offered by the Community[5] (which corresponds to the white sugar price paid to EEC sugar producers). The ACP spokesman claimed that production costs had risen by 16% during the past year but the EEC offer was only 2% higher than the 267 u.a. price for 1976/77.

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[1] See *I.S.J.*, 1977, **79**, 150.
[2] *International Sugar Rpt.*, 1977, **109**, (10), 1.
[3] *Australian Sugar J.*, 1976, **68**, 441, 444, 446–7.
[4] C. Czarnikow Ltd., *Sugar Review*, 1977, (1332), 63.
[5] *The Times*, 29th April 1977.

The absolute determination of sucrose in mill and refinery products by isotope dilution

Part I. Isolation and purification of sucrose for counting

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Introduction

THE sucrose content of mill and refinery products is routinely estimated by polarimetry. Any such determination may be affected by the presence of other optically-active constituents. Many published modifications to the polarimetric methods attempt to reduce the effect of such interfering substances but, according to HIRSCHMÜLLER & HÖRNING[1], none of the methods is completely reliable.

The approach which offers the greatest prospect of providing an absolute determination of sucrose in sugar products is that of isotope dilution. However, the suitability of isotope dilution as an absolute method for sucrose determination depends on a large number of variables. The purpose of this and of a subsequent paper is to consider these variables and their control and to present a standard procedure for the absolute determination of sucrose in cane sugar products. This procedure has a precision (measured as 95% confidence limits on the mean) of about $\pm$ 0·4% relative. This relative precision and accuracy holds for mill and refinery products ranging from 1 to 99% sucrose.

Isotope dilution methods are based on the addition of a measured quantity of radioactively-labelled sucrose to a known quantity of sample, establishment of chemical equilibrium between the labelled sucrose and that in the sample and isolation and purification of the sucrose for radioactive counting. The extent to which the radioactive sucrose has been diluted with non-active sucrose is determined by comparison with the count rate of a radioactive standard which has been diluted with a known amount of pure sucrose. The original sucrose content of the sample is calculated using the equation

$$\% \text{ sucrose} = \frac{100\ W_t}{W_m}\left(\frac{\gamma . S_t}{S_f} - 1\right)$$

where W_t = weight of active sucrose added to sample, W_m = weight of sample, γ = weight ratio of the counting standard to the standard source

$$= \frac{W_{14} + W_{12}}{W_{14}}$$

where W_{12}, W_{14} are weights of non-active sucrose and active sucrose respectively in the counting standard, S_t = count rate of counting standard corrected for dead time and background, S_f = count rate of sample tablet corrected for dead time and background.

An absolute method must fulfil three requirements:

(i) It must be chemically specific for the sucrose.

(ii) It must be accurate (i.e. it must give a result which is a measure of the true sucrose value, not subject to interference from other sources).

(iii) It must be precise (i.e. there must be close agreement between replicates in order to ensure a high degree of reliability in the estimation).

It is therefore necessary to eliminate or reduce to acceptable levels all sources of errors which could possibly affect the final result.

SOURCES OF ERROR

Errors may be categorized under two main headings: those arising from chemical procedure and those involved in radiation counting of the recovered sucrose. The isotope dilution technique measures the ratio of added active sucrose to the chemically-identical inactive sucrose in the sample. Once the mixture of active and inactive sucrose has been brought into equilibrium, this ratio of active to inactive sucrose will remain unchanged irrespective of the chemical and physical processes that the sample undergoes. Since it is a ratio method, the amount of sucrose lost in such processes is unimportant provided sufficient sucrose remains in the final purified form to permit the required radiation counting.

Therefore, the only errors likely to affect the chemical procedure are (i) errors in weighing the active and inactive materials, (ii) failure to allow equilibrium of the active and inactive sucrose before separation of the sucrose, and (iii) failure to obtain a pure product (any impurities in the final counting source will dilute the activity by an amount equal to that which would be obtained from the same weight of sucrose and will cause the sucrose content to be overestimated).

By far the most numerous and difficult errors to overcome are those involved in the radiation counting of the recovered sucrose. These can be summarized as (i) statistical errors based on the random nature of radioactive decay, (ii) errors due to the variability of sources, and (iii) errors due to variability in counter efficiency.

Radioactive decay is a random change. If a series of counts, each of t minutes duration, are made of a single radioactive sample having a true count rate of x counts/min under the geometrical conditions of the counter in use, the total number of counts recorded for each period will be normally distributed about the average value of xt counts with a standard deviation of $\sqrt{xt}$ counts. Therefore, for each determination there is a 95% probability that the true counting rate lies within $\pm 2\sqrt{xt}$ of the measured count rate. Thus, to reduce the random counting error to 95% confidence limits of $\pm$ 0·1% requires that a total of 4 million counts be accumulated for the sample (i.e. 4,000/4,000,000).

Errors due to source and counter variability have not generally been mentioned in previously published papers on the determination of sucrose by isotope dilution. However, these errors can be very significant when a high degree of precision is sought and the

[1] *Zeitsch. Zuckerind.*, 1959, **84**, 389–399.

minimization of these errors must be of primary concern.

Errors concerned in the chemical procedure are dealt with in this part of the paper. Counting errors will be dealt with in detail in Part II.

Published Methods of Sucrose Purification

Two basic approaches to the isolation and purification of sucrose have been used with isotope dilution procedures. The first, introduced by Hörning & Hirschmüller[2] for sugar beet analysis, used diethylamine to extract the sucrose from the beet pulp. Sucrose was crystallized from the extract by the addition of ethanol and the impure crystals were taken up in a copper sulphate solution. The resultant sucrose-copper sulphate complex was filtered and the sucrose recovered by dissociating the complex in hot water and removing the copper with collidine. The sucrose was purified further by repeated crystallizations from a water-alcohol mixture. Although accurate, the method was tedious, required specialized equipment and the preparation of the sucrose-copper sulphate complex was difficult.

Gelen[3] modified this approach, replacing the diethylamine extraction with a basic lead acetate solution extraction, followed by ion-exchange removal of the inorganic ions. The sucrose was crystallized from an alcohol-water mixture and then purified by forming the sucrose-copper sulphate complex and continuing the method described previously. The method was said to be shorter than the earlier procedure.

The second approach was introduced by Sibley *et al.*[4]. In this method, which was more rapid, cheaper and less difficult to carry out, the pulped sample and added radioactive sucrose were mixed in an electric blender with a calcium hydroxide-diatomaceous earth suspension in water. After filtering, the clear solution was heated to 60°C and the sucrose was precipitated with barium hydroxide. After filtering, the recovered barium saccharate was suspended in water. Carbon dioxide was bubbled through the suspension, precipitating barium carbonate and liberating the sucrose into solution. After repeating the barium saccharate-carbonatation cycle the sucrose was purified further by repeated recrystallizations from an alcohol-water mixture.

Bruijn & Carreyet[5] modified the procedure for use with cane juice. They added a small amount of barium hydroxide to the cane juice-active sucrose mixture as a pre-purification step. The amount of barium hydroxide was not sufficient to precipitate the barium saccharate, but produced a light inorganic precipitate which served to remove some impurities. The normal Sibley method was followed through the two barium saccharate separation-carbonatation cycles. Dilute sulphuric acid was then used to remove excess barium which was not otherwise removed by the subsequent ion exchange step. The recovered product was twice recrystallized from ethanol.

This procedure required modification when used for the analysis of molasses because of the interference by starch. The initial barium defecation step was replaced by a precipitation of starches and gums from the sample from an alcoholic solution. No details were published on attempts to determine the accuracy of the method, but the 95% confidence limits were reported to be $\pm$ 0·8% relative.

Sucrose Crystallization

Most published works on the use of isotope dilution for sucrose determination describe concentration of the filtrate from the sucrose purification process to approx. 70°Bx before pouring the concentrate into absolute alcohol. We have carried out some extensive investigations into the conditions of crystallization which have resulted in a considerable modification to the usual procedures.

Crystallizing medium

Early work included the evaluation of alternatives to absolute alcohol as a medium for recrystallization; pyridine, dimethylformamide, hydrazine hydrate, glycerol, dimethylsulphoxide and high-grade denatured absolute alcohol (which contains 2% methanol and is cheaper than absolute alcohol) were tried. Only the denatured absolute alcohol gave results which were comparable to absolute alcohol and, in fact, gave a significantly purer product than did the normal absolute alcohol.

Crystallization rate

The density of the aqueous sugar solution is very important. Using a 60–70°Bx solution in accordance with published methods produced a toffee-like mass of sugar and crystal growth was retarded for many hours. Even after 24 hours standing, inclusions of syrup between the crystals were commonly found.

If the density is less than about 40°Bx, crystallization is difficult without boiling, when inversion of the sucrose can be increased.

A concentration of 45 to 55°Bx poured into a volume of alcohol six times that of the liquor produces excellent crystal results. A yield of 90% after 12 hours crystallization can be obtained and the crystals are large and well-formed. Generally, crystals obtained from high-concentration (70°Bx) solutions are smaller and more aggregated. Polarimetric analysis showed no significant difference in the purity between crystals produced by the two methods, but the less concentrated solution was preferred because of the superior crystals formed.

Recommended Procedure

Reagents

^{14}C-labelled sucrose, 1·0 millicurie (mCi); Radiochemical Centre Ltd. (Amersham, Bucks., England) Cat. No. CFM-4.

Sucrose; A.R., less than 0·05% moisture.

Horne's dry lead (basic lead acetate powder).

De-leading reagent; dissolve 30·0 $\pm$ 0·5 g potassium oxalate and 70 $\pm$ 1 g disodium phosphate (Na_2HPO_4,12_2HO) in distilled water and dilute to 1000 cm^3.

"Supercel" filter aid.

Barium hydroxide; A.R.

[2] *Zeitch. Zuckerind.*, 1959, **84**, 499–507.
[3] *ibid.*, 1970, **95**, 304–306.
[4] *Anal. Chem.*, 1965, **37**, 1701.
[5] *Proc. 47th Congr. S. African Sugar Tech. Assoc.*, 1973, 44–48.

Phenolphthalein indicator; dissolve $1{\cdot}0 \pm 0{\cdot}1$ g phenolphthalein in 50 cm³ alcohol. Dilute to 100 cm³ with distilled water.

Carbon dioxide; high purity, cylinder.

"Amberlite MB-3 AR" ion exchange resin.

"Norit Supra" activated carbon.

Preparation of radioactive sucrose

The active sucrose is prepared by dissolving 1·0 millicurie of ^{14}C-labelled sucrose and 200 g A.R. sucrose in 200 cm³ distilled water. The solution is allowed to stand for 30 minutes, then the sucrose is recrystallized from high-grade denatured absolute alcohol in the manner described in steps (xi) to (xvii) in the section below on sucrose preparation.

Preparation of counting standards

Standards are prepared by accurately weighing $6{\cdot}00 \pm 0{\cdot}01$ g active sucrose and $5{\cdot}60 \pm 0{\cdot}01$ g A.R. sucrose into a beaker and dissolving in 60 cm³ distilled water. All weighings should be accurate to 0·0005 g. The solution is then treated in precisely the same manner as any sample, undergoing complete chemical separation, purification and crystallization of the sucrose.

Normally, standards are prepared in triplicate (standards 1, 2 and 3) and five tablets are prepared for counting from each of the three standards. The three tablets from each group of five which give the best agreement in counting rates are retained as standards, providing a total of nine standard tablets representing three standard preparations.

Sample preparation

All samples should be analysed in duplicate. The time normally required to process duplicate samples to the point where they are ready for concentration and crystallization from alcohol is 90 minutes, excluding the equilibration time.

(*a*) *All products except cane juice and mill mud*

(i) Determine the approximate sucrose content of the sample by polarimetry.

(ii) Weigh out an amount of sample calculated to contain $5{\cdot}60 \pm 0{\cdot}01$ g sucrose (based on pol results), recording all weights accurately to within $\pm$ 0·0005 g.

(iii) Weigh out $6{\cdot}00 \pm 0{\cdot}01$ g of the radioactive sucrose in a separate container, recording all weights accurately to within $\pm$ 0·0005 g.

(iv) Dissolve the sample and active sucrose separately in 30-cm³ quantities of warm (60°C) distilled water. Combine the two solutions, with washings, and stir thoroughly. If insoluble matter is present, allow to stand for 5 to 30 minutes, depending upon the amount of sediment, stirring occasionally.

(*b*) *Cane Juice*

(i) Add 1 g dry lead for every 100 cm³ cane juice immediately the sample has been collected. The lead addition prevents deterioration of the sucrose.

(ii) Add 3–4 heaped teaspoons of "Supercel" filter aid for each 100 cm³ juice and vacuum-filter the solution through a Grade 3 sintered glass filter.

(iii) Determine the approximate sucrose content of the clear cane juice by polarimetry and proceed from step (iii) of the method for other sugar products. (The content of dissolved lead in the sample will not affect the sample weighings.)

(*c*) *Mill mud*

(i) Determine the approximate sucrose content of the mud by polarimetry, using the filtrate from a diluted suspension of a known amount of the mud.

(ii) Weigh out an amount of sample calculated to contain $2{\cdot}00 \pm 0{\cdot}01$ g of sucrose (based on pol result), recording all weights to within $\pm$ 0·0005 g.

(iii) In a separate beaker weigh out $3{\cdot}60 \pm 0{\cdot}01$ g A.R. sucrose, recording the weights to within $\pm$ 0·0005 g.

(iv) In a third beaker weigh out $6{\cdot}00 \pm 0{\cdot}01$ g of the active sucrose, recording the weights to within $\pm$ 0·0005 g.

(v) Dissolve the A.R. sucrose and active sucrose in separate 30-cm³ quantities of warm (60°C) distilled water. Add the two solutions and the mill mud to a 600-cm³ beaker with washings. Slurry the contents, breaking up any lumps, and dilute the sample to about 250 cm³. Stir the sample well and stand for 30 minutes with regular stirring.

Sucrose preparation

(i) Dilute the sample solution to approx. 250 cm³, add 0·5–1·0 g of Horne's dry lead and mix thoroughly. [This and step (ii) can be omitted in the case of cane juice.]

(ii) Add a heaped teaspoon of "Supercel", mix and vacuum-filter the solution through a sintered glass filter (for mill mud, use 10–12 heaped teaspoons of "Supercel").

(iii) Add 15 cm³ de-leading reagent to the filtrate, mix and vacuum-filter through sintered glass using 1 heaped teaspoon of "Supercel" as a filter aid.

(iv) Heat the filtrate to approx. 65°C and add 8 heaped teaspoons of barium hydroxide. Stir until a thick white precipitate forms; this precipitate should settle rapidly. If settling does not occur to any noticeable extent, the stirring should be continued and the temperature raised to 70–75°C. Up to two extra teaspoons of barium hydroxide can be added if necessary to promote flocculation. After formation of the heavy white precipitate, allow the sample to stand at 60–65°C for 30 minutes with occasional stirring.

(v) Vacuum-filter the solution while hot through a Whatman 540 filter paper, washing the precipitate with a small quantity of hot barium hydroxide solution.

(vi) Transfer the precipitate and filter paper to a 250-cm³ beaker and slurry the precipitate with 100 cm³ distilled water. Heat to 75–80°C and add 3 drops of phenolphthalein indicator solution.

(vii) Bubble CO_2 gas through the slurry, while stirring, until the pink colour is removed. Check the end-point by adding an extra drop of phenolphthalein solution and continue carbonatation for a further 3 minutes.

(viii) Vacuum-filter through a sintered glass filter; do not wash the container and precipitate.

(ix) Add 1 teaspoon of "Amberlite MB-3 A.R." resin and 1 teaspoon of "Norit Supra" carbon and stir gently at 25–30°C in a water bath for 30 minutes.

(x) Vacuum-filter through a Millipore HA filter (0·54μ). If the filtrate is not colourless, as may sometimes be the case in samples high in reducing

sugars, repeat steps (ix) and (x) with fresh resin and carbon.

(xi) Evaporate the filtrate to approx. 50°Bx in a rotary evaporator. If the solution appears yellow, dilute and repeat steps (ix) to (xi).

(xii) Pour the concentrated solution into 150 cm^3 high-grade denatured absolute alcohol in a 600-cm^3 beaker with swirling. Cover and allow to stand for at least 48 hours.

(xiii) Decant the alcohol from the crystals; wash the crystals in alcohol, then acetone. Dry the crystals for 5 minutes in an oven at 80°C to remove acetone.

(xiv) Redissolve the sucrose in an amount of water sufficient to produce a 50°Bx solution.

(xv) Repeat steps (xii) and (xiii).

(xvi) Crush the crystals to a fine powder (no grittiness detectable with a spatula). Dry the sucrose powder for 16 hours in a vacuum oven at 50°C.

(xvii) Cool and store the dry sucrose in a desiccator.

Accuracy of the Method

The effectiveness of the chemical procedure was tested by analysing two samples of molasses and one of golden syrup.

Sources were prepared from the recovered sucrose from each sample after the initial crystallization and after each subsequent recrystallization. The results are summarized in Table I. R_0 refers to the initial crystallization. An impure sample will give a sucrose value higher than actual. If the apparent activity reduces with additional recrystallizations, this is indicative of an initially impure sample. A one-way analysis of variance showed that there was no significant difference between the results for all four crystallizations in the case of golden syrup, all five crystallizations for the first molasses sample or for the three recrystallizations of the second molasses sample. The initial molasses crystallization was significantly different from the remaining results, but this may have been due in part to the coincidentally small confidence limits on that result.

Table I. Sucrose results (%) after recrystallization*

Recrystallization	*Sample*		
	Molasses No. 1	*Molasses No. 2*	*Golden syrup*
R_0	33·51 ± 0·21	33·01 ± 0·06	26·67 ± 0·19
R_1	33·54 ± 0·28	32·74 ± 0·21	26·48 ± 0·15
R_2	33·49 ± 0·25	32·73 ± 0·19	26·64 ± 0·18
R_3	33·47 ± 0·35	32·56 ± 0·19	26·52 ± 0·19
R_4	33·35 ± 0·25		

* Errors quoted are 95% Confidence Limits on the Mean.

Although a single crystallization appeared to be sufficient, two crystallizations are recommended to ensure the required purity.

A further check on the purity was made by analysis of further molasses and golden syrup samples with and without the addition of known amounts of pure sucrose. The experimental results of the samples with added sucrose were compared with the expected results based on the sucrose content of the original samples and the known amounts of added sucrose. The results are shown in Table II.

The agreement between the experimental and calculated values is good and clearly demonstrates the accuracy of the method within the limits of the precision attainable. The precision of the method will be dealt with in Part II, with details of the source preparation and counting procedures.

Table II. Accuracy of the procedure

Sample	*Weight of Sample taken, g*	*Active Sucrose added, g*	*Inactive Sucrose added, g*	*Sucrose content %*	
				Experimental	*Theoretical*
Golden syrup	20·7002	6·0001	—	24·51	—
	20·7002	7·2004	1·1001	28·48	28·32
Molasses	16·4000	6·0002	—	33·83	—
	16·4000	7·2003	1·1001	37·81	37·99

Acknowledgements

Much of the early testing of the chemical procedures and variables was performed by Mr. A. J. Darby.

I would like to make grateful acknowledgement to CSR Limited for their permission to publish this work.

Summary

This first part of a two-part paper is concerned with isolation and purification of radioactive sucrose from samples for analysis. The procedure consists of initial clarification of the sample-active sucrose mixture with basic lead acetate, a single barium saccharate-carbonatation cycle followed by treatment of the recovered sucrose solution with activated carbon and ion-exchange resin. The filtrate is concentrated to approx. 50°Bx and sucrose is recrystallized twice from denatured absolute alcohol.

The procedure was found to be free of bias and not affected by high concentrations of impurities.

West Germany 1976/77 campaign results[1].—The Production Department of the Wirtschaftliche Zucker e.V. has published the results of the 1976/77 campaign in West Germany, as follows: on an area of 449,329 hectares (435,573 ha in 1975/76) were grown 18,702,426 metric tons of beet (18,832,134 tons in 1975/76, including 53,504 tons of beet grown in Denmark). The sugar content at the slicer was higher (15·60% in 1976/77 *vs.* 14·67%) as was extraction (13·26%, white value, *vs.* 12·22%). Sugar production totalled 2,712,472 tons, raw value, as against 2,510,214 tons in 1975/76, with 2,097,003 tons (1,994,463 tons in 1975/76) in the form of white sugar, the remainder being raw sugar or syrup.

* * *

Ivory Coast sugar expansion[2].—Nearly 40,000 million francs in foreign credits have been granted to the Ivory Coast for the establishment of a fourth sugar factory to be located on the Bandama River, 350 km to the north of Abidjan. At the site will be developed a 6250-hectare irrigated sugar cane plantation and the factory will produce annually 50,000 metric tons of sugar for export. Decided in 1974 by President Houphouet Boigny, the ambitious sugar plan of the Ivory Coast involves construction of about ten sugar complexes, permitting, towards 1980, annual production of 600,000 tons of cane sugar of which 500,000 tons is intended for export.

