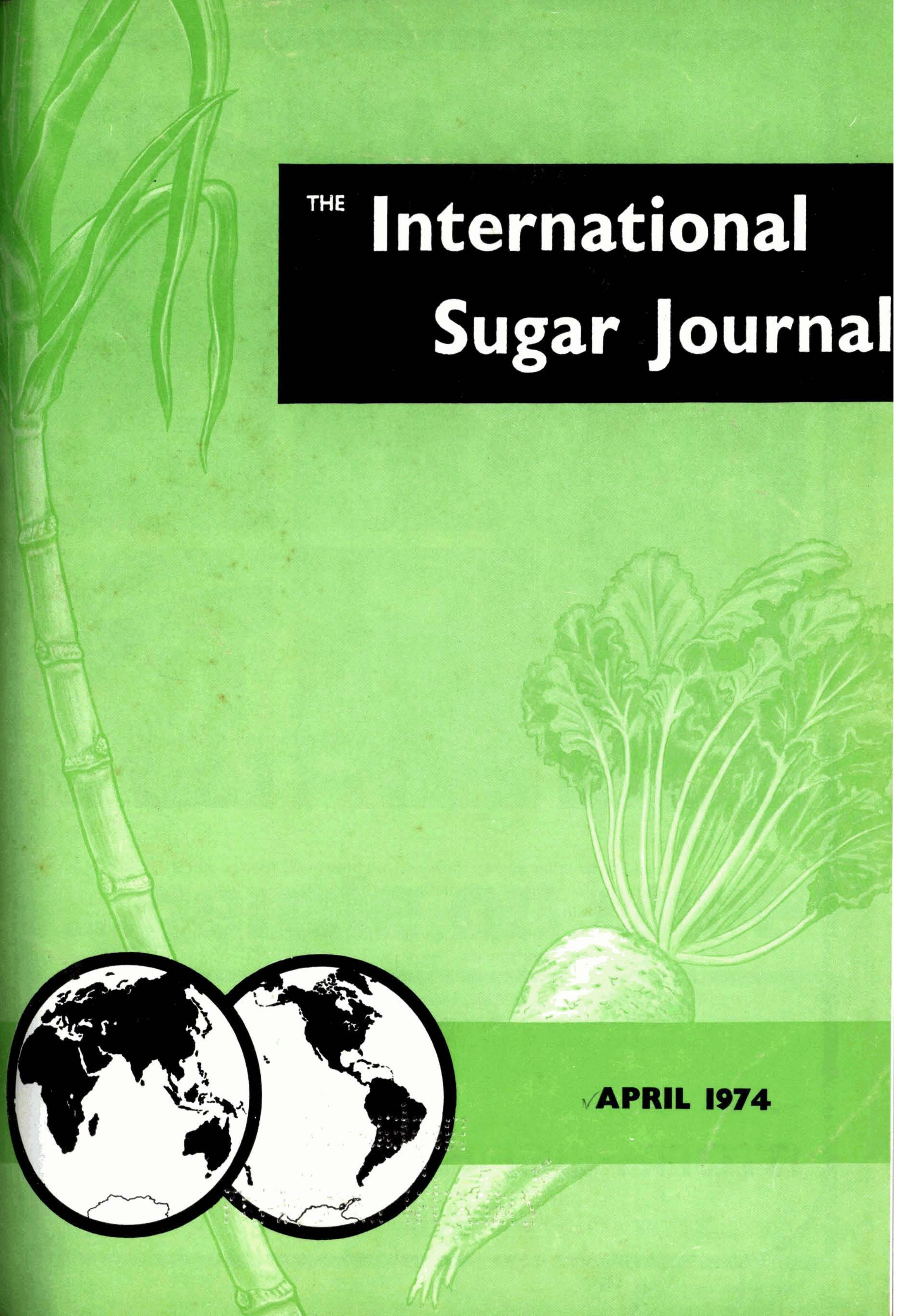
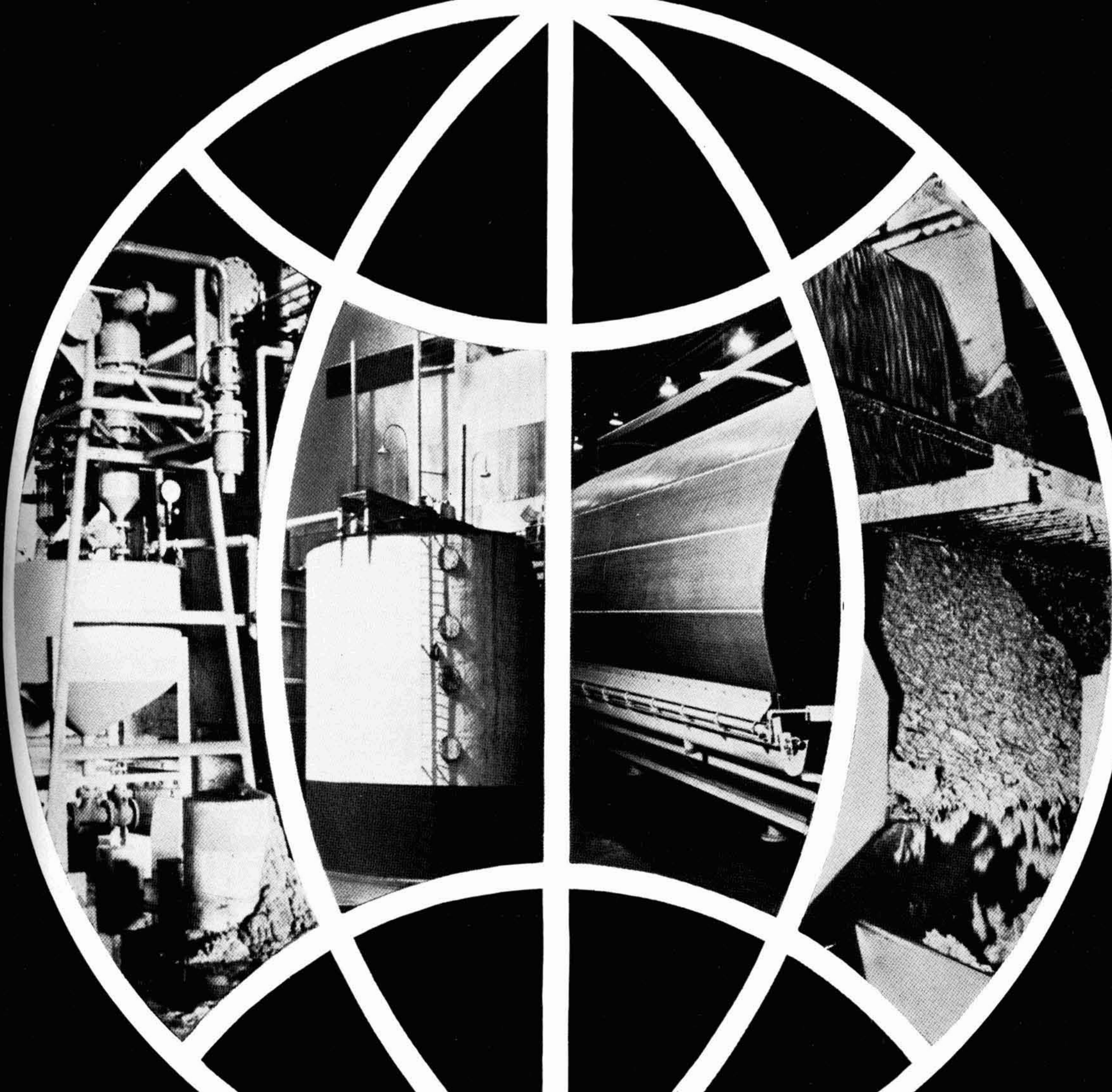