* * *

Egypt sugar expansion[3].—The first Egyptian beet sugar factory is to be built with French aid in the north of Kaft-Alchaich in the Nile Delta; an area of 10,000 hectares is to be planted with beet and sugar production should reach 70,000 tons per annum. As an additional part of the programme for increasing sugar production in Egypt from 650,000 to 1,000,000 tons per annum, the Deshna sugar factory in Upper Egypt is to be expanded to a production capacity of 100,000 tons per annum while a third milling train is to be installed at Kous sugar factory to raise production to 50,000 tons of sugar per annum. At Bellina, also in Upper Egypt, a new cane sugar factory is to be built with a production capacity of 150,000 tons per annum while the capacity of the Hawamdieh sugar refinery, south of Cairo, is to be expanded.

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[1] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (5), 15–16.
[2] *Le Betteravier Franç.*, 1977, (309), 40.
[3] *Zeitsch. Zuckerind.*, 1977, **102**, 110.

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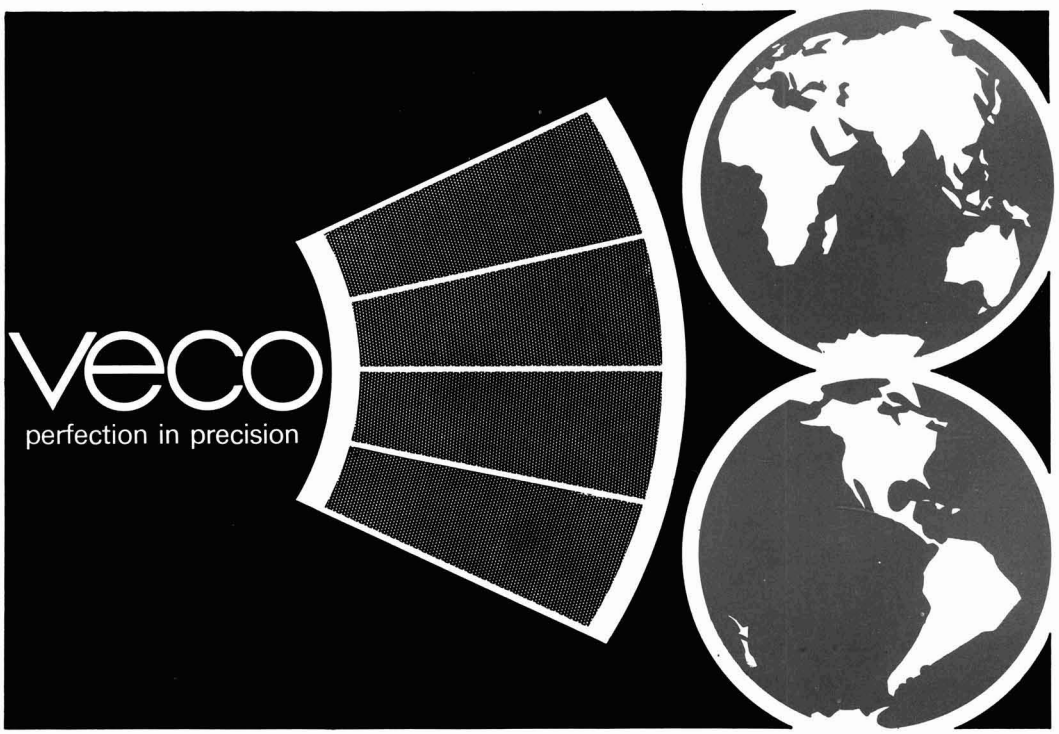

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Diffuser sterility and pulp pressing

By J. F. T. OLDFIELD, M. SHORE and N. W. BROUGHTON

(British Sugar Corporation Research Laboratories, Colney)

Paper presented to the 23rd Tech. Conf., British Sugar Corp. Ltd., 1976

PART II

Diffuser pH and pulp pressing

The relationship between diffusion pH and parameters relating to pulp pressing, such as pulp volume and dry substance, which was indicated by these factory results, was now investigated in more detail in a series of laboratory experiments.

These experiments were carried out in the laboratory micro-diffuser supplied with town mains water with sugar added to increase the solids content to the typical value of 0·7° Brix and sufficient added ammonia to give a characteristic 100 ppm. The calcium content of this artificial supply water was 136 ppm which was substantially more than normally found in factory supply water[27], but it is considered that as it was present in all the experiments it would not affect the relative results when the pH was varied by adding acid. Indeed, GENOTELLE & CARRIÈRE[28] have shown that the effects on pulp pressing of added calcium and added mineral acid are additive. Before each run the pH of this artificial supply water was adjusted to the required value by the addition of dilute sulphuric acid.

A 15-cell battery was maintained at 70°C to which temperature both the supply water and the cossettes were equilibrated before diffusion began. Each cell contained 550 g of cossettes which were extracted with a countercurrent draw of 120% v/w at 5-minute intervals after discarding the tail cell and adding a cell containing fresh cossettes at the juice end; the retention time of the cossettes at 70°C was 80 minutes altogether during diffusion. The exhausted pulp was emptied from each cell onto a screen and, after draining, the wet pulp was weighed and the drained water pH measured. The volume of wet pulp was then determined for the contents of each alternate cell by using Archimedes' principle to displace an equal volume of water.

The dry substance of the wet pulp was measured by 16-hour drying at 105°C of duplicate samples from the well-mixed contents of every second cell. The remainder of the contents of this cell was pressed at a standard pressure in a hydraulic press which had been adjusted to give a pressed pulp dry substance of about 15% for standard diffusion conditions when fermentation was taking place. The pressed pulp was then weighed and its dry substance determined in duplicate. The pH of the press water was recorded. All the values quoted below for dry substances of wet and pressed pulp and for press water pH and yield of pressed pulp are mean figures for the contents of at least six cells.

In the first five experiments, which were run in a random sequence, the supply water pH was adjusted to a fixed value within the range pH_{20} 3–8 and the results then obtained from the procedures described above are set out in Table IX below.

Measurement of lactic acid on juice samples taken throughout these experiments indicated that no fermentation had taken place at any time, which was as expected in view of the short retention time and the use of "sterile" supply water. The experimental observations thus related to the effect on pulp pressing of changes in pH in sterile conditions.

The results above showed that press water was more alkaline than water drained from the exhausted cossettes which, in turn, was of higher pH than diffusion supply water. It is considered that this was due to ion exchange reactions between the cossettes at the tail end of the diffuser and the incoming supply water[29]. The presence in press water of some of the natural buffering constituents of the beet may also have tended to neutralize the more acid supply waters. This effect was, of course, even more marked in the raw juice which decreased only by 0·4 pH units from pH_{20} 6·5 as the supply water pH was reduced from pH_{20} 8 to pH_{20} 3. The results showed that pulp press water was much less influenced by acid addition at the water end than was supply water.

Under conditions of increasing water pH, the volume of wet pulp was found to increase and this confirmed the earlier factory observations that at higher diffusion pH values, the volume of wet pulp increased for a constant slice rate.

Other effects of the higher pH are shown in Table X which includes further data for the wet pulp calculated from the results in Table IX.

These results showed that, as the water pH increased, more solids were extracted from the cossettes, a phenomenon which was undoubtedly due to the increased solubility at higher pH of cell wall constituents such as pectin[29–32]. It is also interesting to note

[27] CARRUTHERS & OLDFIELD: *I.S.J.*, 1961, **63**, 241–243, 271–274.
[28] *Ind. Alim. Agric.*, 1974, **91**, 925–929.
[29] CARRUTHERS & OLDFIELD: *I.S.J.*, 1957, **59**, 277–281.
[30] KARTASHOV *et al.*: *Sakhar. Prom.*, 1960, (1), 9–10; *S.I.A.*, 1960, **22**, 270.
[31] VUKOV: *Zuckererzeugung*, 1961, **5**, 71–74, 105–106.
[32] PIECK: *Ind. Alim. Agric.*, 1969, **86**, 925–930.

Table IX. The effect of supply water pH on exhausted cossette parameters

Expt. No.	Supply water pH_{20}	Drained water pH_{20}	Press water pH_{20}	Wet pulp: Weight, g	Wet pulp: Volume, cm^3	Wet pulp: Dry substance, %	Pressed pulp: Weight, g	Pressed pulp: Dry substance, %
5	8·0	7·8	8·2	499	479	6·2	193	14·1
2	6·8	7·3	7·6	497	480	6·8	205	14·2
1	5·4	6·2	6·3	489	465	6·7	194	14·7
3	4·2	5·9	6·0	484	463	7·2	188	16·2
4	2·9	4·6	5·2	485	448	7·9	190	17·1

Table X. The effect of water pH on wet pulp parameters

Supply water pH_{20}	*Weight of wet pulp,* g	*Weight of solids,* g	*Weight of water,* g	*Volume of wet pulp,* cm^3	*Density of wet pulp,* $g.cm^{-3}$
8·0	499	31	468	479	1·04
6·8	497	34	463	480	1·04
5·4	489	33	456	465	1·05
4·2	484	35	449	463	1·05
2·9	485	38	447	448	1·08

that in the more alkaline conditions the spent pulp contained more water and that in combination with the reduced solids content this produced the decreasing dry substance recorded in Table IX.

Because of volume and weight decreases with decreasing water pH, there was very little change in the bulk density of the wet pulp except with extreme acidification. As the pH of diffusion is increased in a factory, these results indicate that increased filling of the feed scrolls to the presses, sometimes to overflowing, would be due to a greater volume of wet pulp leaving the diffuser at a constant slice rate and not to a reduced wet pulp density. Since such pulp feels noticeably more slippery it may also be that it is not conveyed so positively by the scrolls and that this contributes to the increased filling of the press-station which is observed to occur under such conditions.

These experiments showed that, as the pH at the water end was raised, more solids were extracted from the cossettes and the wet pulp passing to the presses increased in volume and contained less solids and more water for a constant slice rate. Table XI contains data for pressing derived from Tables IX and X.

Table XI. The effect of water pH on pulp pressing

Supply water pH_{20}	*Weight of solids in wet pulp,* g	*Weight of solids in pressed pulp,* g	*Loss of solids in pressing,* g	*Weight of water in pressed pulp,* g
8·0	31	27	4	166
6·8	34	29	5	176
5·4	33	28	5	165
4·2	35	30	5	157
2·9	38	32	6	158

As the results show, at the higher pH values the trend was not only to increased water content in the pressed pulp but also to reduced solids with consequent decrease in pressed pulp dry substance, in confirmation of the well-known observation. The results also show that, although part of this reduction in solids was due to increased extraction in the diffuser, solids were also lost in pressing and, moreover, that additional solids were pressed from the pulp at higher pH values. Loss of marc in such conditions would thus seem to be due both to extraction and to pressing out of extra solids. It is possible that the extraction of colloids from the cell walls causes some loss of rigidity in the pulp which then becomes soft and mushy so that particles may pass more easily through the press screens with the press water.

These findings, which have been confirmed by further experiments, are summarized graphically in Figs. 4 and 5, the latter also showing that the dry substance of the pressed pulp produced was substantially lower when diffusion conditions were such that pH of the press water exceeded pH_{20} 6. This is not intended to imply a causal relationship but rather to suggest that those conditions which cause the water

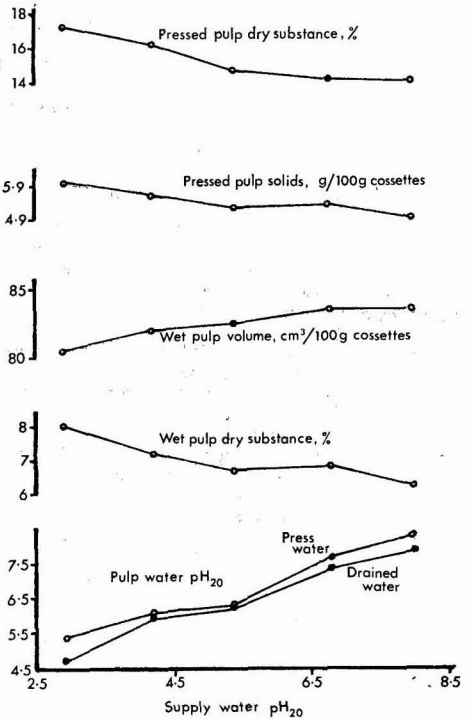

Fig. 4. The effect of variation in supply water pH on pulp pressing parameters

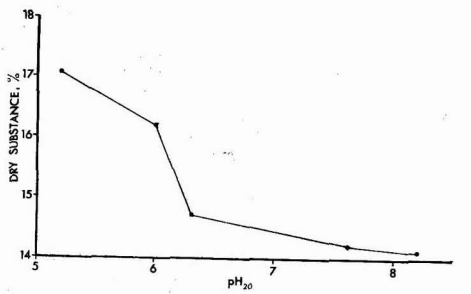

Fig. 5. Variation in pressed pulp dry substance with press water pH

end to be more alkaline may bring about a marked deterioration in pulp "pressability" without causing a substantial change in press water pH so that small changes in the monitored pH values for pulp press water in a factory may sometimes be accompanied by disproportionately large changes in pressed pulp dry substance.

These experiments confirmed some of the adverse effects on pulp pressing which would be brought about by increases in diffusion pH, such as might occur during elimination of fermentation in diffusion as the data in Table V show. Indeed, the somewhat acid diffusion pH profile which has been established by experience over many years is considered to give the most suitable exhausted pulp for further process-

ing whilst ensuring optimum raw juice quality with respect to settling and filtration after carbonatation. It was judged essential, therefore, that such a pH profile should be maintained, possibly by controlled acid addition to the diffuser, when fermentation was eliminated.

The Addition of Sulphuric Acid to Maintain an Optimum Diffuser pH Profile

Hydrochloric acid is considered inappropriate for addition to diffusion juice because chloride ions are not eliminated during carbonatation and so would contribute to molasses production. Sulphuric acid is considered more suitable because some 50% of raw juice sulphate is eliminated before sulphitation[33,34] and also because concentrated sulphuric acid is a much cheaper acid, costing only about one-third of the price of a stoichiometrically equivalent quantity of concentrated hydrochloric acid at 1976 prices.

It proved impossible to maintain the midbay juice of an RT diffuser at pH_{20} 5·5 by adding sulphuric acid via diffusion supply water as fermentation was eliminated. Even after the supply water had been acidified to about pH_{20} 4, at which stage unacceptable corrosion of the water end was very probably occurring, the midbay juice had risen to over pH_{20} 6. This inability to affect juice pH by acidification of supply water has been discussed by Schiweck and is undoubtedly due to the presence of sufficient buffer capacity even in the exhausted cossettes/low Brix juice mixture at the water end to absorb the relatively small amounts of acid which are required to reduce substantially the pH of the poorly buffered supply water[5]. A similar effect was noted in the results reported in Table IX.

It was considered that the most appropriate point for adding extra sulphuric acid to a sterile diffuser would be that region showing minimum pH under fermentation conditions. To reduce the risk of localized inversion of sucrose at the addition point and for safety, dilute sulphuric acid (5% v/v) was used.

At a slice rate of 200 tons of beet per hour with 15° Brix raw juice and a draft of 120% by weight, 3·5 litres per minute of 5% v/v sulphuric acid would be required as the stoichiometric equivalent of 150 ppm lactic acid in the raw juice.

As a general rule, it may be taken that 100 ppm lactic acid in raw juice has to be replaced by about 30 litres per hour of 5% sulphuric acid per 1000 tons per day slice, i.e. by 0·0066% w/w concentrated (96% w/w) sulphuric acid on beet.

Few difficulties were envisaged in making such additions towards the juice end of either a BMA tower or a DDS diffuser but addition to juice in the region of compartments 11 to 14 of a revolving RT drum required more specialized equipment. The problem was solved by using a principle similar to that employed for shock dosing this region of the diffuser with formalin. The plant described below was used at Felsted factory which processes some 125 tons of beet each hour, equally divided between two similar RT2 diffusers.

Concentrated sulphuric acid was diluted approximately twenty times by volume by careful addition to cold river water in a tank equipped with a stirrer; the heat generated gave no problems. The dilute acid was then conveyed, by means of a metering pump with a PTFE-coated head, along polypropylene pipelines and through a PTFE gland mounted axially in the revolving head of the diffuser, from where the acid flow was divided in half and pumped along the outside of the drum by the action of the metering pump to two inlet cocks on opposite sides of the diffuser in the region of compartment 13.

A separate metering pump, drawing from the 4500-litre tank of 5% acid, was installed for each diffuser. The stroke of each pump could be varied to deliver between 0 and 4·5 litres of dilute acid per minute.

Under normal operating conditions formaldehyde was added whenever the midbay juice dropped below about pH_{20} 5·5 from a slightly pressurized supply tank via a gland in the fixed head to the juice in the region of compartment 11. Juice samples taken during normal running from various compartments of one of the diffusers between one-third and one-half the length of the diffuser from the juice end were found to contain as much as 800 ppm lactic acid and it was clear that the typical formaldehyde usage of about 140–150 litres per day to each diffuser, i.e. about 0·01% on beet, was giving rise to a substantial loss of sugar, particularly as it was not being added until there was undeniable evidence from the juice pH of an active fermentation. The effectiveness of the formaldehyde treatment was also being limited by diffuser temperatures of only 68–69°C.

The diffuser temperature throughout was raised by about 2°C and a regime of regular dosing of 6–7 litres of formaldehyde into the midbay of each helix of each diffuser every 2 hours was instituted.

This redeployed usage of 150 litres of formaldehyde daily for each diffuser reduced the fermentation significantly but did not eliminate it even after twelve hours.

Trials showed that the lactic acid concentration throughout the diffuser was only eliminated when the total 2-hourly shock dose to each diffuser was increased to about 20 litres of formaldehyde, mainly to compartment 15 but also to compartment 20. This corresponded to a dosage of about 0·016% on beet and the consequences of this increased dosage can be seen in Table XII which contrasts two periods during which the temperature was about 70°C throughout the drum.

Table XII. Effect of increased formaldehyde dosage on diffusion juice pH and lactic acid concentration

Sample	0·010% *formalin on beet (compartment 15)*		0·016% *formalin on beet (compartments 15 & 20)*	
	pH_{20}	*Lactic acid, ppm*	pH_{20}	*Lactic acid, ppm*
Press water	5·6	100	5·7	100
Supply water	5·9	<100	5·9	<100
Compartment 20	5·3	600	6·5	<100
Compartment 15	5·4	500	6·4	<100
Compartment 13	5·3	500	6·3	<100
Compartment 11	5·8	400	6·4	<100
Compartment 7	5·8	400	6·4	<100
Circulation juice	6·3	200	6·6	<100

The results show that fermentation was controlled by the higher usage of formaldehyde and indeed this

[33] Carruthers *et al.*: *Zeitsch. Zuckerind.*, 1960, **85**, 350–354.
[34] Reinefeld *et al.*: *Zucker*, 1975, **28**, 472–481.

rate was very close to that previously recommended by the Research Laboratories for suppressing thermophilic activity in juice[2], viz. 5 gallons of 30% w/w formaldehyde added every two hours to each of two compartments for a factory slicing 4000 tons of beet per day, which corresponds to 0·015% on beet.

When the diffuser was non-sterile the pressed pulp dry substance was found to be 20·8% and this value decreased to 16·9% when the diffuser was made sterile.

Dilute sulphuric acid was then added to the sterile diffuser via the inlets in compartments 12 and 13 until the juice in this region of the drum had fallen to about pH_{20} 5·5. The data in Table XIII show the steady pH profile which was achieved shortly after starting acid addition. Lactic acid concentrations, determined by a precise colorimetric technique[35], were also measured on these samples and the results are included in the table.

Table XIII. pH and lactic acid profile of sterile RT diffuser with addition of dilute sulphuric acid to midbay juice

Sample	pH_{20}	*Lactic acid, ppm*
Pulp press water	5·6	57
Diffusion supply water	6·0	33
Compartment 20	5·6	52
Compartment 15	5·3	57
Compartment 13	5·2	55
Compartment 11	5·3	50
Compartment 7	5·9	42
Circulation juice	6·5	51

Comparison of these pH values with those given in Table XII shows that the added acid was distributed by the counter-current movement of juice and cossettes although it was considered that the pH profile shown in Table XIII was rather too acid for protracted operations. The lactic acid concentrations given in the table confirmed that fermentation had already been substantially eliminated in this diffuser.

The second diffuser was also sterilized by regular shock doses of 0·016% formaldehyde on beet and a similar pH profile produced by acid addition. The dry substances for two composite samples of pressed pulp which were then taken at an interval of an hour were 19·3 and 19·6%, a substantial improvement on the 16·9% dry substance during sterile operations, confirming the benefit of adding acid to the sterile drums.

Factory staff continued to operate this scheme of diffuser pH control successfully for the remaining two weeks of the campaign and their experience showed that it was possible to maintain a very suitable pH profile, similar to that given by fermentation, acid addition only requiring adjustment when the slice rate was significantly altered. The method was widely considered a more satisfactory way of regulating diffusion pH than the previous system of "controlled' fermentation.

In order to guarantee sterility, it was found over a period of days that formaldehyde addition had to be increased to 28 litres every 2 hours to each diffuser, about 0·025% on beet. At £50 per ton of 30% w/w formaldehyde, this cost about £35 a day.

The optimum sulphuric acid addition was found by experience to be 100 litres of 5% v/v sulphuric acid per hour to each diffuser, corresponding to the replacement of about 230 ppm lactic acid in raw juice and equivalent to 0·015% w/w of 96% w/w concentrated sulphuric acid on beet. At £23 per ton, this acid cost about £10 per day.

The effect of this acid addition on pressed pulp dry substance and on various other parameters which might be expected to have been affected is given in Table XIV. This compares the means and standard deviations of routine factory laboratory measurements for a ten-day period during "fermentation control" just before changing to sterile operations with those for a similar period shortly after the changeover.

Table XIV. Diffusion juice acidification and process parameters

Parameter	*Fermentation control* Mean	S.D.	*Acidification control* Mean	S.D.
Daily slice, tons	2916	88	3040	34
Supply water pH_{20}	6·0	0·3	5·9	0·2
Pressed pulp dry substance, %	19·9	1·0	19·9	1·3
Pulp press water pH_{20}	5·9	0·3	5·9	0·3
Drum 1—midbay juice pH_{20}	5·7	0·3	5·8	0·5
Drum 2—midbay juice pH_{20}	5·8	0·4	5·9	0·4
Raw juice invert, g/100S	0·47	0·12	0·46	0·07
Thin juice apparent purity, %	89·6	0·8	89·3	1·0

With "fermentation control", midbay juices contained 800–1000 ppm lactic acid with about 200 ppm lactic acid in circulation juice, while during the period of "acidification control" with sterile diffusers no lactic acid was detectable by thin-layer chromatography[2] in raw juice, midbay juices or press water.

The results in Table XIV leave no doubt about the suitability of acidification control of sterile diffusers. The pressed pulp dry substance was maintained exactly by acidification; indeed, it is possible that, had the midbay juice pH been lowered by a further 0·2 pH units by increased acid addition, pulp pressing might even have improved somewhat. The table also shows that no unfavourable changes in other important processing parameters were recorded during this period.

No increase in raw juice invert was recorded as a result of adding acid; the very slight drop in thin juice purity was not statistically significant. The addition of 200 litres of 5% v/v sulphuric acid per hour to the diffusion juice at Felsted corresponded to a calculated increase in raw juice sulphate of about 0·15 $mg.cm^{-3}$ and, even discounting the 50% elimination of this in carbonatation, the effect on the apparent purity of thin juice, which typically contains about 15 $mg.cm^{-3}$ non-sugars, would be undetectable.

This residual sulphate would increase molasses production through the melassigenic effect of associated cations but the amount of sugar lost in this way would be considerably less than the loss caused by non-eliminated lactate. Proceeding in the manner outlined earlier, it can be calculated that at Felsted factory 200 ppm lactic acid in raw juice would result in an indirect sugar loss of 0·48% on extraction whereas 150 ppm sulphate with 50% elimination in carbonatation would only give rise to a loss of 0·18% on extraction. Such a gain in extraction would be worth about £180 per day at this factory.

It is worth noting at this stage that, had hydrochloric acid been used for the acidification rather than sulphuric acid, the chloride content of raw juice would have been increased by about 0·1 $mg.cm^{-3}$ but, as none of this would then have been eliminated in carbonatation, the consequent loss of sugar to molasses would have been 0·30% of extraction, i.e.

[35] OLDFIELD & SHORE: *I.S.J.*, 1970, **72**, 3–4.

0·12% more than for use of the stoichiometric equivalent of sulphuric acid.

The total saving of sugar extracted by eliminating fermentation and using acidification control is the sum of the direct and indirect losses for fermentation less the indirect loss with acidification.

At Felsted this was calculated to amount to about 0·7% on extraction, i.e. over £400 per day, whereas the cost of formaldehyde and sulphuric acid to achieve this was £45 per day.

If hydrochloric acid had been used for acidification, the increased extraction would have been rather less than 0·6%, i.e. about £350 per day, and the cost of additives would have been about £65 per day. The economic advantages of using sulphuric acid are made quite plain by this comparison which also indicates the inadvisability of using hydrochloric acid to acidify supply water.

Control of Tower and DDS Diffusers

During the 1975/76 campaign sterilization and acidification experiments were conducted at Bury St. Edmunds factory where BMA tower diffusers are used. Formaldehyde was added to the towers at two diametrically-opposite positions just below the midpoint via metering pumps controlled by time switches to ensure regular addition of the shock doses.

The three diffusers were sterilized with 30% formaldehyde injected at about 0·016% and accurate determinations showed that this treatment had reduced the lactic acid concentrations to about 30 ppm in juice samples from the middles of two of the three towers and to rather less than 50 ppm in the raw juice leaving the scalders. In one tower, however, although mid-tower juice contained only 97 ppm lactic acid, raw juice to the scalder contained 468 ppm. This indicated a serious fermentation in the lower section of the tower and the circulation juice circuit through the mingler which was only eliminated when the return to this diffuser of tails and associated infected transport water was discontinued.

Provision was made for continuous twenty-fold dilution of concentrated sulphuric acid in a polypropylene tank from which it flowed under gravity to acidify the supply water and, via rotameters, to inlet points on opposite sides of each tower, slightly below the middle. To ensure even distribution of the acid in the diffuser it was introduced through a perforated pipe attached to the underside of a stopping bar.

The factory staff used mid-tower acid addition as required throughout the 1975/76 campaign to regulate pulp "pressability". The campaign average for pressed pulp dry substance was 20·2% compared with 19·1% for the previous year which confirmed the suitability of the system.

Acidification of a sterile diffuser was also assessed with the DDS plant at Selby factory which has a daily slice of 1600 tons of beet. The corresponding calculated 5% acid usage was about 50 litres per hour for each 100 ppm lactic acid being replaced in raw juice and the figures reported in Table XV below show the effect on the pH profile of the sterile diffuser brought about by addition of 65 litres of acid per hour to the second compartment, which was slightly towards the juice end from the middle of the diffuser. This was 0·009% w/w concentrated acid on beet, rather less than had been found necessary at Felsted, and equivalent to replacing 150 ppm lactic acid in raw juice.

Table XV. pH profile of sterile DDS diffuser achieved by addition of dilute sulphuric acid to midbay juice

Sample	*Sterile* pH_{20}	*Acidified* pH_{20}
Pulp press water	5·8	5·9
Supply water	6·1	5·9
Compartment 4	6·0	6·1
Compartment 3	6·2	5·7
Compartment 2	6·1	5·6
Compartment 1	6·1	6·0
Raw juice	6·2	6·2

Calcium chloride is normally added at Selby factory at about 100 lb per 100 tons beet, i.e. 0·05% on beet, to improve pressed pulp dry substance but this was discontinued when acidification was started. Composite samples of pressed pulp were made as at Felsted factory, corresponding to periods of sterile operation, by itself, with added calcium chloride or with acidification. The dry substances were determined and the results are reported in Table XVI.

Table XVI. The effects of diffuser acidification and calcium chloride addition on pressed pulp dry substance

	Pressed pulp dry substance, %	
Operation	*Spot composites*	*Mean*
Sterile	19·39, 19·72, 19·11	19·4
Sterile + $CaCl_2$	19·42, 20·60, 20·45	20·2
Sterile + H_2SO_4	19·88, 20·89, 20·69, 20·80, 20·09	20·5

These results clearly confirmed the potential of acid addition for improving pulp pressability. At those factories requiring the use of calcium chloride to improve pressing efficiency, further work will be carried out with the intention of eliminating addition of calcium chloride which is considered less desirable than sulphuric acid addition owing to the non-elimination of chloride ions in carbonatation resulting in increased molasses formation.

Also absorption of calcium by pulp is accompanied by desorption of potassium, magnesium and sodium from pulp[27] and the proportion of this potassium and sodium which is extracted into raw juice, in addition to that normally extracted, will also result in increased molasses formation.

Relative Effect of Sulphuric and Lactic Acids on Diffusion Inversion

Measurements quoted in Table XIV of invert in raw juice at Felsted factory indicated that sulphuric acid addition to the middle of the diffuser gave no measurable increase in inversion. This was confirmed by analyses made at Bury factory at a time when the acid addition rate had been increased to the equivalent of 0·036% concentrated sulphuric acid on beet in an attempt to compensate for a breakdown in diffusion supply water acidification. The invert content of raw juice from the three diffusers averaged 0·36 g/100S which was identical to the typical value measured by the factory laboratory before this abnormally high acid addition rate had been commenced.

Since inversion is simply an acid-catalysed reaction, i.e. depends on the hydrogen ion concentration and not the specific acid, it is considered that the addition of 5% v/v sulphuric acid to diffusion juice as a replacement for typical levels of lactic acid will not lead

to a significant increase in sucrose inversion, a view confirmed by laboratory experiments.

Corrosion

The relative effects of sulphuric and lactic acids on the corrosion of mild steel diffuser plate were examined in some laboratory experiments using low-Brix, low-purity juice from the sterile laboratory diffuser. Carefully weighed and measured pieces of polished, degreased mild steel diffuser plate were suspended in this juice in closed vessels for up to 24 hours at 72°C whilst the pH was maintained within $\pm 0{\cdot}2$ pH units of the equivalent of pH_{20} 5·4 by adding either sodium hydroxide or the appropriate acid by means of an automatic controller linked to the pH meter.

In all the experiments, formaldehyde was added at intervals to maintain a concentration in excess of 300 ppm and lactic acid measurements on juice samples taken at the end of several tests showed that no bacterial activity leading to lactic acid formation had taken place during the experiment. After the test period the steel was removed, the adhering oxide film gently rubbed away, and after degreasing and drying the pieces, they were reweighed.

In some of the tests, acidification was by addition of 5% sulphuric acid and in others by adding similar strength, i.e. approximately 2N, lactic acid. In addition to tests on the suspended pieces, some pieces were slowly rotated just under the surface of the juice to assess the effects of increased oxygen availability on the corrosion. The mean corrosion rates for each of the various experiments are given in Table XVII.

Table XVII. Corrosion of diffuser plate by sulphuric and lactic acids

Nature of test	*Mean corrosion rate* — *Suspended pieces*		*Rotated pieces*	
	g.m⁻² per 24 hr	*mm per 100 days*	*g.m⁻² per 24 hr*	*mm per 100 days*
Unacidified deionized water	19·7	0·26	—	—
Juice + sulphuric acid	21·6	0·29	33·9	0·46
Juice + lactic acid	26·2	0·35	40·2	0·54

These results indicate that replacing lactic acid fermentation by sulphuric acid addition would have no detectable effect on corrosion of the diffuser, which accords with earlier work[1].

A Summary of Economic Considerations

Consider a beet sugar factory slicing 200 tons per hour and regulating pulp "pressability" by allowing fermentation in the diffuser equivalent to 200 ppm lactic acid in raw juice. This fermentation can be "controlled" with 30% formaldehyde equivalent to 0·015% on beet at a cost of £35 per day. The total value of the calculated sugar loss is about £900 per day and molasses worth £200 per day is produced as a result of extra non-sugars in the process.

To render the diffuser sterile and eliminate sugar loss by fermentation and molasses production due to lactic acid, the formaldehyde usage would have to be increased to about 0·02% w/w on beet at an additional cost of £25 a day. The saving would thus be some £675 per day but, if the diffuser pH was allowed to rise and pulp pressing deteriorated to give an increase of 2% in the pressed pulp moisture content, additional drying costs, to maintain the dry substance of the dried product, would be about £500 per day, which would absorb much of the gain from eliminating fermentation.

Now if the pressed pulp dry substance is maintained by the addition of dilute sulphuric acid equivalent to 0·015% w/w 96% w/w concentrated acid on beet to control the sterile diffuser pH profile, this would cost £17 per day and also introduce non-sugar which would carry some £164 worth of sugar to molasses and produce about £70 worth of additional molasses per day. The net saving compared to fermentation would then be £564 per day as there would be no increase in drying costs.

These considerations show the advantage of using mineral acid to control the pH profile of a sterile diffuser in order to maintain pulp pressing efficiency.

Conclusions

1. Diffuser sterility can consistently be achieved by maintaining a temperature above 70°C and shock dosing every 2 hours with formaldehyde in the section near the middle of the diffuser which would otherwise exhibit the maximum bacterial activity.

2. Under sterile conditions sugar losses are decreased but the diffuser pH profile is much less acid than when there is bacterial activity and, as a result, there is a decrease in pulp pressing efficiency, with a consequent decrease in pressed pulp dry substance such that any saving from the production of extra sugar may be offset by the cost of the extra fuel required by the pulp dryers.

3. Under sterile conditions pulp pressing efficiency can be maintained and possibly increased by the controlled continuous addition of dilute sulphuric acid into the diffuser at about one-half to one-third the length from the juice end. For this purpose the equivalent of 0·015% w/w concentrated (96% w/w) sulphuric acid on beet in the form of a 5% v/v solution has been found to maintain a suitable diffuser pH profile.

The cost of this addition is relatively small and with no extra dryer fuel requirement there is a substantial economic benefit from the sugar saving.

4. Lowering the pH of juices by the addition of sulphuric acid rather than lactic acid gave no detectable differences in invert production or corrosion rate of mild steel.

5. The system described offers a more certain and more easily controllable method of regulating the diffuser pH profile than the previously attempted "controlled" fermentation procedure.

Acknowledgments

The authors are pleased to acknowledge the contributions made to this paper by Messrs. J. A. Adams and N. Bumstead of the Research Laboratories who carried out much of the experimental work, in both the laboratory and the factory, that is described in this paper.

Our thanks for their co-operation and interest are due to the managements and staffs of Bury St. Edmunds, Felsted, King's Lynn, Selby and Spalding factories. We are particularly indebted to Mr. F. Reid, Works Chemist at Felsted factory, for all his assistance. We are grateful too for the support given to this development by Mr. T. Rodgers, Production Director of the British Sugar Corporation.

Sugar cane agriculture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Seepage drainage at Mackay. L. K. IZATT. *Cane Growers' Quarterly Bull.*, 1976, **40**, 38–40.—Seepage areas are generally found in medium-to-heavy clay soils with poor internal drainage; they reduce cane yield and cause difficulties during harvesting and planting, a small seepage water flow keeping the soil wet for months. Details are given of a method of seepage water drainage which involves laying flexible corrugated piping of about 60 mm diameter in a 75–100 cm deep trench, the floor of which is covered with a 10-cm layer of sand on which the pipe is laid and covered with a further 20-cm layer of sand.

* * *

New Fiji disease control measures for Isis district. C. D. JONES. *Cane Growers' Quarterly Bull.*, 1976, **40**, 43–45.—Fiji disease has spread into the northern regions of the Isis district of Queensland from the Bundaberg area; almost all of the disease has been transmitted by the leafhopper *Perkinsiella saccharicida*, and it is pointed out that there is little that can be done on a commercial scale to control the numbers or movement of this pest. However, 10 plant quarantine zones have been established with the aim of preventing spread of the disease resulting from the use of infected planting material; the intention is to prevent introduction of plants from the north but to encourage a south-north plant movement. Details are given of the scheme and of the planting and plough-out regulations in force. The cane breeding programme has been substantially increased; while none of the varieties on the approved list has sufficient resistance to the disease to give effective control, their use would have a retarding effect on its spread.

* * *

Fiji disease returns to Maryborough. J. WRIGHT. *Cane Growers' Quarterly Bull.*, 1976, **40**, 45–46. Fiji disease was found on two farms in the Maryborough district of Queensland in early 1976; this was the first time the disease was found in the region, which is relatively isolated from the other cane areas, since 1949. Possible causes of the presence of the leafhoppers, responsible for the outbreak, are listed. The author recounts the history of Fiji disease in Maryborough (first recorded there in 1926 but believed to be present as early as 1916).

* * *

New regulations on cane trailer brakes. T. FUELLING. *Cane Growers' Quarterly Bull.*, 1976, **40**, 47–48.—The author explains what is meant by an "efficient braking system" as prescribed in the new Australian regulations on cane trailer brakes, and suggests some specifications that will meet the official requirements.

The "Act"—and approved varieties. A. A. MATTHEWS. *Cane Growers' Quarterly Bull.*, 1976, **40**, 49.—The author explains some sections of the Sugar Experiment Stations Act that are relevant to new cane varieties. The Act contains a number of regulations which are intended to help in the control of disease and in establishing a coordinated scheme of varietal testing and approval.

* * *

Regular maintenance of drains essential. ANON. *Cane Growers' Quarterly Bull.*, 1976, **40**, 51.—Advice is given on maintenance of drainage channels free of vegetation and silt; inspection of underground drain outlets during the wet eason to ensure that there is no blockage is also considered essential.

* * *

Nitrogen fertilizers—what affects them? ANON. *Cane Growers' Quarterly Bull.*, 1976, **40**, 52–53.—Information is given on how specific nitrogenous fertilizers are manufactured, what happens to them in the soil, the extent of N losses and comparison of losses between various fertilizers (in which it is pointed out that only ammonium nitrate applied to a deep sandy soil under high rainfall conditions will show greater loss than other forms).

* * *

Good quality planting material is important. C. L. TOOHEY. *Cane Growers' Quarterly Bull.*, 1976, **40**, 54.—It is stressed that the quality of the planting material plays a major role in determining the productivity of a cane block for at least the first three years. Hence, great attention should be paid to the selection of the material. The factors to be considered in selection are discussed. Treatment of cut ends of the sett is regarded as important. There is thought to be no difference between plant or ratoon cane with regard to quality of planting material.

* * *

Orange freckle—then and now. W. A. C. WEBB. *Cane Growers' Quarterly Bull.*, 1976, **40**, 55–57.—A survey is given of orange freckle investigations in Queensland and its association with magnesium deficiency.

* * *

Soil type plays a big part in irrigation scheduling. J. F. REIMERS. *Cane Growers' Quarterly Bull.*, 1976, **40**, 58–59.—It is pointed out that soils behave differently with regard to acceptance, retention and release of irrigation water, and that depth of soil and texture of soil and subsoil are two major factors affecting irrigation. The author explains the nature of these influences, and gives advice on the amount of water to apply to a given type of soil and on irrigation frequency.

* * *

Use of pumps in drainage systems. C. HENKEL. *Cane Growers' Quarterly Bull.*, 1976, **40**, 60–62.—Many poorly drained cane areas are sited near tidal rivers or the sea, and experience medium-to-high rainfall

and frequent flooding. To overcome problems created by these factors, levee banks and flood gates are often constructed, but high tides and flooding can create a water level at the outlets which is higher than that "upstream" at the very time that water has to be drained from the cane fields. Pumping water over the gates will solve the problem, and advice is given on suitable types of pumps and factors to consider in their selection. Brief mention is made of home-made pumps, and a warning given that unless they are carefully constructed their efficiency will not usually match that of commercial pumps.

* * *

Response of sugar cane to filter press mud and N, P and K fertilizers. I. Effect on sugar cane yield and sucrose content. II. Effects on plant composition and soil chemical properties. M. PRASAD. *Agron. J.*, 1976, **68**, 539–547; through *S.I.A.*, 1976, **38**, Abs. 76–1478. Filter press mud (FPM) was applied to soils at seven sites in Trinidad at rates of 20 and 40 tons.ha^{-1} (or 34 tons.ha^{-1} dry weight) with three levels of N, three levels of P and two levels of K. In six out of eight experiments (four with plant cane and four with ratoon cane) FPM significantly increased cane yield, the increases being higher in plant than in ratoon cane. One test was conducted on the residual effect of FPM after one year. FPM increased cane sucrose content in four of the experiments. There were significant interactions with the effects of the other fertilizers, especially P; no P fertilizer need be applied where $\leq$20 tons of FPM per ha has been applied. The effects on the contents of N, P, K and nine other elements in cane leaves, and on the contents of seven elements in the soil were investigated. FPM was a more effective source of P than triple superphosphate at the rates tested, and could be used as a substitute for K fertilizers where a maintenance dressing is required.