THE International Sugar Journal

APRIL 1974



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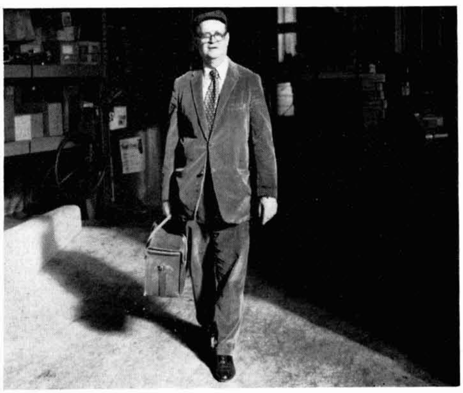

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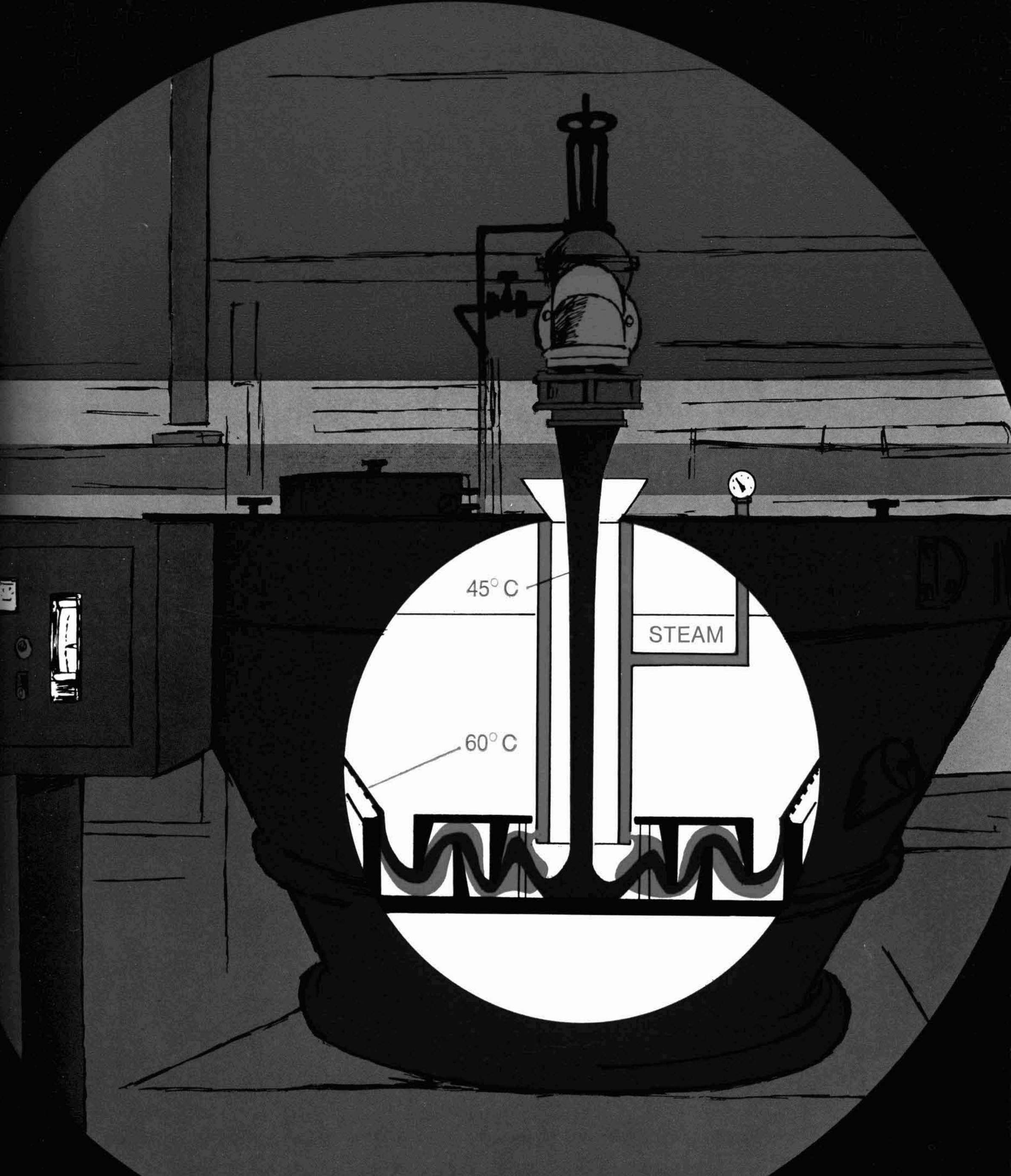

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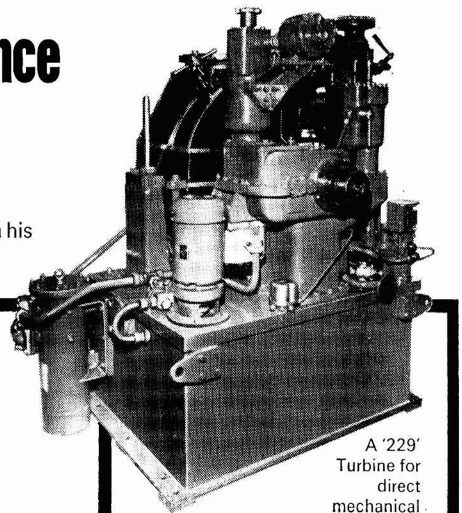