* * *

Agronomy research in Queensland. *Ann. Rpt. Bureau of Sugar Experiment Stations*, 1976, 20–32.—Irrigation scheduling trials at Mackay showed that for a total of four crops, eight irrigations based on a Class A Evaporation Pan factor of 0·5 increased the sugar yield by 5·3 tons.ha^{-1}, while fourteen irrigations based on a factor of 0·9 gave an increase of 5·8 tons.ha^{-1} by comparison with unirrigated plots. In trials at Bundaberg, pan factors ranged from 0·5 to 1·0. While no significant differences were found in cane or sugar yield between the various irrigation regimes, all treatments significantly increased yield by comparison with an unirrigated control plot, while the sugar content was significantly lower in the unirrigated cane at all times up to and including harvest. The plugging of orifices in trickle irrigation piping at Mackay was prevented by means of a combination of sand and screen filtering of the water, addition of chlorine, positioning of the orifices uppermost and provision of individual flushing valves for each tube. At Ayr, plugging has been prevented by sand and screen filtering and addition of sodium polyphosphate to the water, despite the presence of 4·6 mg.litre^{-1} of iron in the water. Continuous injection of 0·5 ppm chlorine has also prevented development of bacterial slime. In an experiment to compare conventional furrow and sprinkler irrigation with simulated solid-set irrigation, Class A Pan factors of 0·25, 0·50, 0·75 and 1·00 were applied for scheduling purposes; at each ratio, more water was used by furrow and overhead irrigation than by solid-set irrigation to give the same cane and sugar yields. Time of planting was found to give a significant effect on yield from four varieties; trying to plant as early in the season as is possible may be detrimental to yield, particularly with slow-germination varieties and where the soil is still too wet. Under favourable climatic conditions, late planting can be carried out successfully without risk of yield loss. Seven-year trials concerned with ratooning time showed that late harvesting consistently had an adverse effect on subsequent ratoon crop yields; while a well-developed stool can withstand the degree of waterlogging frequently encountered during the wet season, with only a minor reduction in yield, small stools which have not completed tillering suffer severe setbacks under the same conditions and fail to catch up in yield during the following season. The ratooning of fields after mid-November should be avoided; if good yields are to be achieved, cane in fields scheduled for ratooning should be harvested by mid-to-late October where rainfall is high or where there are drainage problems. In experiments to evaluate the effect of poor germination in yield and the benefit of filling the resultant gaps, shoots and stools were removed from completely germinated blocks and some of the gaps then filled. Results showed that if only 66% of the setts germinate, leaving 1- or 2-m gaps, there is a serious reduction in yield. Although filling of the gaps may improve the yield, it will not be as high as that of normally germinated cane plots. The removal of every third shoot also reduced the yield but not as much as did the removal of sections of a row. Because of previous indications that wollastonite, a calcium silicate rock, did not have the same activity as calcium metasilicate, although the two are chemically similar, a pot trial was carried out to compare the activity of wollastonite in natural and calcined form with that of calcium metasilicate and cement, as well as fly ash, lime and mixtures of fly ash with cement and with lime. While calcination of wollastonite did increase its activity, this was still lower than that of calcium metasilicate and cement, although it did increase the cane yield (expressed in g) compared with the untreated control as did lime. Fly ash had little effect on cement and lime activity and had no effect when used on its own. Trials at various locations representing a wide range of soils showed that calcium silicate, cement, lime and superphosphate had effects on cane and sugar yield which varied with the soil, although generally all increased yield by comparison with untreated controls. The greatest response to silica occurred where cane suffered from reddish-brown freckling. In eight trials, a response to broadcast applications of superphosphate was recorded despite a relatively high available P content in the soil. A reduction in yield when superphosphate was applied at one site was attributed to a copper deficiency, possibly induced by fixation of the available Cu by the excess P. A survey of third leaf tissue and soil analyses at a number of sites showing varying intensities of the reddish-brown leaf freckle showed that highest correlation was between soil Mg content and freckle rating, followed by soil (Mg + Ca), and then Si, the freckling becoming more intense the lower were the available levels of these elements in the soil. The N, Ca and Mg contents in third leaf tissue fell with increase in freckle intensity. Of trace elements determined in the leaf samples, Cu and Zn approached critical levels in some cases where the freckle rating was at the upper

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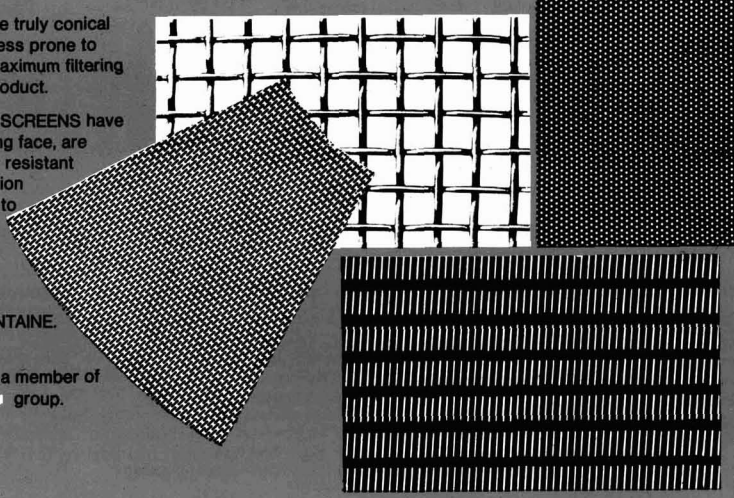

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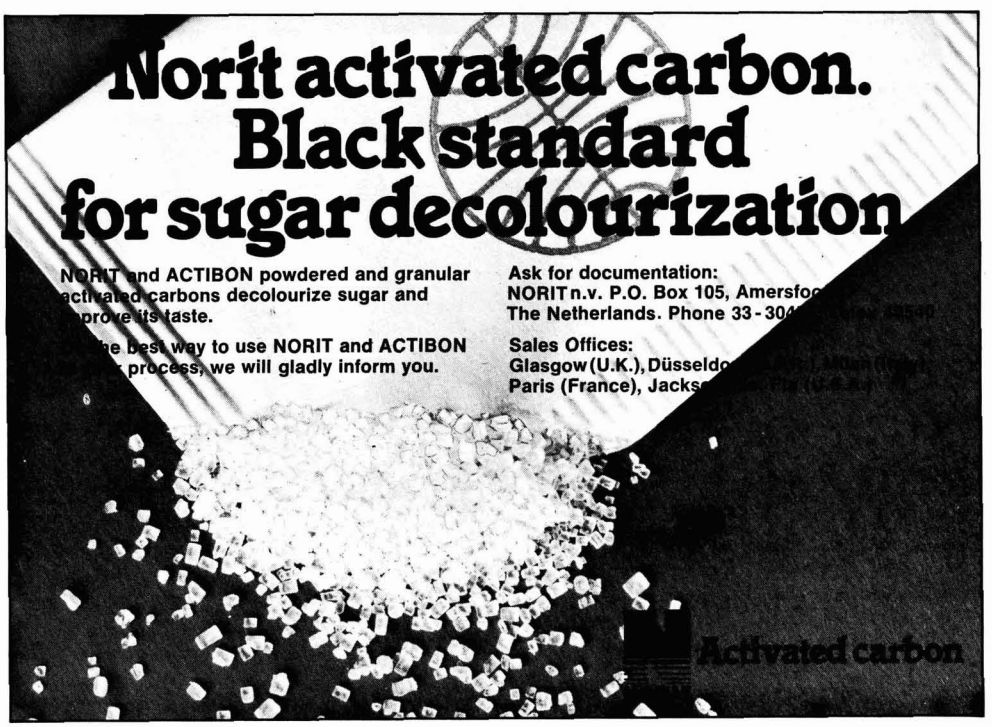

end of the scale of 0–10. Broadcast application of 1·25 tons.ha^{-1} superphosphate on new land before cane planting gave spectacular responses in yield. Samples of third leaf tissue were analysed and in practically all cases showed an increase in nutrient uptake where superphosphate had been applied. In trials on nut grass control by "Glyphosate" application, variable results were obtained, with good control in some areas but little obvious effect in others; however, most of the failures were attributed to late application. In trials on control of *Phragmites communis*, both "Glyphosate" and "Amitrole" gave promising results.

* * *

Cane pest research in Queensland. *Ann. Rpt. Bureau of Sugar Experiment Stations*, 1976, 32-36.—Investigations showed that small numbers of viable eggs of the leafhopper *Perkinsiella saccharicida* were present on mature cane throughout the winter of 1975, so that some of the egg predators *Tytthus mundulus* and *T. parvoceps* were able to survive, while in other years both viable eggs and *Tytthus* spp. disappeared from mature cane about May; leafhopper eggs then appeared on young cane from August onwards, whereas the predator occurred only in November-December, but in large numbers. Persistence of the predator throughout the winter allowed it to populate young cane as soon as adult leafhoppers migrated from mature cane and started to oviposit. Leafhopper numbers in late summer and autumn were found to be unusually low. Studies on *Tytthus* spp. confined on caged stools in the field during the winter showed that the adults oviposited in July and the eggs hatched about one month later. The adult stage was reached by mid-August. Where swarms of leafhoppers reach seed cane plots (separated from other cane by several km of bushland), spraying is necessary. Application of "Chlorpyriphos" at 560 g.ha^{-1} in December killed most nymphs and adults, reducing oviposition until mid-January, after which maturing nymphs provided increasing numbers of eggs, so that the nymph population started to increase; spraying in early February again controlled adults and its effect on nymphs persisted until the end of the month, although the adult numbers were swollen by incoming leafhoppers, so that the egg supply rose and consequently the nymph numbers during March. Numbers of *Tytthus* spp. remained low until mid-February, and the predator had no marked effect on leafhopper numbers. The December and February applications of "Chlorpyriphos" killed almost all adults and nymphs of the predator, but on both occasions the population soon recovered, either because of egg survival or as a result of immigration. From late February, the numbers increased with the supply of leafhopper eggs, and by late March the leafhopper nymph population was falling rapidly because of egg destruction by the predator. Although the numbers of adult leafhoppers increased up to the end of March (because of immigration and maturation of nymphs), fewer eggs seemed to be laid. In another trial, 250 g.ha^{-1} "Chlorpyriphos" gave only partial leafhopper control, while 500, 750 and 1000 g.ha^{-1} gave good control. Results indicated a rapid recovery of the predator after spraying with 500 g.ha^{-1} which is regarded as the optimum rate for leafhopper control. Although it does not destroy eggs, "Chlorpyriphos" does kill nymphs as they hatch as well as those emerging from trash (which protects them from the spray) onto treated foliage; its action against nymphs and a certain degree of persistence make the chemical better than "Malathion". While both leafhopper and predator are equally affected by treatment and recommence from similar levels, the predator gained the ascendancy under the test conditions. In trials on soldier fly control, 12 chemicals were sprayed at the rate of 4 kg.ha^{-1} onto a fallow field infested with the fly and subsequently incorporated into the soil by discing and ploughing. Maize was then planted, and after 10 weeks the larvae in soil samples around the plants were counted. Results indicated that "Phorate" gave by far the best control in two trials, reducing the soldier fly numbers from 98 and 48 in untreated soil to 14 and 20, respectively. In trials on *Lepidiota frenchi* control, assessed by counting second instar grubs under two cane stools in each plot, only "Carbofuran" reduced grub numbers substantially (from 11 in untreated ground to 1). Of plant parasitic nematodes identified in North Queensland, those most consistently associated with nematode-damaged cane appear to be *Radolphus* spp., *Pratylenchus* spp. and *Meloidogyne* spp. Nematodes from other genera have also been associated with poor cane growth, but usually only in conjunction with one or more of the three harmful genera mentioned. In control trials, "Aldicarb" at 5·6 kg.ha^{-1} applied to young cane together with BHC gave a 14% increase in the number of millable stalks compared with the untreated controls, while the stalks were on average 12% longer. Nematode numbers dropped considerably for 4 months after treatment, but by the end of 7 months were similar in both treated and untreated plots. Simulation of cane damage by rats involved mechanically damaging the stalks to provide both erect and lodged cane with "bitten" bases. Monthly determinations of sugar content confirmed earlier findings that damaged stalks which remained erect lost little sugar in contrast to lodged cane. However, also of significance was the time of damage. In June the sugar content was low but increasing, and damaged but erect stalks continued to make sugar until October, after which the fall in content was similar to that in undamaged cane. On the other hand, lodged stalks damaged in June maintained approximately the same sugar content until September, after which there was a sharp fall. By comparison, the sugar content in August-damaged cane was already high at the time of damage, so that the fall in sugar content as a result of the failure of lodged cane to make sugar was quite small; moreover, the period between damage and harvest was shorter, and the fall in sugar content was possibly smaller because of the shorter time for micro-organisms to invade the damaged tissue. Hence, it is recommended to carry out baiting to coincide with movement of rats into cane blocks, since the earlier damage has the greater effect on sugar content. Of various "Warfarin" formulations tested against *Rattus conatus* and *Melomys littoralis*, the best accepted was a pelleted grain meal containing 0·1% "Warfarin" which gave 75% kill of *R. conatus* and 50% kill of *M. littoralis*, whereas a loose grain bait containing 0·04% "Warfarin" gave a total kill of *R. conatus* but only 25% kill of *M. littoralis*. Paraffin wax blocks containing "Warfarin"-treated cracked grain or grain meal plus "Warfarin" gave little or no control. Blocks containing cracked grain survived 24 hours' immersion in water but disintegrated after 48 hours' immersion, while those containing grain meal disintegrated after a few minutes' immersion. "Di-

phacinone" in a cracked grain bait killed up to 75% *R. conatus* and 100% *M. littoralis* after four nights. (A single feed is claimed to kill *R. norvegicus* but produced few mortalities among the two above-mentioned species.) Trials were conducted on selection of suitable bait for feral pig control. Of the various materials tested, only fat proved to be readily accepted, and udder fat injected with a poison, 1080, proved successful, although there are limitations on use of the poison[1].

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Cane diseases in Queensland. *Ann. Rpt. Bureau of Sugar Experiment Stations*, 1976, 36–39.—Fiji disease resistance trials showed that much higher levels of infection occurred in ratoon crops of spring-planted cane than of autumn-planted cane. Some indications are given of susceptible and resistant varieties. Experiments aimed at improving techniques for field trials showed that the greatest infection occurred where cane was planted in September, ratooned in October of the next year and again in December of the third year; this method also had the lowest coefficient of variation of the five methods tested, and has been adopted for all trials concerning Fiji disease. None of the techniques produced very satisfactory results based on 1st ratoon inspection. Details are given of a yield loss assessment method applied to Fiji disease-infected cane; while it probably gave fairly reliable estimates in six trials, it was laborious and is considered unsuitable for fields with a very high level of infection, since the estimation of the number of healthy stalks would be unreliable. Losses ranged from 2·8 to 16·3%. While the feeding pattern of *Perkinsiella saccharicida* on bana grass (*Pennisetum purpureum*) was similar to that of the leafhopper on cane, and investigations showed that the grass can support populations of the pest, the feeding pattern on blady grass (*Imperata cylindrica* var. *major*) was different from that on cane, and no phloem feeding was recorded. Leafhoppers raised on Fiji disease-infected cane were caged on young shoots of bana grass and cane of variety Q 70 for one week; symptoms of Fiji disease appeared on 85% of the cane shoots but none were observed on the bana grass, although this does not preclude the possibility of bana grass being a symptomless carrier. Other investigations showed a major difference between cane varieties in the % total time spent by the leafhopper in ingesting food from the phloem elements; it is in these elements that the concentration of Fiji disease virus is greatest. The percentage ranged from 33 on a highly susceptible cane to 1·5 on a very resistant variety. Leaf scald investigations showed that juice from diseased stalks used as inoculum is more reliable in producing systemic infection than is inoculum prepared from pure cultures of leaf scald bacteria. However, since the concentration of bacteria in juice is likely to vary considerably, controlled tests were undertaken, in which dilutions as low as 10^{-4} were found to be just as effective as undiluted juice in producing symptoms. Other studies showed an apparent association between leaf scald presence as indicated by symptom expression and the cane field drainage system. Also associated with high incidence of the disease was a heavy wet season in the preceding summer followed by dry conditions during the year in which much diseased cane was found. A preliminary trial in growth chambers has indicated that reduced watering following inoculation may improve symptom expression. Isolation of the pathogen *Xanthomonas albilineans* from blady grass adjacent to a field of diseased cane as well as in a year when the cane had been ploughed out and the stubble destroyed gives support to the argument that the grass could serve as a long-term source of leaf scald infection. The pathogen was also isolated from blady grass at a farm where leaf scald was last recorded in 1960. Phase-contrast microscopy has been established as a means of routine testing for ratoon stunting disease.

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Application of chemical ripeners to cane fields in the centre-south of Brazil. J. FERNANDES, G. M. AZZI and A. KUMAR. *Brasil Açuc.*, 1976, **88**, 200–212 (*Portuguese*).—Plant cane, 10–18 months old, showed no response to "Polaris" in trials made in 1972–75. On the other hand, 5–7½-months-old ratoon cane of variety CB 49-260 showed a good response to 4 kg.ha^{-1} of "Polaris". The best response was obtained when application was in May when the cane was starting to mature. The effects of the "Polaris" became evident after four weeks and lasted up to 16 weeks after application. When conditions were adverse for ripening but favourable for vegetative growth, "Polaris" was effective in inducing ripening in first and second ratoon cane of varieties CB 49-260 and IAC 50/134. The effects became evident 4–5 weeks after application to 6½-months-old cane but continued to increase, the greatest difference in juice pol being found 4 months after application.

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Trials on nematode control in sugar cane with "Aldicarb". A. O. ROCCIA, L. G. E. LORDELLO and R. R. A. LORDELLO. *Brasil Açuc.*, 1976, **88**, 218–221 (*Portuguese*).—Trials are reported involving two cane varieties (CB 47–355 and CB 49–260, the former tolerant and the second susceptible to *Meloidogyne* spp.) planted in four locations with different soil properties and nematode population levels. "Aldicarb" ("Temik 10G") was applied at 30 kg.ha^{-1} and results indicated that both varieties showed improved yields, significant at the 1% probability level, while the nematode populations were drastically reduced for a period of 6 months. It is concluded that treatment with "Aldicarb" is a very efficient control method for at least this period.

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Attraction of the root froghopper *Mahanarva fimbriolata* (Stal, 1854) (Homoptera:Cercopidae) by lights of different wavelengths. P. S. M. BOTELHO, A. C. MENDES, N. MACEDO and L. S. NETO. *Brasil Açuc.*, 1976, **88**, 225–229 (*Portuguese*).—Comparative testing of light traps for attraction of *M. fimbriolata* showed that the efficiency of the F15T8 fluorescent lamps was in the descending order CG (cool green), G (green), BL, BLB (both ultra-violet), UB (ultra-blue) and B (blue), the last two showing identical results.

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Effect of potassium fertilization on yield and quality of sugar cane. V. G. DAGADE. *Indian Sugar*, 1976, **26**, 195–197.—Three-year trials are reported in which 100, 200 and 300 kg.ha^{-1} K_2O as KCl equivalent was applied to cane also treated with constant N and P.

[1] *I.S.J.*, 1977, **79**, 139.

Results indicated that cane and sugar yield rose with K rate by comparison with the untreated controls, but the optimum was 100 kg.ha^{-1}, since the higher rates gave only slight improvement on performance at this level.

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Screening of sugar cane varieties against smut disease. M. B. BACHCHHAV and A. O. PATIL. *Indian Sugar*, 1976, **26**, 199–200.—Details are given of screening tests involving cane varieties of the Co and PS series. Co 6608, Co 6609 and Co 62101 were found to be completely resistant to smut in three field and two glasshouse trials.

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Effect of some soil-applied insecticides on the microbial population in calcareous soil of the sugar cane belt in north Bihar. B. P. SAHI, M. RAI and M. M. HAQUE. *Indian Sugar*, 1976, **26**, 203–204.—In view of earlier suggestions that increases in cane growth and yield have not been entirely attributable to the chemical control of pests but have been also the result of soil nutrient mineralization by the pesticides, trials were conducted with "Aldrin", "Heptachlor", BHC and gamma-BHC in which the pesticides were applied at 1 kg a.i. per ha to a calcareous soil of pH 8 which was then incubated in sterilized bottles at 30°C for 30 days, during which period samples were taken at specific intervals. Whereas after 30 days the total bacterial population was lower in untreated soil than initially, while the fungal and protozoal populations were higher than the initial value, gamma-BHC increased the bacterial population by comparison with both the initial population and that in the untreated soil after 30 days; it also caused the fungal population to be somewhat higher than the initial population but lower after 30 days than that in the untreated soil, and the protozoal population was lower than the initial level and that after 30 days in the untreated soil. The other pesticides were somewhat less effective than gamma-BHC.

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Pre-harvest maturity service for the sugar cane crop to increase sugar recovery. A. P. GUPTA. *Sugar News* (India), 1976, **8**, (3), 26–27.—Factors affecting cane maturity are briefly examined and methods and equipment for maturity testing are described. Advantages of harvest scheduling on the basis of maturity are listed.

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Biological nitrogen fixation in sugar cane with specific reference to *Azotobacter*. J. S. JADHAV and S. S. ANDHALE. *Sugar News* (India), 1976, **8**, (4), 8–9. Because of economic problems concerning N fertilizer production and use in India, investigations were conducted on the possible use of an *Azotobacter* culture. Soil samples were collected from the rhizospheres and non-rhizospheres of different cane varieties at three stages of growth in three different soils; from 72 samples taken, 50 pure cultures were obtained and their N fixing capacity determined on JENSEN'S medium after 15 days' incubation at 30°C. One culture having a fixing capacity of 14 mg N per g sucrose was tested in seven different ways on cane grown in a small plot. In three seasons, smearing the culture on sett rootbands gave a yield averaging 103·15 tons.ha^{-1} compared with 71·48 tons.ha^{-1} in the untreated control. (This result was considerably better than that given by the other treatment methods.) Height, girth and number of internodes were unaffected by treatment.

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Effect of water spray on post-harvest deterioration of sugar cane. J. K. KAPUR and S. KUMAR. *Sugar News* (India), 1976, **8**, (4), 16–18.—Tests were conducted with two cane varieties which were harvested, topped and stripped before being piled. Daily application of water to the heaped stalks reduced the deterioration associated with staleness up to six days after cutting, although it is recommended that the cane should be transported to the factory within three days, since by the third day the differences resulting from treatment were maximum as regards sugar content, purity and reducing sugars content.

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A note on the geometry of the cane stalk in the production of rayungan tails. P. K. VERMA, R. K. SHARMA and S. R. SHARMA. *Sugar News* (India), 1976, **8**, (4), 19–20.—In the rayungan method of cane planting, shoots are allowed to develop from buds on standing cane, the stalks topped at 6–8 months and (2–4 weeks later) the shoots from the upper lateral buds harvested; each shoot is then severed, together with the node to which it is attached and part of the adjoining internodes, and planted. While the method is of benefit where planting is late, it has been found that not all the buds germinate, so that the number of "tails" is reduced. Experiments in 1973–74 and 1974–75 showed that the number of tails was significantly increased by bending the stalk to an angle of 30°; the effect was attributed to regularization of the movement of auxin throughout the cane, since stems and roots lying close to the horizontal displayed an auxin accumulation at the expense of the quantity in the more vertical sections, resulting in bud sprouting in both bottom and upper halves. In cane which was deliberately lodged, tails formed only in the stem section in contact with the soil.

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What's new (?) in sugar cane harvesters. R. T. SYMES. *Sugar y Azúcar*, 1976, **71**, (11), 21–23.—The author discusses features of modern cane harvesters which are desirable and points to those design aspects which require improvement. It is shown that many basic features found in today's machines were to be found in harvesters developed many years ago. Why some types of harvesters have gained acceptance while others have not is discussed.

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Developments in cane harvesting and transport in Africa. H. A. THOMPSON. *Sugar y Azúcar*, 1976, **71**, (11), 27–34.—A general review is presented of cane harvesting and transport in African countries, with particular mention of the latest harvesters, loaders and trailers being used in the more advanced sugar industries.

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Weight transfer coupling used in sugar cane transportation. R. J. GREATBATCH. *Sugar y Azúcar*, 1976, **71**, (11), 42–47.—The advantage of the weight transfer coupling to increase tractive power in the case of infield cane transport is discussed but a word of caution given on application of the principle, aspects of which must be considered carefully in each individual case.

Double-bin side-tipping unit. ANON. *Producers' Rev.*, 1976, **66,** (10), 16.—A brief description is given of a side-tipping unit built by a farmer to discharge chopped cane from a pair of bins by means of hydraulic rams which lift the bins and tip the contents into a rail truck without the need for the driver of the tractor towing the special 2-bin trailers (also built by the farmer) to leave his cab. Each bin has a capacity of 3 metric tons and can be emptied in just over 1 minute.

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New varieties lift sugar production. D. M. HOGARTH. *Producers' Rev.*, 1976, **66,** (10), 21–22.—A survey is presented of the development of cane breeding in Australia from the end of the 19th Century to the present day, and the significant contribution made by modern varieties to increases in sugar yield is discussed.

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Total area harvesting. ANON. *Producers' Rev.*, 1976, **66,** (10), 31–44.—The contents of a report on total area cane harvesting drawn up by a sub-committee of the Racecourse Mill Suppliers' Committee are discussed. The object was to seek an alternative to the present harvesting system in the face of sharply rising costs. It is stressed that harvesting by the farmer using his own equipment or by independent contractors with their machinery will soon become uneconomical where the average output per harvesting unit is 10,000–15,000 metric tons per season. The Racecourse factory is a cooperative enterprise owned by the cane farmers and is thus held to be most suitable for a total area harvest system similar to the type used by the Rio Grande Sugar Growers Inc. in Texas, operation of which has been used as basis for the ideas in the Australian report. Under the system proposed, the factory general manager would be responsible for coordination of both a factory and a field division; the latter division would incorporate a harvesting section, with control of harvesting operations in the hands of a shift supervisor who would be responsible for daily operations as well as deployment of harvesters; scheduling would have to be based on collection of cane from locations convenient for the harvesters rather than based on the present system having convenience of collection as criterion. The area would be divided into four zones each corresponding to 200,000–250,000 tons of cane; the harvesters would move from farm to farm under a rotation system which would be flexible to take account of wet conditions or other unforeseen circumstances, the rotation being decided by the factory field division. The system should allow for at least five cuts per farm per season so as to ensure that areas for ratooning were kept at manageable levels. The individual farmer would be responsible for the decision regarding rotation on his farm and would provide equipment for burning, endeavouring to keep the burns together in large blocks in order to facilitate large-scale operation. The present system of burning would have to be altered. Details are given of the systems envisaged for payment of harvesting charges by the farmers and for payment to the growers for cane supplied. More precise details are given of the schemes proposed for harvester shift working and cane transport as well as equipment repair and maintenance. The work of the agricultural advisor and of assessment officers is also specified, and quality control and field hygiene are discussed. Compensation for wet harvesting damage and loss of burnt cane through rain is considered essential. Advantages of the total area harvesting system for the grower and factory are discussed.

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Hot water cane treatment makes sense. E.O. MAYNARD. *Producers' Rev.*, 1976, **66,** (10), 45.—Records for the years 1967–75 have shown that hot water treatment of seed cane at least six times during the 9-year period gave plant cane and ratoon yields well above the average for the Harwood factory area. Reduction in the number of treatments during the period caused a fall in the yields; regular treatment is considered to result in a yield increase of 26 tons.ha^{-1} in plant cane and of 23·5 tons.ha^{-1} in ratoon cane. Some seed cane should be treated each year, it is suggested.

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Sugar cane variety trials in Texas, 1975-76 harvest season. S. A. REEVES. *Tech. Rpt. Texas Agric. Expt. Sta.*, 1976, (76–4), 67 pp.—Fourteen cane varietal trials were conducted at 10 sites in the Lower Rio Grande Valley, where harvesting is carried out from October to March. Tabulated results show N:Co 310 to be still the most outstanding variety in terms of sugar yield; this was followed in the trials by CP 65-357, released to growers as recently as 1975, which matures before N:Co 310 and gives excellent yields. The only two varieties exhibiting a yield potential equal to that of N:Co 310 were CP 66-315 and CP 57-603, both new late-season varieties, while CP 48-103 and L 61-49 were the most promising early varieties which give high sugar yields in October.

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Possibility of sugar cane breeding in central U.P. M. L. AGARWAL and H. P. VARMA. *Sugar News* (India), 1976, **8,** (5), 13–16.—Cane flowering studies in central Uttar Pradesh are reported, the results being expressed in the form of flowering intensity and period, pollen viability and seed formation.

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Economic feasibility of growing sugar beet as an intercrop in autumn-planted sugar cane. O. P. SINGH, S. N. L. SRIVASTAVA and C. N. BABU. *Sugar News* (India), 1976, **8,** (5), 17–20.—Of various combinations investigated, autumn-planted cane + beet was the most profitable, closely followed by autumn-planted cane alone, after which came beet + guara fodder, beet + spring-planted cane and autumn-planted cane + wheat. Wheat followed by spring-planted cane was very much less profitable than any of the other combinations.

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The use of biofertilizers in the nitrogen economy of sugar cane in calcareous soil of north Bihar. N. AHMAD, M. RAI, N. L. YADAV and B. P. SAHI. *Sugar News* (India), 1976, **8,** (5), 21–23.—An *Azotobacter* culture produced at the Sugarcane Research Institute at Pusa, Bihar, and applied to pot-grown cane plants together with N:P:K at 35:85:30 kg.ha^{-1} gavs almost the same yield as did N:P:K at 70:85:30 kg.ha^{-1} applied on its own but the cane yielded a juice of higher pol and purity than with the latter treatment, indicating that use of such a culture would halve the quantity of N applied without reducing yield and quality. *Azotobacter* cultures from other sources were not as effective as the SRI culture.

Study on the use of the sulphurous acid crossing technique of sugar cane in Taiwan. I. S. SHEN, C. S. YEH and J. S. CHEN. *Rpt. Taiwan Sugar Research Inst.*, 1976, (72), 1–16 (*Chinese*).—Investigations at Wantan Sugar Cane Breeding Station showed that an aqueous solution containing SO_2 and phosphoric, nitric and sulphuric acids (in concentrations of 150, 75, 38 and 38 ppm, respectively) and covered with a layer of paraffin oil was optimum for cane crossing, giving levels of seed germination (more than 400 seedlings germinated per 3 g of fuzz) which were the same as given by marcotting. Use of the solution is of value in reducing labour requirements during a 60-day crossing season. For best results, the cut flowering stalks should be 150 cm long (the +1 leaf before tasselling being taken as standard point). Good germination was obtained from stalks after 1 hour's treatment with the solution followed by 7 hours' standing in the open air, whereas 8 hours in the open air was insufficient to give satisfactory germination after crossing without prior treatment. Seed germination was unaffected by removing the excess part of flowering stalks either under water or in the air before transference to the crossing solution.

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Compaction studies on mechanized cane field soils. II. Effect of mechanical harvesting on soil compaction and yield of ratoon crop. S. J. YANG, F. W. HO and P. C. YANG. *Rpt. Taiwan Sugar Research Inst.*, 1976, (72), 17–29 (*Chinese*).—Soil compaction studies involved two, four and six passes by a harvester and loader on wet and dry soil at two sites having silty loam and clay loam soils, respectively. Results showed that soil bulk density, total porosity and penetration resistance increased with the number of passes and that the effects were greater with high soil moisture content. The zone of influence of compaction extended 40 cm below the surface of silty loam soil, while compaction had similar effects but of smaller magnitude on the clay loam. Compaction caused a significant reduction in root distribution and in ratoon crop yield; in the silty loam the roots extended only to a depth of 50 cm after six passes compared with 80 cm after two passes. The drop in yield was linear with increase in soil bulk density; because of the columnar structure of the clay loam, there was only moderate fall in yield on this type of soil.

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Cooperative disease resistance trial for foreign sugar cane varieties in Taiwan. L. S. LEU, Z. N. WANG, W. H. HSIEH and S. S. TZEAN. *Rpt. Taiwan Sugar Research Inst.*, 1976, (72), 31–40.—The methods and procedures used to screen imported cane varieties for resistance to mosaic, leaf blight, leaf scorch, red rot, downy mildew, white leaf, culmicolous smut, yellow spot and purple spot at the Taiwan Sugar Research Institute are described, and results of tests on varieties from Australia, Fiji and Hawaii (cuttings from which are sent to Taiwan annually) are discussed.

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Sex pheromone of the sugar cane grey borer. II. Attractiveness of virgin female moths in the field. W. Y. CHENG and J. K. HUNG. *Rpt. Taiwan Sugar Research Inst.*, 1976, (72), 41–47 (*Chinese*).—Traps baited with 1-day-old virgin females of *Argyroploce schistaceana* were placed at various locations in a cane field to determine their attractiveness to males. No males were caught in the daytime, in contrast to results at night. Slightly more males were caught in traps placed inside the field than in traps on the perimeter. The number of trapped males was greater with older cane than with young cane. The number of males caught was comparatively low where the traps were placed in an open field 20 m from the nearest cane. The number of males caught on the 2nd night was not reduced by placing the traps in the same spot as on the 1st night. Where cane was planted in a north-south direction the number of males caught in traps placed parallel with the rows was considerably greater than of those caught in traps placed at right-angles to the rows. (During the investigations the wind blew mostly from the north-east and south-east.)

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Chemical ripening of sugar cane with "Ethrel" and "Polaris". H. ROSTRON. *Sugar J.*, 1976, **39**, (5), 22–27.—See *I.S.J.*, 1975, **77**, 116.

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Agricultural productivity of sugar cane in the State of São Paulo. L. C. C. CARVALHO and L. R. GRACA. *Brasil Açuc.*, 1976, **88**, 308–331 (*Portuguese*).—Crop data from the 1971/72–1975/76 seasons were analysed to compare yields in tons/hectare and production in tons/hectare/month for six regions within São Paulo State. Productivity was significantly lower in the 2nd and 3rd ratoons and slightly lower in plant cane than in the 1st ratoons, while there was a relative fall of about 25% in yield between plant cane and succeeding ratoon crops.

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New cane planter. L. L. LAUDEN. *Sugar Bull.*, 1976, **55**, (2), 4.—A brief description is given of a cane planter built by a Mr. BOUDREAUX, of Labadieville, Louisiana. The carrier-type planter is made of steel and is designed to fit across the whole width of a straight-sided planter's aid; the carrier comprises 15 slats, each of which carries a cane rake. The rakes are so arranged that at one complete turn of the carrier, cane is raked off evenly to the rear. The rear-facing operator moves only one lever to feed the cane to the carrier, which turns at constant speed. Observations have shown that the planter leaves fewer gaps and drops fewer large piles of cane than do other planters, and growers who have seen the new unit in action have been impressed by its performance. At least four farmers have used the planter.

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New cane loader proving highly successful. ANON. *S. African Sugar J.*, 1976, **60**, 625.—A brief description, with photographs, is given of the German-built Atlas "Quik-Lift" cane loader which lifts about 1 ton of cane at a time and is based on a design developed by a South African cane farmer. The loader can be mounted on any tractor, which is then driven in reverse to push the windrow into a pile, to be picked up by the grab. The load can be placed wherever the operator wishes, by slewing the tractor or extending/withdrawing the hydraulic boom. Central mounting of the loader permits it to move about freely; greater stability is imparted by extending the space between the tractor's rear wheels to just over 2 m (by use of spacers). The hydraulic boom extends to a maximum of 5·5 m.

Sugar beet agriculture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Weed control in beet. T. STROUTHOPOULOU. *Hellenic Sugar Ind. Quarterly Bull.*, 1976, (26), 169–194 (*Greek*). The weed situation in Greek beet fields is surveyed, with information on specific weeds encountered and major problems which they create. While manual and mechanical weeding is the usual form of control, it is stressed that there is need for use of chemical weed control. A number of well-known herbicides are described, with details of the weeds against which each is particularly active, and advice is given on their application.

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A new agricultural development: stone removal from soil. J. DEMAY. *Le Betteravier Franç.*, 1976, **46**, (303), 28–29 (*French*).—The author describes the three major types of machinery used to remove stones from beet fields: "aligners" which are preferably used for only a small quantity of stones (10–15 kg.m^{-2}) no bigger than 15 cm and where the stones are well-scattered on the soil surface; they operate at 2–4 kph and, in the case of the Nicolas aligner, over a band width of 3·4 m. They really only prepare the way for stone collectors or crushers. Collectors are tractor-drawn machines for use on a dry, friable and even soil which is free from plant debris; typical of the screen types is the Mator "Rockpicker" which works on a band width of 1·7 m and has a capacity of 2 tons of stones. It can lift very large stones at the rate of about 10 tons.hr^{-1} and discharge them at a height of 2·2 m. Crushers are applicable where the stones are soft enough to be broken into small pieces measuring a few cm which are then easily incorporated into the top soil; while this means that the lime content of the soil is increased, it is not raised so much that the active content reaches danger level.

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The beet nematode. L. VAN STEYVOORT. *Le Betteravier*, 1976, **10**, (103), 10–11 (*French*).—A description is given of the means by which the nematode has an injurious effect on the beet. The latter is unable to absorb water from the soil because of the action of a toxin injected by the nematode into the plant cells; the beet endeavours to combat the effect by growing a large quantity of hairy roots. The cysts formed by the females contain large numbers of eggs; they become detached from the roots at the end of the season, turn brown and can preserve the eggs unharmed for a number of years in the soil until the eggs are able to come into contact with a suitable host plant and hatch. However, in the absence of a host plant there is no multiplication and gradually a number of the cysts abort; it is considered that the number of viable cysts can be halved each year in the absence of hosts. Suitable soil hygiene and crop rotation accompanied by regular chemical treatment will help to reduce the risk of injury by the pest. Two forms of chemical control are described (soil fumigation and application of "Temik" granules) and the advantages and disadvantages of each discussed.

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Sugar losses by beet respiration. A new unit for their measurement. R. VANSTALLEN. *Le Betteravier*, 1976, **10**, (103), 11–12 (*French*).—Details are given of a unit for measurement of CO_2 production by beet samples under controlled storage conditions and hence of the sugar losses. Some results are discussed. Recommendations for reduction of losses include good scalping of beet so that the wound area is minimum and all the leaves removed, and avoidance of storage of frozen beet.

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A note on the performance of some sugar beet varieties in the south Bihar plain. B. K. SINGH and K. D. SINGH. *Indian Sugar*, 1976, **26**, 211.—Beet varietal trials on a sandy loam of pH 6·6 are reported in which AJ Poly-1 was found to be the best in terms of yield.

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Plant population, organic fertilization and precrop affect sugar yield. W. C. VON KESSEL. *Die Zuckerrübe*, 1976, **25**, (6), 6–9 (*German*).—Statistical evaluation of results from some 400 beet fields in a given district of West Germany, sampled for sugar yield in July of each year in the period 1966–75 at the rate of 39–51 fields per year, is used as the basis for establishment of optimum conditions whereby a maximum sugar yield is obtainable. Sugar yield per ha rose with number of cultivations and with beet population (particularly over 75,000 plants per ha). Study of the effect of organic fertilization on plant population and on sugar yield showed discrepancies between the population and yield for given fertilizers. Hence, while leguminous green manure gave the highest sugar yield, it did not give the maximum plant population, which was obtained with non-leguminous green manure; on the other hand, the latter green manure did not give as much sugar per ha as did lack of organic fertilization. Legumes as a preceding crop gave the maximum sugar yield. Recommendations are given on the basis of the evaluations.

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Guarantee of beet yields in nematode-infested fields. ANON. *Die Zuckerrübe*, 1976, **25**, (6), 14–15 (*German*). Information is given on a Dutch machine for field fumigation. This has been used to control nematodes and has even proved effective against other beet enemies such as insects and fungi. It can inject the fumigant 18–20 cm into the soil. Three possible chemicals which have been tested with potato crops are "Ditrapex", "Tellone" and DD.

Which single seed drill shall I buy? ANON. *Die Zuckerrübe*, 1976, **25**, (6), 22–23 (*German*).—Details with photographs are given of single seed beet drills of various types, and requirements of modern drills are discussed.

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Possibilities of detecting and controlling the beet nematode. Experience in Bavaria. P. BEHRINGER. *Zucker*, 1976, **29**, 679–684 (*German*).—The damage caused by *Heterodera schachtii* and its life cycle are surveyed. In an endeavour to predict beet yield as a function of nematode infestation of a field, investigations were carried out on soil samples taken from a large number of small plots (varying from 10 to 200 m²) shortly before emergence of the beets. The number of viable nematodes in each sample was determined and the degree of infestation compared with the crop results in the autumn; those samples without nematode infestation were used as controls. A graph plotted on the basis of the results indicates the effect of nematodes (as expressed by newly formed cysts per vessel in a special biotest) on beet yield per ha. Yield reductions rose from 13% with 10 newly formed cysts to 24% with 20 cysts and 37% with 100 cysts, compared with uninfested plants. Infested plants were found to contain more K, Na and amino-N as well more N than unaffected beets. Moreover, the extensive growth of fibrous roots associated with nematode infestation contributed to greater soil adherence; it was not easy to top and lift the small and often misshapen beets. Measures used against nematodes in Bavaria include those aimed at disturbing the soil so as to expose the cysts to adverse conditions such as created by wind and water, adoption of suitable crop rotation, biological control and the use of chemicals. The various methods are described.