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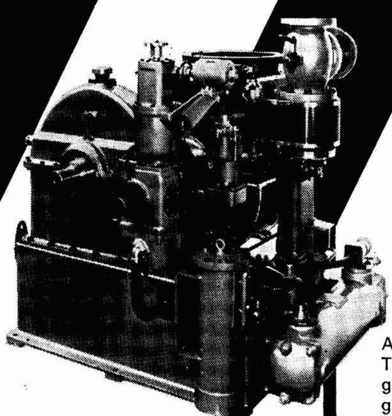

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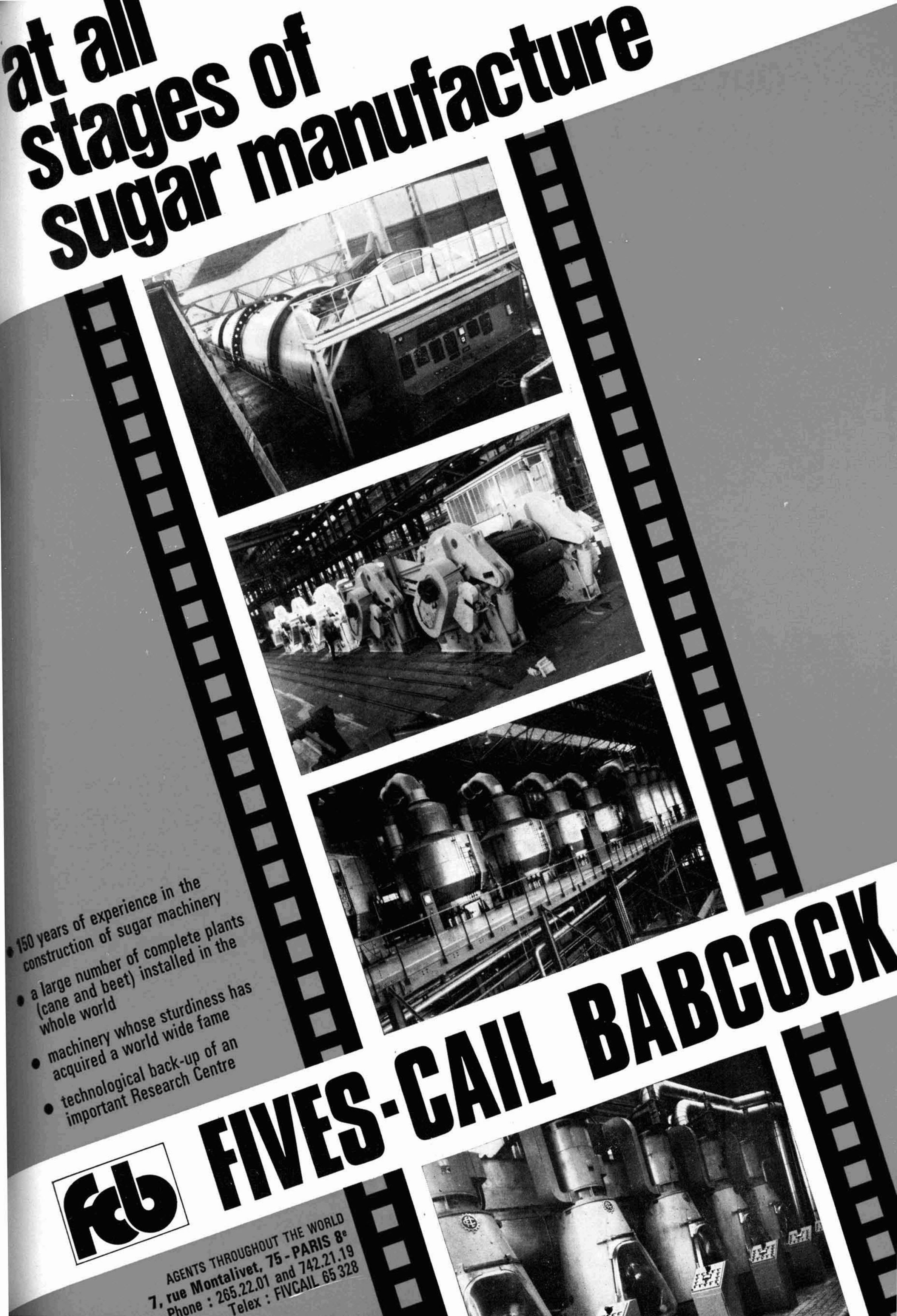
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On décrit le système interne de chauffage de la centrifugeuse continue pour arrière-produit "Konti 10-DC". La vapeur saturée passe au travers des jets de masse cuite qui alimente la centrifugeuse, formés à partir d'un flux continu par des moyens spéciaux. La vapeur se condense et cède sa chaleur latente à la masse cuite. Ceci permet un réchauffage de la masse cuite à une température bien supérieure au point de sursaturation sans dissolution des cristaux; la viscosité de la liqueur mère est considérablement réduite et la capacité augmentée. Un réchauffage externe de la masse cuite n'est pas nécessaire et la masse cuite peut être concentrée sans se soucier des propriétés de centrifugation.

* * *

Analyse du dextrane dans le sucre—une méthode enzymatique. G. N. RICHARDS et G. STOKIE. p. 103–107

On décrit en détail une méthode pour le dosage du dextrane dans le sucre brut qui a été mise au point comme alternative à la mesure du "brouillard" (turbidité). La nouvelle méthode comprend l'enlèvement du saccharose par dialyse suivi par une dialyse supplémentaire des substances restantes auxquelles on ajoute alors de la dextranase pour dégrader le dextrane. Après la dialyse enzymatique, les produits de dégradation du dextrane (oligosaccharides) sont dosés comme glucose. La précision est supérieure à 10%. On traite de la question de la définition du dextrane.

* * *

La fibre dans la canne à sucre de Floride. Dosage et effet de plusieurs variables. J. T. SNOW. *p.* 107–108

On décrit une méthode pour le dosage rapide de la teneur en fibre de la canne, méthode qui a été appliquée à la canne de Floride. Elle consiste à mélanger, dans un coupe-cannes broyeur, des échantillons de 100 g avec de l'eau puis à les filtrer (chaque opération 3 fois). La pulpe résultante est lavée à l'eau et séchée à poids constant. Le poids de matière sèche en g représente la teneur en fibre en % et la moyenne des déterminations répétées est la valeur donnée dans l'article. On donne des valeurs des teneurs en fibre et des variations pour plusieurs variétés de Floride.