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Irrigation. K. F. CLARKE, S. P. MCCLEAN and D. CHARLESWORTH. *British Sugar Beet Rev.*, 1976, **44**, (4), 9–15.—The importance of water to the beet plant and the effects of short- and long-term lack of rainfall are explained. Advice is given on how to decide whether to irrigate or not (based on the soil moisture deficit for each month during April-October in the driest of 10 previous years), and in the event of a decision to irrigate, how to choose the most suitable equipment and calculate the costs. It is stressed that local farm reservoirs are not large enough to provide the supplies of water needed for adequate irrigation and that it is better to approach regional water authorities. It is stated that of the 400,000 acres of beet fields in the Anglian Water Authority region of England, only 5% is irrigated. Reference is made to experiments conducted at Gleadthorpe Experimental Husbandry Farm in eastern England on beet irrigation. The question of drought probability in future years is examined, and, in association with this, the question (on the part of the farmer) of whether to irrigate or not. It is pointed out that it is comparatively easy to decide this on the basis of yields obtained in past years of extreme drought; if the yields were "respectable" in those years, there is probably no need for irrigation, whereas if they were very low irrigation equipment should be installed. The effects of prolonged delay before irrigation water is applied are discussed; it is stated that, on the land belonging to the Gleadthorpe Farm, the point at which to start irrigating is easily indicated by wilting of the plants before mid-day. The optimum quantity of water to apply is also discussed. Overhead irrigation on a farm of which 75 acres are devoted to beet is described and the costs indicated. The owner of the farm has installed a Bauer "Rainstar" which can irrigate 15 acres without being moved. The system is expected to give increased beet yield and sugar content compared with results from unirrigated fields.

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Seedbed preparation for sugar beet. R. W. CLARE. *British Sugar Beet Rev.*, 1976, **44**, (4), 16–18, 26. Reduction and delay in the effects of the 1976 drought were attributed to early drilling and good seedbed preparation; the importance of these two factors in drilling to a stand and calculation of the optimum density at drilling to give a required final plant density are discussed. Trials at the Norfolk Agricultural Station are reported in which the effects of seedbed preparation on plant population and sugar yield were determined in three successive years (1972–74). While the method of seedbed preparation and the time of ploughing had no effect on plant population in 1972, marked differences occurred in the other years—later ploughing (in mid-December as opposed to late September) caused a fall in plant population (and in 1974 reduced sugar yield) while shallow cultivation of the seedbed in two passes gave the highest populations and sugar yields per ha. This method of seedbed preparation gave the finest tilth, and linearity has been established in the relationship between plant population and the percentage of soil aggregates less than 4·75 mm in size. Subsoiling did not improve seedling establishment nor increase sugar yield. The seedbeds prepared by shallow cultivation suffered least from compaction. A one-pass system in which N was applied at drilling (all other fertilizer having been applied to the previous cereal stubble and ploughed in) was investigated. Two drilling times were tested with two types of seedbed preparation: a traditional minimum method and rolling. Yield differences occurred with the early sowing, mainly a result of differences in plant population and soil compaction, the lowest plant population and sugar yield occurring with traditional seedbed preparation and earlier drilling. With later drilling, yields were similar and were not affected by the seedbed preparation method. Comparison of seed spacing showed that highest sugar yield was obtained with a spacing of 19 cm, although this did not give the highest plant population; on the other hand, the differences in sugar yield between 15, 19 and 23 cm were not great, while a spacing of 28 cm gave the lowest yield.

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Herbicides—the lessons of 1976 and recommendations for 1977. W. E. BRAY. *British Sugar Beet Rev.*, 1976, **44**, (4), 21–22.—Because of the dry conditions and protracted beet seedling emergence in 1976, the activity of all pre-emergence surface-applied herbicides was restricted and more reliance had to be placed on use of post-emergence herbicides for season-long weed control. However, the problem of insufficient rain for pre-emergence herbicide activity can be solved by using pre-drilling soil-incorporated herbicides. A number of newer pre-drilling, pre- and post-emergence herbicides are discussed. "Metamitron" ("Goltix") was to be introduced in 1977 on a limited scale. Investigations over a number of years have shown this herbicide to have both foliar and soil activity. Trials in 1976 with split applications of "Betanal E" and

"Betanal E" + "Nortron" (each application being half of the total dose) 5–7 days apart indicated that the system gave better weed control and greater crop safety than did a single application at the full dosage. Advice is given on chemical weed control in fields of growing beet.

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Virus yellows in 1976. Effectiveness of sprays and granules. A. DUNNING. *British Sugar Beet Rev.*, 1976, **44,** (4), 26.—In 1976 only 19% of beet plants exhibited symptoms of virus yellows at the end of August, although it is admitted that the severe drought could have masked symptoms. A survey showed that aphids resistant to organophosphorus were widespread in beet-growing areas of England; while the resistance is not extreme, it is sufficient to make control of the pest with such materials difficult, so that "Pirimicarb" (a carbamate) is likely to be the most effective spray chemical available, particularly under dry, hot conditions. Field trials in 1975 and 1976 did show that "Pirimicarb" gave the best control of all spray materials in general use, followed by formulations of "Demephion" and "Demeton-S-methyl" organophosphorus materials. In the last three years, early spraying seems to have given poorer control of green aphids and virus yellows than in former years (when two early sprayings were found to be optimum) and the optimum spraying time is usually later. While soil application of "Temik" or "Dacamox" has proved highly effective, "Temik" is expensive and, where soil pests are a problem, gamma-BHC is considered more reliable as well as cheaper. "Dacamox" has not been sufficiently tested for recommendations to be made. Granules are recommended for application in areas most subject to virus yellows, especially where Docking disorder or seedling pests are liable to reduce seedling vigour. They are preferable to sprays, but, like them, will give only partial control of yellows; additional methods of control are greatly needed. Meanwhile, careful use of the new aphicides is important, since excessive use will reduce their efficiency.

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Beating the blow. R. WICKENS. *British Sugar Beet Rev.*, 1976, **44,** (4), 28–29.—The areas of England worst affected by wind erosion are in the eastern half where sandy soils and peat abound; 30% of the beet area is thus composed of highly vulnerable soil. Wind erosion occurs at a high wind speed in an exposed situation under conditions of low rainfall and a low wind relative humidity, although soil particle size and density are important factors. Methods of reducing wind erosion are discussed, including long- and short-term solutions. It has been calculated that windbreaks will have a shelter effect extending to 20 times their height; permeability should be about 50% to break up the wind but avoid eddying associated with more solid barriers. Tests at the author's experimental husbandry farm showed a 20–40% reduction in wind speed 95 m to the lee of hedges of red willow having a height of up to 4·5 m and planted 95 cm apart on the two most exposed edges of a sandy peat field; while this result was achieved when the hedges were in full leaf, even when leafless the windbreaks gave a 15–20% reduction, and it was found that the higher the wind speed the greater was the proportional reduction. Addition of clay to sandy soils reduces wind erosion, but availability and costs must be considered. Where light topsoil is located on clay, raising the subsoil to the surface and mixing with the topsoil will also control erosion. Other materials such as by-products from the petrochemical industry are probably more effective on sand than on peat, are considered too expensive and difficult to apply, impose restraints on side hoeing and are not completely reliable. Waste lime from sugar factories applied at 12–15 tons.ha^{-1} has succeeded in stabilizing beet seedbeds on sand, and is relatively cheap and easy to handle. Inter-row crops of barley and mustard can become highly competitive with beet unless well controlled by herbicides; moreover, mustard is also susceptible to wind damage. Blanket growing of cereals is of advantage provided the cereals are completely killed before beet drilling as in the Dutch rye method[1]. One disadvantage is the demand for farm resources in October, which is a difficult period. Also effective is the "planting" of straw between beet rows[2], which is generally regarded as more suited to peat than sandy soils.

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Multi-row harvesters create the interest. D. CHARLESWORTH. *British Sugar Beet Rev.*, 1976, **44,** (4), 33–35, 42.—A brief report is given on the National Sugar Beet Autumn Demonstration held at Newmarket, England, with a table showing assessments of the performances of 13 harvesters in terms of root losses, quality of topping, cleaning efficiency and trash content.

* * *

Use of air-cushion transport in the sugar industry. V. A. NOVIKOV and I. A. BANIN. *Sakhar. Prom.*, 1976, (12), 23–25 (*Russian*).—Reference is made to an account of a "hover-trailer" used in experiments as infield beet transport on a rain-washed field in Holland. Hauled by a track-mounted tractor, the trailer was provided with steering wheels and a beet unloading conveyor; it had a capacity of 15 metric tons. Tests were to be continued under other difficult conditions. Advantages and disadvantages of hovercraft for use in agriculture are discussed, and information is given on partial propulsion relief craft (as tested in the USSR and by Vickers Ltd. in the UK) which are provided with normal wheel or track drive; the air cushion is used to increase flotation or speed of travel. Merits and demerits of this type of transport are also examined.

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The role of pre-drilling herbicides in beet growing. ANON. *Le Betteravier*, 1976, **10,** (104), 7 (*French*). The role played by the pre-drilling herbicide is examined, and desirable features of such a herbicide are indicated. It is pointed out that at present there is no product available on the market which meets all requirements, although a combination of two complementary herbicides (such as "Ro-Neet" and "Lenacil") wiil give almost ideal systems.

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Results of sugar beet variety trials. N. ROUSSEL, W. ROELANTS and T. VREVEN. *Le Betteravier*, 1976, **10,** (104), 11–14 (*French*).—Details are given of trials with 16 varieties held in Belgium in 1976, and average results are given for the three years 1974–76. Information is given on the varieties most suitable for early and for late harvesting.

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[1] ASCROFT-LEIGH: *I.S.J.*, 1976, **78,** 242.
[2] NORRIS: *ibid.*, 1975, **77,** 52.

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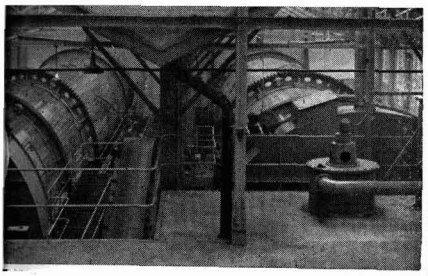

Beet sugar manufacture

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

The pollution load of sugar factory total effluent and fresh water consumption and effluent quantity. K. SKALSKI. *Gaz. Cukr.*, 1976, **84**, 228–230 (*Polish*). From investigations at a number of Polish sugar factories during certain periods of the campaigns in the years 1970–74, it was found that there is a linear relationship between the BOD_5 of total effluent (kg O_2 per 1000 tons of beet) and fresh water requirements (% on beet), and between BOD_5 and effluent quantity (% on beet). A nomogram based on the two relationships permits calculation of water losses in terms of the above parameters at given fresh water requirements (% on beet) and is of value in regulating the water-effluent economy of a factory.

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Trials on addition of air to juice in the main limer. H. ZAORSKA. *Zeitsch. Zuckerind.*, 1976, **101**, 707–710 (*German*).—Trials were conducted in 1975–76 on aeration of juice in the main liming vessel at a Polish sugar factory where the beet and juice quality were significantly lower than in previous campaigns. Up to 1·07 Nm^3 of air was injected per ton of juice (limitation was imposed by the diameter of the feed line). Measurements of specific extinction showed linear correlation with the amount of air injected. Towards the start of the campaign the maximum quantity of air caused a 37% reduction in colour (giving a specific extinction at 560 nm of 0·088 compared with 0·139 without air). The results towards the end of the campaign, when the juice was much darker, showed that addition of 1 Nm^3 of air per ton of juice gave a specific extinction of 0·143 compared with 0·200 without treatment, i.e. a decolorization efficiency of 28·5%. In determination of the effect of the air on juice evaporation it was found that increase in the Brix from 14·5 to 66° was accompanied by a colour increase greater than 100%; on the other hand, aerated juice contained 20–40% less colour after evaporation and suffered a smaller fall in pH. In addition, from measurements of ammonia in condensate from the 2nd evaporator effect (used as boiler feed) it was concluded that the air treatment caused a 20–30% fall in the ammonia content of 1st effect vapour compared with lack of treatment. (Nm^3 values are the actual volumes brought to N.T.P.)

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Questions of magnesium salts in sugar manufacture. J. STUDNICKÝ, A. DANDÁR and M. VANIŠ. *Listy Cukr.*, 1976, **92**, 203–209 (*Czech*).—The use of MgO in purification of cane juice is discussed and results given of chemical and differential thermal analysis of samples of magnesite obtained from Cuba. Tests on beet juice purification with MgO are reported and the results compared with those obtained using milk-of-lime. Tabulated data demonstrate the advantage of MgO over CaO in terms of thin and thick juice purity, colloid content, colour and ash. Brief mention is also made of ion exchange with resin in Mg^{++} form as in the Quentin process.

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New means of purifying beet juices. J. ČEPELÁK and R. OSVALD. *Listy Cukr.*, 1976, **92**, 209–211 (*Czech*). Eight variants of juice purification in which predefecation mud is removed before main liming were tested on a laboratory scale, and two were later subjected to pilot-plant trials, one involving mud removal in a centrifuge and the other incorporating mud removal by filtration. With the former method, the juice is prelimed to an alkalinity of 0·06–0·08% CaO, while in the latter scheme it is taken to an alkalinity of 0·13–0·15%CaO with recycling of 100% 1st carbonatation mud to preliming. Trials with a continuous horizontal centrifuge at a throughput of 250 litres.hr^{-1} gave an average mud separation of 96·9% and in all cases greater than 92%. The mud solids content was 53·2% and its sugar content 4·9% on solids.

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Influence of the method of diffusion juice purification on the thermostability of thin juice obtained from sugar beet. L. PETROV. *Zbornik Radova, Tehn. Fakultet Novi Sad*, 1973, **4**, 137–143; through *S.I.A.*, 1976, **38**, Abs. 76–1347.—Diffusion juices obtained by the method of VAVRA[1] using two cycles at 73°C were heated to 85°C and purified by (*a*) adding milk-of-lime, reheating to 85°C and passing CO_2, or (*b*) adding preheated milk-of-lime and carbonatating, immediately or (*c*) after 15 minutes at 85°C; after filtration the juices were heated to 95°C, recarbonatated, filtered, cooled and analysed for quality parameters and for 17 amino-acids and NH_3; to represent evaporation, the thin juices were heated at a constant 115°C for 40 minutes in a 7-litre Pretis crucible, then reanalysed. Tabulated results show that treatments (*b*) and (*c*) were superior to (*a*); heating at constant temperature decreased the contents of most amino-acids, particularly threonine which was the most abundant, and increased that of ammonia. Corresponding values of temperature (100–127°C) and pressure are shown for various loads on the valve of the Pretis crucible.

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New ion exchange systems for the beet sugar industry. III. Processing of ion exchange waste. D. COSTESSO, A. GUPTA and K. W. R. SCHOENROCK. *Sucr. Belge*, 1976, **95**, 371–376.—Details are given of the scheme used to treat the waste from cation and anion exchange processing of beet juice[2]. After distillation to recover excess ammonium carbonate from cation exchanger regenerant, the bottoms are concentrated by evaporation, and multi-stage crystallization used for recovery of K and Na carbonates (more than 90% of the beet

[1] *I.S.J.*, 1971, **73**, 280.
[2] GUPTA & SCHOENROCK: *ibid.*, 1977, **79**, 83.

cations being recoverable as carbonates by the various treatments). The waste from the anion exchange treatment (regarded primarily as a decolorization process) is filtered and decalcified (using a combination of neutral and basic brine from anion exchange treatment) to prevent co-crystallization of divalent salts together with the Na and K chlorides. After filtration, the solution is essentially free of Mg because of the low solubility of Mg hydroxide. Any residual hardness due to calcium carbonate is removed by combining the filtrate with the final mother-liquor from cation exchanger waste, after which the mixture is evaporated and crystallized to yield a chloride mixture suitable for stripping of the primary cation exchanger and regeneration of the anion exchanger, while the final mother-liquor (rich in organic non-sugars) may be dried on pulp and sold as animal fodder. The economics of the process are discussed.

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Investigation of optimal conditions for decolorization of industrial sugar solutions using "Amberlite IRA-900" resin. S. PETROV, L. VIDRIČ, L. PETROV and J. DURA. *Zbornik Radova, Tehn. Fakultet Novi Sad*, 1973, **4**, 155–161; through *S.I.A.*, 1976, **38**, Abs. 76–1459. 10-cm³ portions of resin were treated with consecutive 150-cm³ portions of 60°Bx syrup (of 8–10°St colour content) prepared from *B*-massecuite, white sugar and water, either by suspension for 30 minutes or passage through a column at 5 $cm^3.min^{-1}$. Extinctions at 560 nm are tabulated for six portions of syrup treated at 70, 80 or 90°C with resin which had been regenerated 0–5 times. Total colouring matter adsorbed and thus decolorizing capacity is tabulated for each operating cycle at each temperature; "column" values are typically twice those for suspensions. Operation at 80°C gave the highest decolorization and lowest loss of capacity after five regenerations, viz. 20% compared with 35% at 90°C and 45% at 70°C.

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Utilization and treatment of sugar factory effluent in irrigation fields. G. A. BEREZNIKOV and A. D. NOVIKOV. *Sakhar. Prom.*, 1976, (11), 12–16 (*Russian*). Investigations on Class III waste water disposal by irrigation at five sugar factories in the Kursk region of the USSR are reported. The mineral composition of the untreated effluent is indicated, and the changes brought about in form and concentration of the various cations are described. Comparison between clarified and unclarified effluent showed that treatment reduced the (Ca+Mg) and (K+Na) contents as well as the bichromate oxidizability (mg O_2 per litre), while storage pond water had much lower values for the above-mentioned minerals as well as chloride and nitrate. Percolation to a depth of 40 cm in the soil (black earth) reduced the differences in mineral concentration between all three types of water, with only the pond water chloride content being obviously lower; percolation through the top 20 cm of soil caused a sharp reduction in Ca, Mg, K and Na contents from the initial values. The increase in pond water nitrate concentration was attributed to the effect of percolation on the water-soluble forms of N. Yields of all crops grown on soil irrigated with effluent increased in earlier tests, but in 1975 summer wheat suffered a fall in yield; this was ascribed to a sharp fall in N content, in turn associated with a marked increase in the C:N ratio in the original effluent. Laboratory soil tests showed that a C:N ratio of 30:1 in the soil favoured nitrate accumulation, but a higher ratio had a negative effect, and in this case the amount of nitrogenous fertilizer applied should be doubled.

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Treatment and utilization of sugar factory effluent on low-load irrigation fields. N. A. RONSKAYA. *Sakhar. Prom.*, 1976, (11), 16–21 (*Russian*).—Advantages of irrigating fields with sugar factory effluent, possibly combined with river water, are discussed and factors to be considered in planning such operations, as well as the most suitable crops for the conditions, are examined. One recommendation given is grassing of 40–50% of the land under irrigation, with the remainder used for crops.

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Acceleration of flume-wash water settling by means of beet sugar factory waste products. A. B. KHANIN, G. I. BELOZEROVA, R. S. VOLYNSKAYA, N. D. NIKONOVA and K. K. KHALILBEKOVA. *Sakhar. Prom.*, 1976, (11), 21–23 (*Russian*).—While lime acts as an effective coagulant in the treatment of flume-wash water, sometimes there is insufficient for the purpose. A possible alternative treatment was investigated in which the waste water was treated with carbonatation mud and products obtained from electrolysis in a 3-cell unit, the middle cell of which contained NaCl or regenerant eluate from boiler feed water softening plant while the outer anode and cathode cells were filled with flume-wash water. The process was based on formation of HCl at the anode and of NaOH at the cathode, followed by reaction between HCl and $CaCO_3$ to yield $CaCl_2$ which then reacted with the alkali to give $Ca(OH)_2$ and NaCl. In the presence of electrolysis products and carbonatation mud, the suspended matter content in the waste water was lower than in waste water treated with lime by the normal method; the BOD of the treated waste water was about the same for both treatments. The quantities involved in the new process are indicated.

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Application of electrolytic sodium hypochlorite to disinfection of Class I and II waste waters. A. P. PARKHOMETS, A. I. SOROKIN, V. Z. NAKHODKINA, O. M. SOROKINA and E. V. IVASHCHENKO. *Sakhar. Prom.*, 1976, (11), 23–31 (*Russian*).—Class I waste water consists of that used for various cooling purposes in the sugar factory and condensate; Class II waste water comprises flume-wash water. Details are given of a scheme for preparation of sodium hypochlorite from NaCl by electrolysis in a specially-designed unit, the product from which is then automatically fed into pressure feedlines carrying the waste waters to treatment tanks whence the Class I water is transferred to a recirculation pond while the Class II water is recycled to the factory. Tabulated results give the reductions in numbers of thermophiles, mesophiles, moulds and slime-forming mesophiles.

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Kinetics of thermal dissociation of limestone in sugar factory kilns. I. Temperature of the heating medium constant. N. P. TABUNSHCHIKOV, A. V. KAPATS, N. N. MARUTOVSKAYA and A. M. AIZEN. *Sakhar. Prom.*, 1976, (11), 45–48 (*Russian*).—The article concerns the kinetics of $CaCO_3$ dissociation in filter cake during calcination; the study was aimed at establishing economically optimum conditions on the

basis of temperature, external heat exchange, time, bulk weight, heat flux and particle size. Graphed results show close agreement between theoretical values and experimental results at lower temperatures in the range 900–1400°C.

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Treatment of weeds and rootlets at Boiry-Sainte-Rictrude sugar factory. P. DEVILLERS and J. P. LESCURE. *Sucr. Franç.*, 1976, **117**, 397–401 (*French*). Details are given of the Maguin plant at this French factory. It comprises two installations: the first, a washer-stone catcher (1) receives material from the beet screens, weed catchers and filters used for beet washer flushing water; it removes stones and sand, and washes and separates the weeds and rootlets. The second, also a washer-stone catcher (2), handles primarily material separated by the muddy water filters as well as weeds which are collected from beneath the conveyors taking them from the catchers; this also removes stones and sand and washes and separates the weeds and rootlets. The rootlets from (1) are separated into those of larger size, which are recycled to the beet washers, and those of smaller size which are screened and crushed and finally poured onto the feeders conveying the cossettes to the diffusers. The weeds from (1) and (2) are crushed and pressed before being added to pulp pellets to promote greater agglomeration and binding properties; rootlets from (2) are pumped to the washers. Measurements made in December showed that, out of an input of 500 tons of beet per hour, larger rootlets totalling 0·64 tons were recycled to washing, while smaller rootlets amounted to 5·5–5·8 tons and weeds pressed to 14% dry solids totalled 20 tons. The economics are discussed.

* * *

The microscopic determination of grain size distribution in magmas and raw sugars with the Zeiss "Micro-Videomat". T. CRONEWITZ and M. MUNIR. *Zucker*, 1976, **29**, 665–669 (*German*).—Details are given of a television picture analyser developed by Carl Zeiss, Oberkochen, in collaboration with Siemens AG., for crystal size distribution. The optical unit, e.g. a microscope, is connected to a television camera so that the image is transferred to the screen. Use of the interlaced scanning process permits stereometric measurements to be made with a linear analyser. The crystals are depicted as a bright field image after automatic brightness equilibration over the whole screen. The differences in brightness created by the crystals are adjusted by discriminators so that they are in the same plane as the crystal images. The analyser then counts the total number of crystals as distinguished by their brightness differences. The crystal size determination is carried out by horizontal electronic chord length measurement which gives the number of crystals within a given size group. This gives the so-called "statistical particle size", but requires at least 1000 crystals to give an evaluation. The crystal number distribution given by the computer can be converted to volume or weight distribution (assuming a spherical crystal). An automatic scanning table is used to count the crystals in a number of fields of vision for statistical averaging. Use of the unit for vacuum pan and centrifugal performance evaluation is demonstrated. It is shown that it is possible to determine the increase in molasses purity in batch centrifugals on the basis of the crystal size distribution in low-grade massecuite and sugar (the purity rise being governed by the fines composition). Details are given of the sequence of operations in preparation of samples and operation of the unit. Possible application of the system to predefecation and carbonatation mud particle studies is also suggested.

* * *

Condensation of dryer vapours with heat utilization in process technology. H. WUNSCH. *Zucker*, 1976, **29**, 673–676 (*German*).—The author looks at the possibility of utilizing condensation heat from the condensable portion of pulp dryer vapour. Use of a jet pump will give heated injection water which can be used, e.g. to heat the water in a flume water circuit (as used by BMA in US factories because of the early onset of winter) or to heat waste water in order to accelerate biological degradation processes. However, particular attention is drawn to the possibility of using the condensate in thin juice pre-evaporation, such as applied in an Alfa-Laval unit in a French factory. The juice at 95°C is treated by 2-stage evaporation, in which the vapour from Stage 1 is used for Stage 2. The juice, cooled to 48°C, flows via a coiled tube pre-heater, installed in the 1st stage pre-evaporator, to a plate-type heat exchanger whence it is transferred, at 90°C, to the multiple-effect evaporator. Pre-evaporation evaporates up to 300 kg water per ton of beet. The possibility of using the reheat vapour from the thin juice to heat e.g. circulation juice, limed juice or press water is also suggested, and a heat scheme is outlined. Costs are briefly discussed. It is pointed out that while a number of firms have concerned themselves with the problem of dryer vapour heat utilization and found solutions to the material problems which had been present earlier, the investment costs of such schemes as described above are very high so that there is no likelihood of profit. Moreover, while the problem of dust and SO_2 emission is solved by such systems, the environmental pollution problem still remains, but now shifted to the effluent side.

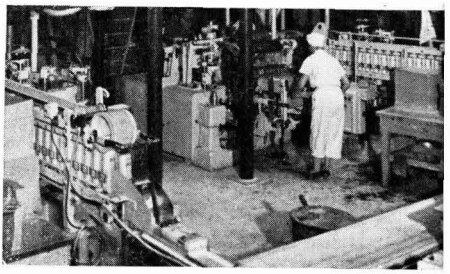
* * *

Continuous ion exchange—a new suggestion. F. AMDING. *Zucker*, 1976, **29**, 677–678 (*German*).—A description is given of a scheme, patented by the author, for continuous ion exchange in which the cation and anion exchange resin beds are located on endless "chains" of screen chambers which move in the same direction parallel to each other but with one "chain" carrying anion exchange resin following a path within the outer cation exchanger "chain". Receiving vessels for treated liquor, anion exchanger regenerant and cation exchanger regenerant are placed in series below the upper inner chain, the lower inner chain and the lower outer chain, respectively. The liquor treated by the cation exchanger and the wash liquor are able to flow under gravity to the anion exchanger bed. Liquor treated by both cation and anion exchanger is recycled a number of times; it is pumped from the receiver to the feed pipe corresponding to the succeeding receiver, and so on until it is discharged from the last receiver in the line. Details are given of the system for resin washing and regeneration, and advantages claimed for the system are listed.

* * *

Steam turbines at British Sugar Corporation. A. C. VALENTINE. *Sugar y Azúcar*, 1976, **71**, (11), 55–64. Steam turbines installed in BSC factories by Amalgamated Power Engineering Ltd. for power generation are described.

Sugar refining



Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Processing cane raw sugar with separate defecosaturation of 1st product run-off. V. V. GUZII and I. P. FEDOROVA. *Sakhar. Prom.*, 1976, (9), 36–39 (*Russian*). While recycling of at least 60% 1st product run-off to remelt liquor carbonatation has been found to increase white sugar yield from cane raw sugar processed at a beet sugar factory between campaigns, the quantity of low-grade massecuite and hence of molasses has stayed relatively high. It was therefore proposed to melt low-grade sugar in the run-off and subject this to separate carbonatation (as is normally carried out at the factory in question in the case of 2nd product remelt liquor). After carbonatation and filtration, the clear liquor is used to melt 2nd product sugar and treated by sulphitation; it is then combined with raw sugar remelt liquor and treated 1st product run-off and low-grade sugar melt and filtered for use in 1st massecuite boiling. The result is an increased white sugar yield, lower molasses losses and greater daily throughput.

* * *

Studies on the process for producing liquid sugar from raw sugar. I. Examination of the method for clarifying raw sugar with industrial ethyl alcohol. C. S. CHANG. *Rpt. Taiwan Sugar Research Inst.*, 1975, (69), 31–44. (*Chinese*)—Optimum conditions for treatment of raw sugar with ethanol were: 2 minutes' pre-wetting with 0·2 $cm^3.g^{-1}$ 60–65% alcohol at 30°C followed by washing with 2·5 $cm^3.g^{-1}$ 96° alcohol at 35°C during 10 minutes' stirring at 200 rpm. The raw sugar pol can thus be raised to 99·4° and the pol recovery to 94%. The washing was found to remove up to 70% of the turbidity, up to 60% of the colour, up to 55% of the ash and up to 70% of the reducing sugars.

* * *

The melt house computer installation at C and H Sugar Company. A. O. MAYLOTT and J. W. DE CELIS. *Rpts. 1975 Meeting Hawaiian Sugar Tech.*, 158–171.—See *I.S.J.*, 1976, **78**, 315.

* * *

Colorant formation under refining conditions. F. G. CARPENTER and E. J. ROBERTS. *Sugar J.*, 1976, **39**, (1), 41–43.—See *I.S.J.*, 1976, **78**, 251.

* * *

Decolorization of sugar solutions by adsorbent resin according to the "Schwebebett" principle. –. DROGERYS. *Proc. Conf. Ion Exchangers in the Sugar Industry* (Applexion, Paris), 1975, 85–94 (*French*).—The types of colorants formed by non-sugar degradation are listed and the benefit of decolorization by adsorbent resin is briefly discussed. It is stressed that since the resins, usually in Cl^- form, are highly porous and not intended to deal with colloids or suspended matter, physical pre-treatment of the solution is necessary. Elution is usually carried out with a solution of 10% NaCl and 1–2% NaOH; $MgCl_2$ may be used, but since its elution capacity is low, regeneration with NaCl + NaOH is required approximately every 10 cycles. "Shock" treatment with Cl_2-containing solutions to counteract resin poisoning is outlined. Information is given on the Bayer floating-bed process and its application to syrup and remelt liquor decolorization. Results achieved at two refineries and one beet sugar factory are cited; an average decolorizing efficiency of 70% with remelt liquor and 40–50% with syrup is considered typical. Whatever the conditions, the cycle should not be too long, e.g. ranging from 200 bed volumes for a well pre-treated remelt liquor to less than 50 volumes for a syrup, although many factors will influence the throughput. The life of a resin is governed by the conditions of the decolorization process itself, the type of impurities in the sugar solution, the regeneration process and intermediate treatment. Typical life cycles for "Lewatit MP 500" are given.

* * *

Decolorization of raw sugar melt by ion exchange resins. P. HOAREAU, J. P. LAMUSSE and M. MATIC. *S. African Sugar J.*, 1976, **60**, 485–487.—Raw sugar in the purity range 99·3–99·7 obtained from three factories was melted to a Brix in the range 61–65° and screened to remove bagacillo, followed by adjustment to pH 8 with NaOH. The melts were then heated to 70°C and passed continuously through two columns in series, each containing 5 litres of Rohm & Haas SDC 301 resin. Samples were analysed for colour at 420 nm and for pH at the start of each 48-hour cycle, after 24 hours and at the end of the cycle, which was equivalent to 96 bed volumes. After resin sweetening-off, regeneration of the columns was carried out in parallel with 10% NaCl solution (240 kg per m^3 resin). Typical results are given for *A*, *B* and *C* melts, showing a colour reduction of 70–80% to give a value well below the maximum of 450 ICUMSA units accepted for South Africa refined sugar boiling. The *C* melt colour, for instance, was reduced from 1490 to 415 units after 48 hours, while the colour of the *A* and *B* melts was reduced from 900 to 170 and from 1252 to 385 units, respectively. The colour after 48 hours was only slightly higher than after 24 hours, so that there would be little advantage in operating on a shorter cycle. Three crops of sugar boiled from the treated melt had a colour of 21–29 ICUMSA units, an ash content of 0·003–0·009% and a reducing sugar content of 0·005–0·011%, thus complying with the South African standards for refined sugar in all three parameters. A slight haze in the clear liquor was easily removable by filtration of the raw melt instead of screening, thus further improving sugar quality.

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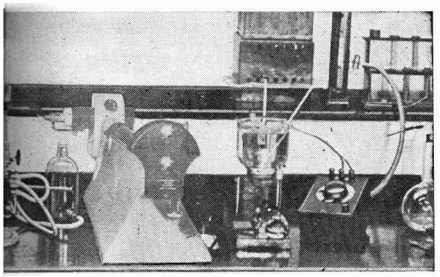
Stage-wise sweetening-off. J. DOBRZYCKI. *Gaz. Cukr.*, 1976, **84**, 176–178 (*Polish*).—See *I.S.J.*, 1976, **78**, 139–142.



Laboratory methods & Chemical reports

Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Investigations of colorant formation during the formaldehyde condensation reaction in alkaline medium. III. V. PREY, H. ANDRES and H. GUSBETH. *Zeitsch. Zuckerind.*, 1976, **101**, 660–662 (*German*).—From analysis of the browning products formed from formaldehyde in the presence of milk-of-lime (in ratios of 1:5 and 1:1) at various temperatures, it is concluded that they are aldol addition products of formaldehyde. Model tests have shown that formalin added during diffusion can thus be a potential source of colouring matter during juice purification. The investigations have shown that such colorants are comparable with browning products formed by alkaline degradation of invert sugar during purification. It has already been shown[1] that the browning products are not formed from formalin in the presence of NaOH.

* * *

Determination of the composition and quantity of free amino-acids in intermediates of sugar manufacture. L. PETROV. *Zbornik Radova, Tehn. Fakultet Novi Sad*, 1973, **4**, 145–153; through *S.I.A.*, 1976, **38**, Abs. 76–1441.—Diffusion juice, thin juice and thick juice from Zrenjanin factory in 1972-73 were analysed for amino-acids and NH_3 with a "Bio-Cal BC-200" analyser using ion exchange separation and ninhydrin colorimetry; chromatograms obtained are reproduced and contests of 17 components are tabulated. The juices respectively contained 1·333, 1·011 and 0·38% total amino-acids on Brix, contents of threonine + serine being respectively 0·707, 0·268 and 0·063%; the other principal constituents were glutamic and aspartic acids (largely lost during evaporation), tyrosine and alanine, with proline apparently being a major constituent only of thin juice; no cystine was detected.

* * *

Determination of chromium in several proposed standard samples and of zinc and chromium in wheat milling and beet sugar refining samples. J. J. CHRISTENSEN, P. A. HEARTY and R. M. IZATT. *J. Agric. Food Chem.*, 1976, **24**, 811–815; through *S.I.A.*, 1976, **38**, Abs. 76–1503.—Zinc and chromium were determined in various plant materials by flameless atomic absorption spectroscopy. Levels in sugar beet and beet factory intermediates and products are tabulated. Contact of the beet with stainless steel during slicing may have contributed measurable amounts of Cr. Carbonatation mud and molasses contained comparatively high concentrations of Zn and Cr, showing that removal of these elements by carbonatation and more especially by crystallization was responsible for the low levels in refined sugar. The Cr content found in refined sugar, 2 ng per g, is lower than that reported by WOLF[2].

Occurrence of metals in crystal sugar. Determination by atomic absorption spectrophotometry. L. G. DE SOUZA, L. A. DE LIMA and M. M. MISCHAN. *Brasil Açuc.*, 1976, **88**, 213–217 (*Portuguese*).—Samples of white sugar from five sugar factories in São Paulo were collected in the 1974/75 season and analysed by the method of SANG *et al.*[3], using atomic absorption spectrophotometry, for a number of metals. The results are tabulated and show the ranges to be: K 55·6–111·6 ppm, CaO 90·0–225·5 ppm, Mg 11·07–23·70 ppm, Fe 3·12–4·37 ppm, Al 9·0–12·5 ppm, Cu 0·25–0·57 ppm, Zn 0·80–1·97 ppm and Mn 0·45–1·45 ppm.

* * *

Rapid turbidimetric method for determination of sugar beet pectin peptization in the diffusion process. T. B. AIMUKHAMEDOVA, N. P. SHELUKHINA and M. N. BARKO. *Sakhar. Prom.*, 1976, (11), 39–42 (*Russian*). It has been found that coagulated pectins obtained from diffusion juice by alcoholic precipitation differ in appearance according to the juice temperature: at >80°C the coagulate has a transparent gelatinous appearance with a large number of air bubbles; it settles on the bottom of a test tube only with great difficulty, even after 10–30 minutes' centrifuging at 2800–3000 rpm. It is of high molecular weight and high hygroscopicity which is favoured by a larger number of methoxyl groups. The pectin obtained at 80°C or below takes the form of finely dispersed, dark coloured floc which is evenly distributed throughout the juice sample but which settles easily after a few minutes. On the basis of the physical appearance and behaviour after 5 minutes' settling and centrifuging, a rapid method has been developed for determining whether diffusion temperature is optimum as regards peptization; in it, 5 cm^3 of 96% ethyl alcohol is added to 2 cm^3 of raw juice with agitation and the behaviour of the pectins observed.

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Active and titratable alkalinity of juices. Z. D. ZHURAVLEVA and L. D. RYAZANOVA. *Sakhar. Prom.*, 1976, (12), 31–32 (*Russian*).—While active alkalinity as expressed by pH is of importance in juice purification processes, at many Soviet factories only the titratable alkalinity is checked, with the result that there is risk of oversaturation, particularly when low-quality beets are being processed and optimum pH values correspond to high titratable alkalinity values. The authors compare the values of both measures in various stages of juice treatment to illustrate their point that the juice pH should be determined together with the titratable alkalinity which should correspond to the optimum pH for a given process.

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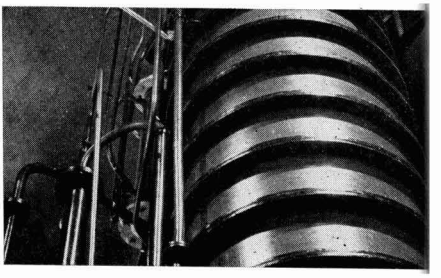
[1] *I.S.J.*, 1977, **79**, 27.
[2] *ibid.*, 1976, **78**, 27.
[3] *ibid.*, 1975, **77**, 71–75.

By-products



Unless otherwise stated, English is the language of the original articles from which the abstracts in this section have been taken.

Additive effect of ferrocyanide treatment and step change of pH on citric acid production from Iranian beet molasses with *Aspergillus niger*. T. OGAWA and A. FAZELI. *J. Ferment. Tech.* (Osaka), 1976, **54,** (2), 63–66; through *S.I.A.*, 1976, **38,** Abs. 76-1143.—The above treatments in combination increased the yield of citric acid by 45%, so that it reached 86% on sugar consumed.

* * *

Processes for sugar recovery from molasses. S. DE HAUSS. *Proc. Conf. Ion Exchangers in the Sugar Industry* (Applexion, Paris), 1975, 12–19 (*French*). See *I.S.J.*, 1977, **79,** 116.

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The beet as source of energy. ANON. *Le Betteravier Franç.*, 1976, **46,** (302), 22–23 (*French*).—Reference is made to discussion of the sugar beet as a source of products other than sugar by utilization of all the plant (including tops). It has been suggested that biomass transformation by microbiological means could provide methane and ethanol at one factory, while another factory could use thermochemical processes to produce ammonia, methanol and gas. Mention is made of the use of bagasse as fuel to produce electricity. Diagrams demonstrate the basic concepts as well as the typical composition of a sugar beet, showing the proportion of material which is fermentable and that proportion which can be used as fuel.

* * *

By-product research in Mauritius. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1975, 54.—While the digestibility of the crude fibre component of bagasse (with molasses and spent yeast incorporated in the ration to give a satisfactory intake) was not increased by steam treatment of the bagasse, voluntary intake of the treated bagasse was more than double that of the untreated bagasse, viz. 688 g dry matter as opposed to 318 g. Whereas the digestibility of the organic matter in filter cake was increased by drying (essential for prevention of fungus growth) in tests with sheep, the digestibility of the nitrogenous matter was halved by drying.

* * *

Use of sodium hydrosulphite for increasing the citric acid yield. E. S. MINTS, L. F. IVANOVA and E. I. GORBATAYA. *Khlebopek. Konditer. Prom.*, 1976, (8), 36–37; through *S.I.A.*, 1976, **38,** Abs. 76-1465.—When comparatively unreactive molasses samples are treated with potassium ferrocyanide, the residual $Fe(CN)_6^{4-}$ concentration often exceeds 40 mg.litre^{-1} and is then toxic to the mould; it can be decreased to its optimum value by adding an optimal amount of sodium hydrosulphite which forms an unidentified compound or complex with $Fe(CN)_6^{4-}$. Citric acid yields from 14 molasses samples treated with 1–1·8 g potassium ferrocyanide and 20-140 mg sodium hydrosulphite per litre were 1239–2028 g.m^{-2} per day, compared with 715–1892 g.m^{-2} per day without sodium hydrosulphite addition.

* * *

Study for the manufacture of unbleached high yield pulp from bagasse. S. M. SAAD, M. T. ZIMAITY and M. S. FAHMY. *Holzforschung*, 1975, **29,** (5), 177–180; through *S.I.A.*, 1976, **38,** Abs. 76-1474.—Depithed bagasse containing 16% pith was submitted to various mild soda pulping processes; conditions were 4, 6 or 8% NaOH on bagasse, liquor ratio 1:7, cooking temperature 70 or 90°C, cooking time 1, 2 or 3 hr. Delignification was a 1st order reaction, and there was a straight line relationship between % dissolved lignin and % dissolved bagasse. Pulps produced by cooking with 4% NaOH failed to form sheets when subjected to beating; with increasing NaOH concentration and/or cooking time, the yield of pulp and its lignin content decreased, the breaking lengths, folding numbers and burst factors of the sheets formed from the pulp increased, but their brightness and opacity decreased.