Erwärmen von Nachproduktfüllmasse in kontinuierlichen Zentrifugen. G. TROJAN. *S.* 99–103

Das innere Heizsystem der kontinuierlichen Nachproduktzentrifuge "Konti 10-DC" wird beschrieben. Bei diesem System trifft gesättigter Dampf auf die aus einem kontinuierlichen Strom durch besondere Mittel eingespritzte Füllmasse, kondensiert sich und gibt seine latente Wärme an die Füllmasse ab. Dadurch wird, ohne dass sich Kristalle auflösen, die Füllmasse auf eine Temperatur erwärmt, die deutlich über dem Uebersättigungspunkt liegt. Die Viskosität der Mutterlauge wird beträchtlich reduziert und der Durchsatz erhöht. Eine Erwärmung der Füllmasse von aussen ist nicht erforderlich, und die Füllmasse kann ohne Rücksicht auf ihre Schleudereigenschaften konzentriert werden.

* * *

Bestimmung von Dextran in Zucker—eine enzymatische Methode. G. N. RICHARDS und G. STOKIE. *S.* 103–107

Die Autoren geben Einzelheiten über eine Methode zur Bestimmung von Dextran in Rohzucker an, die als Alternativmethode zur Trübungsmessung entwickelt wurde. Die neue Methode besteht darin, dass man die Saccharose durch Dialyse entfernt, die übrigen Komponenten erneut dialysiert und zu diesem Gemisch dann Dextranase zugibt, um das Dextran abzubauen. Nach der enzymatischen Dialyse werden die Dextran-Abbauprodukte (Oligosaccharide) als Glucose bestimmt. Die Genauigkeit dieser Methode ist besser als 10%. Schliesslich wird die Frage der Definition von Dextran behandelt.

* * *

Fibergehalt von Florida-Zuckerrohr. Analytische Bestimmung und Einfluss verschiedener Faktoren. J. T. SNOW. *S.* 107–108

Der Verfasser beschreibt eine Methode zur Schnellbestimmung des Fibergehaltes von Zuckerrohr, die auf Florida-Zuckerrohr angewendet wurde. Dabei werden Proben von 100 g in einer Zerkleinerungsmaschine mit Wasser vermischt und filtriert und beide Arbeitsgange zweimal wiederholt. Dann wird die resultierend Pulpe mit wasser gewaschen und bis zur Gewichtskonstanz getrocknet. Das Gewicht des getrockneten Materials in g entspricht dem Fibergehalt in Prozent. Der angegebene Fibergehalt stellt den Mittelwert aus Doppelbestimmungen dar. Es werden Zahlenwerte mitgeteilt, aus denen der unterschiedliche Fibergehalt verschiedener Florida-Rohrsorten hervorgeht.

Recalefacción de masa cocida de bajo grado en centrífugas continuas. G. TROJAN. *Pág.* 99–103

Se describe la sistema de la centrífuga continue tipo "Konti 10-DC" para calefacción interna de masa cocida de bajo grado. En ésta, vapor saturado pase a través de rocios de masa cocida, formado de un flujo continuo por un dispositivo especial, el condensa y transfere su calor latente a la masa cocida. Esta sistema permite recalefacción de la masa a una temperatura mucho más alto que el punto de saturación sin disolución de cristales; la viscosidad del madre-licor se reduce sensiblemente y la capacidad se aumenta. No requierese recalefacción externa y la masa cocida puede concentrarse sin respecto a su propiedades en centrifugación.

* * *

Análisis de dextrano en azúcar—un método enzimático. G. N. RICHARDS y G. STOKIE. *Pág.* 103–107

Se presenta detalles de un método para determinar dextrano en azúcar crudo que se ha desarrollado como alternativo al misura de "calina" (turbidez). El nuevo método incluye eliminación de sacarosa por diálisis y entonces nueva diálisis de los componentes residuales a los cuales se añade dextranasa para degradar el dextrano que se contiene. Después del diálisis enzimático, los productos de degradación de dextrano (oligosacaridos) se miden como glucosa. Precisión es mejor de 10%. Se considera la cuestión de la definición de dextrano.

* * *

Fibra en caña de azúcar del estado de Florida. Determinación analítica y el efecto de algunas variables. J. T. SNOW. *Pág.* 107–108

Se describe un método para determinación rapida del contenido de fibra en caña, que se ha aplicado a caña en Florida, que consiste en la mezcla de muestras de 100 g con agua (en un máquina de corte y disintegración) y su filtración (ambas etapas tres veces), lavado con agua de la pulpa producido y secado a peso constante. El peso del material seco en gramos representa el contenido de fibra en porcentaje, y el promedio de determinaciones duplicados es el valor registrado de la fibra. Se presentan dados sobre contenidos de fibra y variaciones en algunas variedades originado en Florida.

THE

INTERNATIONAL SUGAR JOURNAL

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Notes & Comments

World raw sugar price

The price of £274 per ton reported in our previous issue proved to be the peak and over four days fell by no less than £59 a ton; subsequently, during the first half of March prices have ranged between £208 and £238. Curiously enough, the sudden fall at the end of February was not brought about by any change in the apparent statistical situation, and the volatility of the futures market has been such that alternate trading periods have seen "limit-up" trading followed by "limit-down", while few would guess in which way the market would turn at the next period.

* * *

Commonwealth Sugar Agreement

Discussions took place in London between the UK Government and Ministers from Guyana and Jamaica concerning a request for an upward adjustment of the price paid for sugar under the CSA. The negotiated price had been set in December 1971 at £50 per long ton plus a variable amount between £7 and £11 for developing members. Since that time costs had increased to the point where production costs were now over the £61 paid to the two countries above.

British membership of the EEC requires, however, that an increase in the price paid for 1974 imports has the sanction of the Commission and other members of the Community and securing this would both require time and could meet with difficulty. To avoid this, a formula was agreed whereby a retrospective increase was to be paid for sugar supplied under the Agreement during 1972, the year before the UK became a member of the EEC. Although not officially announced it has been reported that the increase paid is £22 per ton, bringing the price for the 1972 supplies from the West Indies suppliers from £61 to £83. Subsequent meetings have been held with other members of the Agreement and it is understood that Mauritius is to receive an additional £22 a ton also for her 1972 supplies. Supplies of sugar from the West Indies, interrupted, as reported earlier[1], were to be resumed.

The arrangements cause no legal problems under existing EEC regulations, Commission officials agreed, but the effective rise is likely to provoke opposition to continuance of the £4 a ton subsidy allowed to British refiners of raw cane sugar.

* * *

UK sugar imports and exports

Elsewhere in this issue are tabulated statistics of imports and exports by the UK for 1973 with comparative figures for 1972 and 1971. Referring to these figures, C. Czarnikow Ltd. note[2]:

"The United Kingdom is one of the major importers of sugar in the world, taking about 10% of the total tonnage traded internationally, or rather more than two million tons. In 1973, however, imports at 2,015,743 tons were the lowest since 1948. This fall, of course, reflects the very high level of domestic production in the 1973/74 campaign which was by far the largest on record and was nearly 300,000 tons above the previous season's output. The campaign has, in fact, overlapped much further into the new calendar year than is customary and it may be anticipated that this will have its effect on 1974 imports.

"Deliveries from Commonwealth countries fell by 230,000 tons in 1973. Mauritius was the largest supplier with 378,000 tons, which was a reduction of nearly 40,000 tons on the quantity delivered from that origin in the previous year. Australia followed with 315,000 tons, which was a much lower tonnage than in either 1972 or 1971.

"Imports of sugar from foreign countries are, of course, almost entirely needed as raw material for British refined exports and consequently in a year when a high level of exports was attained there was a corresponding increase in imports from non-Commonwealth countries. By far the largest supplier in this category was Cuba, with 126,000 tons. Brazil supplied 74,000 tons and France, Dominican Republic and Argentina each delivered in excess of 40,000 tons.

[1] *I.S.J.*, 1974, **76**, 66.
[2] *Sugar Review*, 1974, (1167), 31-32, 34.

"Exports of white sugar from East Europe have been much less in evidence during the past few years than was formerly the case and British refiners have seized the opportunity to expand their sales. Total exports in 1973 amounted to 343,000 tons, the highest total since 1964. The largest quantity, 59,000 tons, was shipped to Switzerland while Norway and Kenya each acquired more than 40,000 tons. Each of these countries had been an important buyer in 1972, but it was interesting to note that almost 40,000 tons were shipped to Greece, a destination which had taken only very small quantities since 1967.

"It may be anticipated that all the time the present very tight world statistical position for sugar remains British refiners will be able to maintain a very satisfactory export performance. So far as the domestic market is concerned, however, 1974 is the last year in which the full tonnage of raws will be imported under the Commonwealth Sugar Agreement and so far as can be foreseen at the moment white sugar from other EEC countries will probably fill any gap left."

* * *

World sugar expansion prospects

After his review of the world sugar economy in 1973, the Editor of C. Czarnikow Ltd.'s *Sugar Review* writes[1], concerning the problem of rectifying the present imbalance in the world supply and demand situation: "Unless consumption is to be held in check there must be a massive expansion in production; otherwise rapidly moving prices at high levels and real physical shortages can be expected to be a feature of the future. Much of the required increase in production—and this would certainly be the cheapest way—could be obtained by utilizing existing facilities more efficiently. This would entail extending processing seasons. In some cases this could be done without reducing the yield of sugar per hectare, but in other cases an extended season would mean smaller yields as beet and cane were processed out of the optimum times. Nevertheless, the level of prices now ruling might well make this worthwhile.

"Not all the additional sugar needed can be secured from adjusting current processing arrangements, however, and supplies must also be forthcoming from new factories. The problem here is that it is now generally considered uneconomical to erect a factory which cannot produce at least 100,000 tons of sugar in a season. But the annual servicing charge on the capital outlay for a complete agricultural complex with a factory and ancillary services able to produce this tonnage of sugar costs, at present interest levels, around £25 a ton, even when favourable terms are secured. This is a heavy oncost to be borne as an overhead on sugar production and acts as a considerable deterrent to the establishment of new factories and estates.

"But additional supplies of sugar must and no doubt will be forthcoming. The problem is to ensure that it comes soon enough to meet the needs of the rapidly expanding world population. The massive service charges on capital are clearly a burden which no developing country can be expected to bear and if the economies of these countries are ever to be expanded it would seem that some form of loan subsidy must be forthcoming.

"After years of rapid, though perhaps not steady, economic expansion the world stands now at what may be a turning point in the fortunes of nations. The oil crisis, with its shortages and price increases, has brought matters to a head, but there is an increasingly tight supply situation for nearly all commodities which, in the short if not the long term, is going to affect the balance of payment patterns of nations throughout the world. There will undoubtedly be steps taken to economize on the use of commodities, to expand production where possible and to find acceptable substitutes. All three of these will no doubt affect sugar, through it may be that not all developments will be adverse.

"In the field of substitutes sugar may, indeed, gain new markets. It has long been known that sugar could be used in many non-food industries, with paints, detergents and plastics perhaps the best known. Many of these have for long been derived from by-products of the oil industry. In the past these have been supplied at prices which have made the use of sugar uneconomical but the new price structure for oil and other commodities will make it necessary to re-examine this entire field and it is possible that sugar will come to be considered an acceptable raw material in the non-food field.

"A few years ago we referred to forecasts that world sugar consumption would reach some 100 million tons by 1980. Even then we stated that production would be the controlling factor. How much more true this is today. In the past sugar production has responded rapidly to high prices but so far, in a period extending for more than two years, there has not been the hoped-for expansion. The ball would now seem to be in the importers' court; if they do not wish to continue to have to pay high prices coupled with the very real possibility of having occasions when sugar physically is not available, they may well feel they should offer exporters regional arrangements giving security of outlet coupled with a guaranteed price. Best of all, of course, would be a new International Sugar Agreement embracing as many countries as possible on both sides of the market at the earliest opportunity."

Guadeloupe sugar factory closures[2].—Two more sugar factories in Guadeloupe have recently closed so that seven remain. The sugar industry in the French West Indies suffers especially from near-European level minimum wage rates and high social security benefits, and the decline in production has continued despite French Government subsidies to the industry. Most factory owners have been reluctant to modernize their old plants and Guadeloupe's output in 1972/73 fell to 121,000 metric tons, so that she was not able to meet her EEC quota of 184,000 tons.

[1] 1973, (1159), 242.

[2] F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (1), 8.

Reheating of low-grade massecuite in continuous centrifugals

By GUENTER TROJAN
(Hein, Lehmann A.G., Duesseldorf, Germany)

Introduction

THE capacity of continuous centrifugals can be increased by reheating the cooled massecuite coming from the crystallizer. When reheating is carried out, the supersaturation temperature, which is usually around 55°C, must not be exceeded in order to prevent redissolving the crystals.

In 1973 continuous centrifugals became available offering the possibility of reheating the massecuite inside the machine. This new reheating method has been investigated on the new Hein, Lehmann "Konti 10-DC".

Table I

	Continuous centrifugal	*Batch centrifugal*
Screen hole diameter (*d*)	0·06 mm	0·4 mm
Open screen area (*a*)	7%	25%

Capacity, viscosity and reheating temperature

Why is the massecuite temperature so important for the purging process? The capacity of continuous centrifugals depends on how much mother liquor can pass through the screen openings, as the sugar layer on the screen is thin and does not offer substantial resistance.