* * *

Fermentation: science and practice. A. C. CHATTERJEE and B. M. DUTT. *Sugar News* (India), 1976, **8,** (3), 7–9.—Requirements of equipment used for alcohol fermentation of molasses and factors governing optimum conditions are discussed, and the basic stages in the process explained.

* * *

Device for local closed heating of viscous products. A. I. ANDRUKH and A. A. GLUSHAK. *Sakhar. Prom.*, 1976, (11), 37–38 (*Russian*).—Details are given of a patented system for applying heat to e.g. molasses in a closed storage tank as used at a distillery. At the bottom and towards one corner of the tank is a special housing in which is located a heating coil supplied with steam. There is a gap between the open-ended "base" of the housing and the tank floor. The upper side of the housing contains an air valve; a bottom branch pipe runs from the base of the storage tank below the housing, which also has a lateral branch pipe towards its top and leading out of the tank wall down to an extension of the bottom branch pipe. Molasses fills the tank under gravity through operation of the air valve in the housing. Heating steam is supplied to the element, at which a pressure valve is opened and a similar valve on the bottom pipe is closed. As the viscosity of the heated molasses falls the material rises towards the top of the housing and is discharged through the lateral pipe, while cold molasses enters the housing through the gap at the bottom of the tank. When the level of the molasses in the tank falls to the level of or below the housing top surface, or when complete discharge of the tank contents is required, the pressure valve on the lateral pipe is closed, heat is applied and the molasses is discharged through the bottom pipe.

World sugar production estimates 1976/77[1]

BEET SUGAR	1976/77	1975/76	1974/75
	(metric tons, raw value)		
EUROPE			
Belgium/Luxembourg	732,000	716,000	607,000
Denmark	415,000	423,000	415,000
France	2,958,000	3,239,000	2,947,000
Germany, West	2,733,000	2,540,000	2,439,000
Holland	945,000	914,000	778,000
Ireland	188,000	203,000	145,000
Italy	1,739,000	1,467,000	1,012,000
United Kingdom	761,000	697,000	601,000
Total EEC	*10,471,000*	*10,199,000*	*8,944,000*
Austria	416,000	512,000	394,000
Finland	77,000	88,000	82,000
Greece	386,000	307,000	187,000
Spain	1,326,000	917,000	572,000
Sweden	302,000	277,000	305,000
Switzerland	83,000	65,000	72,000
Turkey	1,304,000	986,000	834,000
Yugoslavia	653,000	483,000	556,000
Total West Europe	*15,018,000*	*13,834,000*	*11,946,000*
Albania	20,000	18,000	16,000
Bulgaria	240,000	157,000	204,000
Czechoslovakia	690,000	800,000	750,000
Germany, East	560,000	665,000	655,000
Hungary	400,000	331,000	338,000
Poland	1,801,000	1,840,000	1,589,000
Rumania	810,000	620,000	618,000
USSR	9,100,000	7,700,000	7,800,000
Total East Europe	*13,621,000*	*12,131,000*	*11,970,000*
Total Europe	28,639,000	25,965,000	23,916,000
OTHER CONTINENTS			
Afghanistan	8,000	8,000	8,000
Algeria	20,000	18,000	14,000
Azores	7,000	7,000	7,000
Canada	163,000	133,000	101,000
Chile	302,000	319,000	219,000
China	1,000,000	960,000	950,000
Iran	630,000	625,000	586,000
Iraq	80,000	75,000	50,000
Israel	40,000	31,000	31,000
Japan	330,000	244,000	280,000
Lebanon	5,000	18,000	9,000
Morocco	302,000	255,000	264,000
Pakistan	30,000	27,000	24,000
Syria	31,000	25,000	20,000
Tunisia	10,000	8,000	7,000
United States	3,543,000	3,719,000	2,726,000
Uruguay	100,000	109,000	85,000
Total Other Continents	6,601,000	6,581,000	5,380,000
TOTAL BEET SUGAR	35,240,000	32,546,000	29,296,000
CANE SUGAR			
EUROPE			
Spain	20,000	19,000	19,000
NORTH & CENTRAL AMERICA			
Barbados	100,000	106,000	101,000
Belize	95,000	63,000	85,000
Costa Rica	190,000	173,000	175,000
Cuba	5,500,000	5,700,000	6,432,000
Dominican Republic	1,250,000	1,230,000	1,234,000
Guadeloupe	105,000	96,000	88,000
Guatemala	500,000	544,000	381,000
Haiti	54,000	60,000	58,000
Honduras	122,000	88,000	77,000
Jamaica	325,000	369,000	366,000
Martinique	15,000	14,000	16,000
Mexico	2,775,000	2,725,000	2,727,000
Nicaragua	260,000	246,000	196,000
Panama	120,000	137,000	132,000
Puerto Rico	272,000	279,000	271,000
St. Kitts	40,000	36,000	26,000
El Salvador	270,000	261,000	269,000
Trinidad	210,000	205,000	163,000
USA—Mainland	1,483,000	1,657,000	1,334,000
Hawaii	1,006,000	953,000	1,004,000
Total N. & C. America	14,692,000	14,942,000	15,135,000
SOUTH AMERICA			
Argentina	1,551,000	1,353,000	1,532,000
Bolivia	278,000	209,000	165,000
Brazil	7,340,000	6,180,000	6,985,000
Colombia	926,000	935,000	970,000
Ecuador	310,000	300,000	267,000
Guyana	330,000	343,000	311,000
Paraguay	57,000	55,000	77,000
Peru	968,000	950,000	990,000
Surinam	11,000	11,000	10,000
Uruguay	34,000	29,000	23,000
Venezuela	540,000	478,000	527,000
Total South America	12,345,000	10,843,000	11,857,000
AFRICA			
Angola	50,000	40,000	49,000
Cameroun	33,000	30,000	29,000
Congo (Brazzaville)	40,000	32,000	29,000
Egypt	680,000	626,000	550,000
Ethiopia	146,000	134,000	140,000
Ghana	17,000	15,000	12,000
Ivory Coast	35,000	23,000	5,000
Kenya	187,000	173,000	174,000
Madeira	2,000	2,000	3,000
Malagasy Republic	117,000	125,000	123,000
Malawi	90,000	68,000	50,000
Mali	15,000	14,000	15,000
Mauritius	731,000	496,000	738,000
Morocco	8,000	4,000	0
Mozambique	260,000	240,000	272,000
Nigeria	37,000	35,000	38,000
Réunion	250,000	226,000	228,000
Rhodesia	250,000	260,000	250,000
Somalia	39,000	30,000	36,000
South Africa	2,100,000	1,928,000	2,033,000
Sudan	163,000	125,000	140,000
Swaziland	220,000	224,000	207,000
Tanzania	136,000	103,000	110,000
Uganda	18,000	21,000	40,000
Zaire	74,000	69,000	68,000
Zambia	85,000	85,000	64,000
Total Africa	5,823,000	5,164,000	5,403,000
ASIA			
Afghanistan	2,000	2,000	2,000
Bangladesh	115,000	95,000	108,000
Burma	85,000	75,000	72,000
China	2,750,000	2,650,000	2,600,000
India, excl. khandsari	5,000,000	4,630,000	5,212,000
Indonesia	1,149,000	1,126,000	1,137,000
Iran	74,000	89,000	108,000
Iraq	70,000	75,000	50,000
Japan	196,000	223,000	192,000
Malaysia	88,000	70,000	50,000
Nepal	15,000	12,000	12,000
Pakistan	700,000	641,000	514,000
Philippines	2,850,000	2,735,000	2,471,000
Sri Lanka	30,000	25,000	20,000
Taiwan	950,000	817,000	751,000
Thailand	1,871,000	1,710,000	1,139,000
Total Asia	15,945,000	14,975,000	14,438,000
OCEANIA			
Australia	3,390,000	2,933,000	2,921,000
Fiji	298,000	283,000	273,000
Total Oceania	3,688,000	3,216,000	3,194,000
TOTAL CANE SUGAR	52,513,000	49,159,000	50,046,000
TOTAL BEET SUGAR	35,240,000	32,546,000	29,296,000
TOTAL SUGAR PRODUCTION	87,753,000	81,705,000	79,342,000

[1] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (9), 1–4.

East Germany sugar exports[1]

	1976	1975	1974
	(*metric tons, raw value*)		
Belgium/Luxembourg	0	163	1,051
Bulgaria	0	5,435	14,130
Cyprus	0	630	0
Denmark	0	0	3,478
Egypt	21,692	998	21,913
Gambia	739	163	0
Germany, West	25,647	19,350	40,773
Greece	0	11,288	0
Hungary	0	609	47,544
Iceland	0	286	516
Ivory Coast	0	652	3,804
Nigeria	0	2,207	38
Norway	0	44	4,194
Rumania	0	3,940	12,364
Sierra Leone	815	902	0
Syria	0	0	10,870
Tunisia	0	5,435	5,406
UK	0	0	5,435
USSR	18,478	0	0
Yugoslavia	0	10,869	3,820
Other countries	109	628	10,329
	67,480	63,599	185,665

Ivory Coast sugar project.—In April, the Belgian-Dutch consortium ABR/HVA-ENCO and the Government of the Republic of Ivory Coast signed a contract, valued at 6000 million Belgian francs, for the construction in Zuenoula of a complete agro-industrial sugar complex comprising a turn-key sugar factory with a processing capacity of 4000 tons of cane per day, a sugar cane plantation of 5200 ha, the installation of an irrigation system for 4200 ha with a dam and the construction of roads and houses. Within the framework of this contract, ABR Engineering will provide the industrial part of the project, viz. engineering, delivery of equipment for the factory and industrial zone, and technical assistance in erection and commissioning of the factory which has been scheduled for 1980. This recent order increases to ten the number of sugar factories which are being built by ABR Engineering in three continents. The reference, on p. 118 of our April issue, to the sugar factory to be erected by ABR Engineering at Melut should have indicated that the location is in Sudan and not Egypt as stated.

* * *

Summer Conference of Austrian sugar technologists.—The Summer Conference of the Fachverein der Zuckerfabriken Österreichs is to be held in Vienna from the 23rd to the 25th June 1977. Among papers to be read will be "Thoughts on colour formation during juice purification" by Dr. N. KUBADINOW of the Zuckerforschungsinstitut, Fuchsenbigl, "The efficiency of various soil testing systems as aids to sugar beet fertilization estimation" by Dr. H. MÜLLER, also of the Zuckerforschungsinstitut, "Further experiments on improving the quality of thin juices having no alkalinity reserves through partial anion exchange" by Dr. F. PERSCHAK of Hohenau sugar factory, and "Use of a computer for data retrieval and processing in factory supervision" by Dr. IR. VAN DER POEL of Holland, and Dr. E. STEINBAUER of Enns sugar factory.

* * *

Queensland cane variety changes[2].—The time has come for phasing out of the variety N:Co 310 in the Bundaberg area, according to the Director of the Bureau of Sugar Experiment Stations, Mr. OWEN STURGESS. Despite a major effort to maintain the productivity of the variety in the face of the continuing spread of Fiji disease, important mill losses are occurring and were higher in 1976 than in 1975. A newer variety, Q87, should be used in disease-affected areas; it is reasonably resistant to Fiji disease and gives yields comparable to those of healthy N:Co 310 and considerably better than diseased cane. Another new variety, CP 44-101, has similar resistance to that of Q87 but will not be available in large quantities as seed material until 1978.

* * *

New sugar factory in Yugoslavia[3].—For the first time, Poland is to erect a sugar factory in Yugoslavia. The daily processing capacity of the factory, located near Rijelina, is said to be 4000 tons of beet, and it is to be put into operation in autumn 1979.

Poland sugar exports[4]

	1976	1975	1974
	(*metric tons, raw value*)		
Algeria	6,012	651	0
Bulgaria	0	0	7,578
Cameroun	0	271	2,134
Chad	0	0	4,864
Dubai	934	325	869
Germany, West	12,636	1,635	0
Guinea	0	0	1,083
Hungary	12,554	0	11,053
Iceland	292	702	567
Iraq	24,368	0	0
Ivory Coast	0	650	3,790
Jordan	13,641	0	0
Kenya	0	0	3,248
Kuwait	920	325	22,981
Lebanon	0	4,330	0
Liberia	1,139	415	1,143
Libya	109,373	31,979	12,320
Malta	0	0	1,083
Nigeria	434	2,165	12,928
Norway	7,091	135	8,312
Saudi Arabia	3,242	0	12,504
Sierra Leone	27	758	758
Spain	2,151	3,541	14,545
Sudan	0	12,495	0
Switzerland	1,083	13,527	3,036
Syria	15,210	10,160	35,401
Tunisia	11,367	0	0
Turkey	0	0	17,887
USSR	114,759	0	0
Yemen	7,849	0	0
Yemen Dem. Rep.	5,684	0	0
Other countries	1,139	683	1,759
	351,905	84,747	179,843

US cane breeding and weed control programme.—The American Sugar Cane League is providing funds to the US Dept. of Agriculture's Agricultural Research Service to finance a sugar cane variety improvement and weed control programme at the US Sugarcane Laboratory, Houma, Louisiana. The programme will include crossing, screening for disease resistance, and testing for high sucrose, yield and processing qualities, as well as investigations on the control of weeds in sugar cane.

* * *

Citric acid factory for India[5].—Citurgia Biochemicals Ltd., a new company promoted by the Bombay Dyeing & Manufacturing Co. Ltd., jointly with John & E. Sturge Ltd. of the UK, is building a plant near Surat to produce 3000 metric tons of citric acid annually from cane molasses. Sturge, who are providing the technical knowledge, developed the unique deep-fermentation technique for the manufacture of citric acid. The cost of the project is estimated at Rs. 78,000,000 (over £5,000,000).

* * *

Nicaragua sugar production[6].—According to a US Dept. of Agriculture report, Nicaragua attained a record harvest in 1975/76, with sugar production at 246,064 metric tons, 26% more than in the previous season. Unlike 1974/75, fertilizer was readily available and growing conditions were good throughout the season. The cane area for 1976/77 was expected to total 39,879 hectares, compared with 34,476 hectares in 1975/76 and 29,113 hectares in 1974/75. Yield is likely to be somewhat below recent historical averages, however, owing to the July/September 1976 drought; nevertheless, because of the increased area, total production is projected to be higher than in 1975/76 and is currently estimated at 260,000 metric tons.

* * *

Cyprus sugar imports 1976[7].—Imports of sugar by Cyprus totalled 11,757 metric tons, white value, in 1976 as against 9,951 tons in 1975.

[1] C. Czarnikow Ltd., *Sugar Review*, 1977, (1327), 45.
[2] *Australian Sugar J.*, 1977, **68**, 509.
[3] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (6), 9.
[4] C. Czarnikow Ltd., *Sugar Review*, 1977, (1327), 44.
[5] *Standard Chartered Review*, March 1977, 22–23.
[6] F. O. Licht, *International Sugar Rpt.*, 1977, **109**, (6), 12.
[7] C. Czarnikow Ltd., *Sugar Review*, 1977, (1325), 36.

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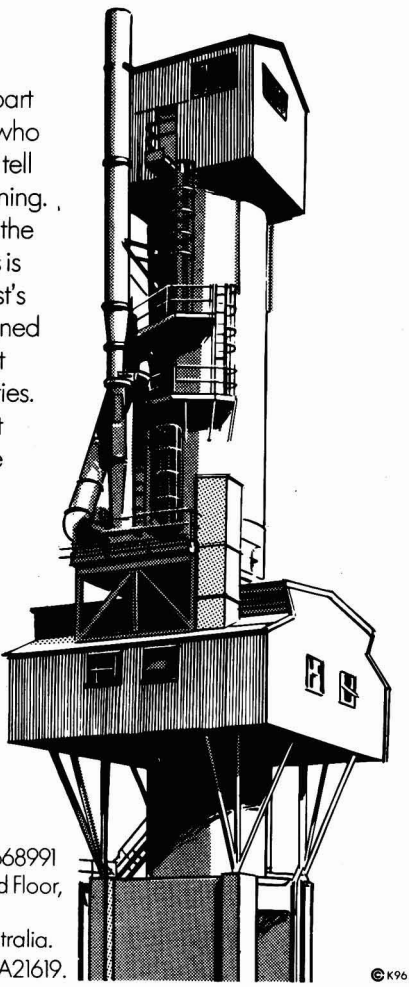

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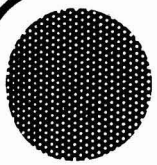

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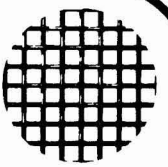

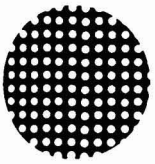

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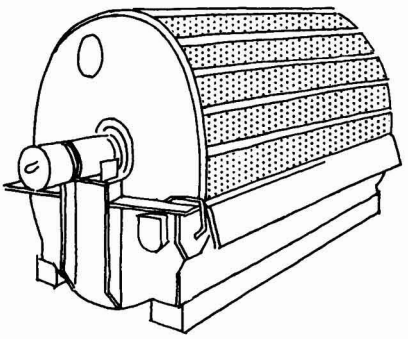

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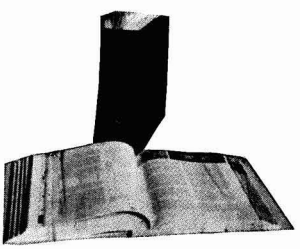

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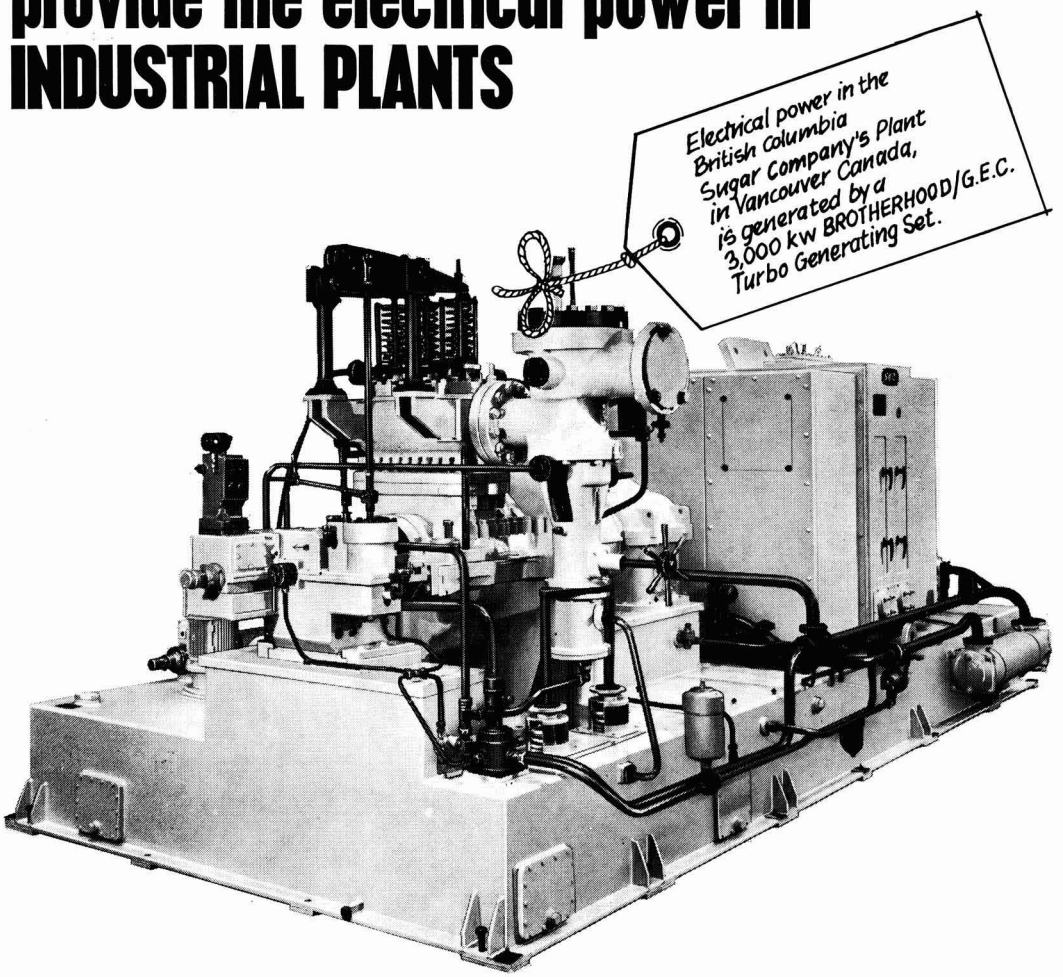

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