For laminar flow through a screen opening we may apply the equation:

$$w = \frac{\Delta P \, . \, d^2}{32 \, . \, l \, . \, \eta} \quad \ldots\ldots (1)$$

where w = flow velocity in the screen hole, ΔP = pressure difference on the screen hole, d = diameter of the screen hole, l = depth of the screen hole, and η = dynamic viscosity of the syrup.

The total liquid volume v passing through all screen holes, replacing l by d and assuming a medium pressure difference ΔP_m, will then be

$$v = \frac{\Delta P_m \, . \, d \, . \, A \, . \, a}{3200 \, . \, \eta} \quad \ldots (2)$$

where A = total screen area, and a = (%) open area of screen.

We recognize how much the flow of syrup is restricted in continuous centrifugals by the fine nickel screen if we compare the screen hole dimensions as in Table I.

This disadvantage of high screen resistance associated with the principle of continuous purging must be compensated by reducing the viscosity η. With batch type centrifugals the mother liquor of a low-grade massecuite may have a viscosity of 600–800 poises* in spite of

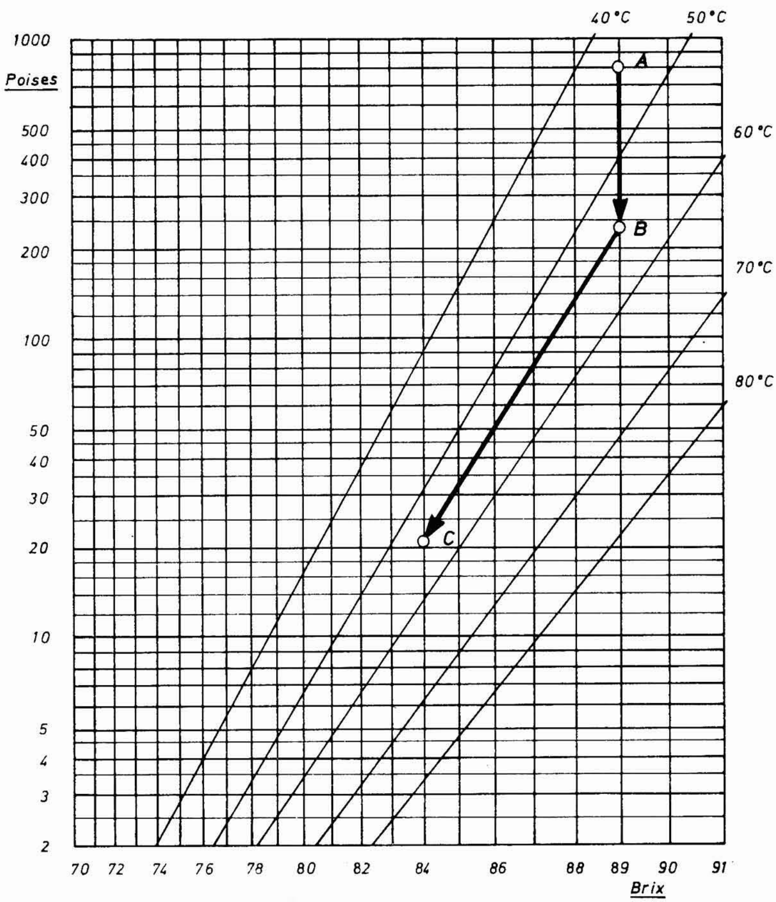

Fig. 1. Viscosity of final molasses as a function of its temperature and Brix

* Viscosities measured with a Haake rotating disc viscosimeter

the thick sugar layer, whereas continuous centrifugals can only handle viscosities below 40 poises for satisfactory purging capacity and good sugar quality. Therefore wash water is introduced into all continuous low-grade centrifugals and very often the massecuite temperature must be increased.

This procedure of lowering the viscosity is illustrated by the graph in Fig. 1 drawn according to researches of BREITUNG[1] and our additional measurements. If we assume a mother liquor of 45°C, 89°Bx and 800 poises (point A), then reheating is normally done in a Stevens Coil type mixer or crystallizer to 55°C (point B), thereby lowering the viscosity to 240 poises. Then wash water is introduced into the centrifugal so that the Brix is reduced to 84° and the viscosity to 21 poises (point C).

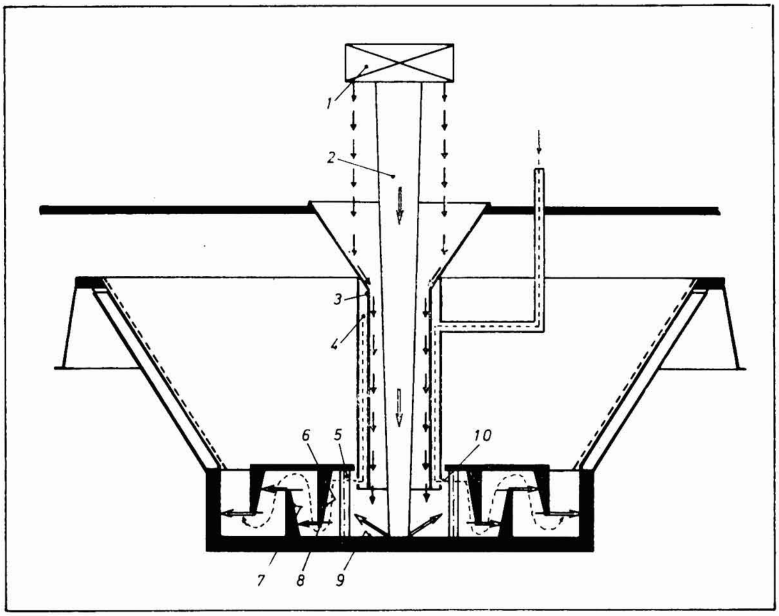

Fig. 2. "Konti 10-DC" with massecuite reheating system

This total viscosity drop from e.g. 800 to 21 poises can now be achieved in the "Konti 10-DC" centrifugal (DC for direct curing). No additional reheating equipment is required.

The internal heating system

The principle of the internal heating system of the "Konti 10-DC" is shown in Fig. 2. The cold massecuite is fed through tube (3) in a free flowing stream (2), in general not touching the inner pipe wall. When striking the bottom plate it is thrown outwards against the rods (5), which disintegrate the stream. It then passes on to the surface (6) and a massecuite layer will form which proceeds over the rim (8) as a thin spray to the next surface (7) and so on, finally being delivered to the working screen.

Steam is introduced through ring compartment (4) and the apertures (10) and passes through the massecuite sprays, condensing and directly transferring its latent heat to the massecuite. Saturated steam of 2–3 $kp.cm^{-2}$ should be used. The steam consumption will be in the order of 100 to 150 $kp.hr^{-1}$.

Wash water is supplied via the iris valve (1) from which it drops into the pipe (3) constantly moistening the inner pipe surface. This prevents the massecuite from adhering to the pipe wall should it come into contact as a result of fluctuating feed conditions.

Reheating time

To measure the reheating time, rice grains and big sugar crystals were introduced into the feed pipe, while the bottom screen area of the running centrifugal basket was observed by means of a stroboscope. It took the particles 1·5 seconds to pass through the reheating system. Table II gives an interesting comparison of the reheating time required by different equipments and the time to pass through the DC reheating circuit.

Table II

Equipment	*Reheating time for a temperature elevation of 10°C*
Crystallizer with stationary heating pipes	10 hours
Crystallizer with rotating heating discs, special heating mixers	1 hour
Electrical resistant heating	1 minute
Internal steam heating in "Konti 10-DC"	1·5 seconds

Reheating temperature and molasses purity

Does reheating above the saturation point for a very short period cause the redissolving of sugar crystals? To investigate this question, the following test was carried out:

At a constant massecuite feed rate of 3 tons/hr and 3% wash water the massecuite temperature was raised from 54°C to 70°C. At every 4°C temperature increase, at least 3 molasses samples were taken and analysed (refractometric Brix, polarization).

The reheating temperature was measured in the molasses very near the centrifugal, because the

[1] *Zeitsch. Zuckerind.*, 1956, **81**, 185.

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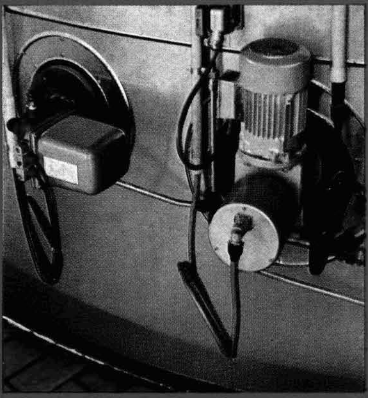

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Table III. Molasses purity and reheating temperature at constant feed rate of 3 tons/hr and 3% wash

Test No.	Time	Steam kp.cm^{-2}	Molasses Brix	Molasses Purity	Molasses Mean Purity	Molasses Temp., °C	Sugar quality
1			84·8	61·1			No sugar obtained, unpurged massecuite in the sugar compartment
2	13.10	0	85·2	61·0			
3			85·2	60·8			
4			85·0	60·9	60·95	54°	
5			84·6	60·7			Sugar of low quality
6	13.25	0·4	84·8	60·7			
7			85·0	60·6			
8			84·6	60·8	60·70	58°	
9			84·6	60·9			Good sugar, improving with reheating temperature
10	13.40	1·1	84·6	60·9			
11			84·8	60·4			
12			84·8	60·3	60·63	62°	
13			84·4	61·0			
14	13.55	1·4	84·8	60·5			
15			84·8	60·5	60·67	66°	
16			84·8	60·6			
17	14.10	1·7	84·8	60·6			
18			84·4	61·0	60·73	70°	

Massecuite: 94·2°Bx, 75·9 purity, viscosity 3000 poises, temp. 53°C

reheated massecuite itself can only be found in areas where it is rotating at the angular speed of the basket.

The results obtained are summarized in Table III and presented graphically in Fig. 3.

The following conclusions can be drawn:

1. The molasses purity without reheating is higher than with reheating up to temperatures of 70°C.

2. There is a purity minimum in the region of 62°C that corresponds to the qualification: "good sugar".

3. A maximum mean purity difference of 1/10 of a point was found in the wide temperature range between 58°C and 70°C.

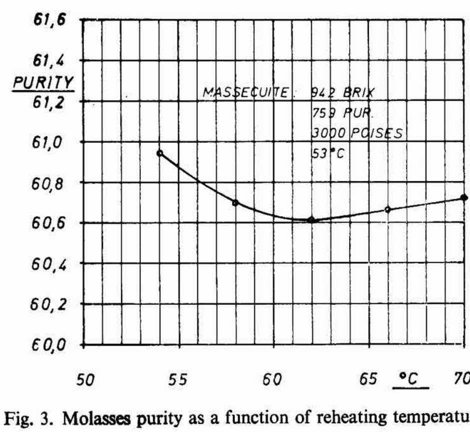

Fig. 3. Molasses purity as a function of reheating temperature

Centrifugal capacity

Following the positive results of the purity test, the effect of various reheating temperatures and viscosities on the centrifugal capacity was investigated.

Two test runs with different massecuites were carried out:

With wash water at a fixed percentage, the reheating temperature was increased together with the feed rate so that constant sugar qualities were produced.

The relationship between the maximum capacities obtained and the viscosity of the outflowing molasses are shown in Fig. 4. Curve 3 represents equation (2) when calculation is started from the point 4 tons.hr^{-1} and 25 poises.

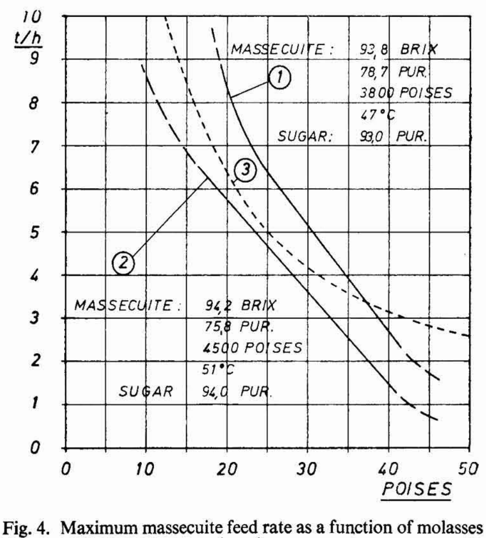

Fig. 4. Maximum massecuite feed rate as a function of molasses viscosity

We see that, to obtain a good sugar quality and a reasonable capacity of 4 tons.hr^{-1}, it is necessary to keep the molasses viscosity under 35 poises.

Fig. 5 shows the relationship between capacity and reheating temperature. What is the capacity increase effected by the internal heating system? Fig. 5 shows that, without reheating, the centrifugal capacity would have been limited to 1·4 tons.hr^{-1}, whereas with reheating the same massecuite up to 65°C the maximum capacity was 6·5 tons.hr^{-1} which means an increase of more than 460%. In general such heavy massecuites of more than 4000 poises could not be purged satisfactorily in either batch or standard continuous centrifugals.

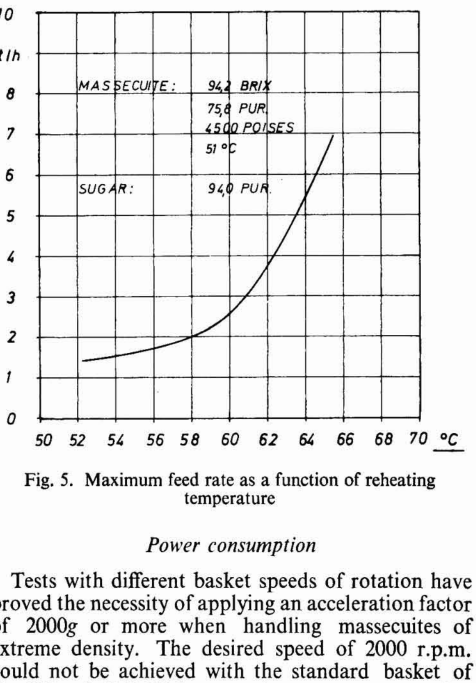

Fig. 5. Maximum feed rate as a function of reheating temperature

Power consumption

Tests with different basket speeds of rotation have proved the necessity of applying an acceleration factor of 2000*g* or more when handling massecuites of extreme density. The desired speed of 2000 r.p.m. could not be achieved with the standard basket of the "Konti 10-DC" because the power consumption due to windage was too high.

Therefore a new basket was designed with completely even surfaces, which lowered drastically the current consumption of the main motor and allowed a speed of more than 2000 r.p.m.

The relationship between massecuite feed rate and current consumption is shown graphically in Fig. 6. The rated current of the 45 kW/380 V induction motor is reached at a feed rate of about 7 tons.hr^{-1}. Power consumption is then approximately 7 kWh per ton of massecuite.

Consequences of the new purging method

Many benefits are derived from the fact that the new centrifugal can handle low-grade massecuites with a high feed rate independent of their temperatures and concentrations.

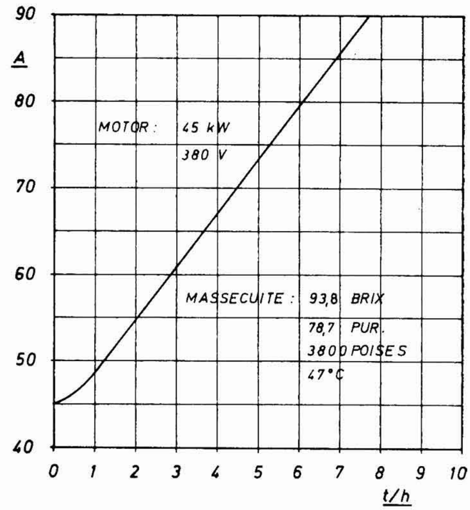

Fig. 6. Massecuite feed rate and current consumption at 2000 r.p.m.

Therefore, massecuite concentration in the pans and crystallizers can be pushed as far as the mechanical strength of the crystallizer agitators allows, without considering the process of centrifugalling. This, of course, will improve the exhaustion and thus give lower molasses purities. We believe that batch centrifugals have now lost their advantage of delivering a final molasses of lower purity.

Outside reheating equipment is no longer required. If reheating was done in a crystallizer the volume needed for reheating can now be used for cooling. Open mixers between an upper crystallizer and the centrifugal station should be avoided because they limit the static pressure of the massecuite through the pipe lines. Instead there should be a direct pipe connexion, preferably of 300 mm dia. from the crystallizer, with constant head of massecuite of 5 metres.

If the layout of a sugar factory does not offer the opportunity of producing a very highly concentrated low-grade massecuite, there would still be the advantage of the high machine capacity, for the new method allows reheating of the massecuite to far higher temperatures than is possible by conventional methods.

Summary

A method of reheating low-grade massecuites within a continuous centrifugal allows reheating far above the supersaturation point. Thus the viscosity of the mother liquor is drastically decreased and the machine capacity increased. Outside reheating equipment is no longer required, and the massecuite can be concentrated without regard to its purgeability.

Analysis of dextran in sugar—an enzymic method

By G. N. RICHARDS* and G. STOKIE

(Chemistry Department, James Cook University of North Queensland, Australia)

INTRODUCTION

DEXTRANS frequently occur in juices and sugars produced from stale cane[1]. The dextrans are predominantly α-1,6-linked glucans, at least in chopper-harvested cane, and appear to be produced mainly by bacteria such as *Leuconostoc mesenteroides*. The dextrans usually appear only in stale cane and improved control in harvesting and transport has now reduced the frequency of occurrence to a very low level under Australian conditions. The considerable commercial interest in dextrans within the sugar industry, however, results from their ability to slow the rate of crystallization of sucrose on the c-axis, resulting in elongated crystals[2], from deleterious effects on filtrability[3] and from increased viscosity effects. The need for analysis of dextran in both juice and raw sugar is therefore self-evident, but the only method available to date relies on the measurement of turbidity ("haze") produced by addition of ethanol to an aqueous solution of the sugar[4]. Such a method is likely to be subject to uncertainties resulting from any factors which cause irreproducible particle size or stability in production of the "haze" or from any substances other than dextran which may produce "haze" (e.g. reference[5], p.299). We have therefore sought an alternative method of analysis which must of course be applicable in the presence of the other likely impurities in the juice or sucrose systems, such as salts, reducing sugars, protein, and other polysaccharides such as starch and hemicelluloses.

EXPERIMENTAL

Materials and general methods

The following materials were used: B512 native dextran from *L. mesenteroides* (batch TG2941) and a partially hydrolysed and fractionated dextran T110, kindly provided by Pharmacia AB., Uppsala, Sweden; B.D.H. "Analar"-grade sucrose; B.D.H. soluble starch; hemicellulose B from sugar cane[6]; and dextranase-CB (bacterial), B grade, supplied by Calbiochem, California. Total carbohydrate analysis was carried out by the phenol-sulphuric acid method[7] using anhydrous D-glucose as reference standard.

Removal of sucrose by dialysis

Dialysis tubing (Visking thin-wall, 26/32) was washed inside and outside in running hot water (55–60°) for 1 hr, then immersed in water at 90° for 2 hr and subsequently stored for periods up to a few days under cold water. A 30 cm length of tubing was knotted at one end and tied to a 10 cm length of glass tubing at the other end. A solution of 5·0 g sucrose in 15 ml water, followed by 2 ml of toluene, was added by funnel so that no sucrose solution came into contact with the glass tube or the upper part of the dialysis sack, which was then immersed in running tap water. At intervals, additional toluene was added and samples of the aqueous solution were withdrawn from the sack for carbohydrate analysis and the volume of solution was measured by immersing the sack to its internal water level in water contained in a measuring cylinder. Results are shown in Table I.

Table I. Removal of sucrose by dialysis

Time, hr	0	24	30	48	72
Carbohydrate (as mg glucose)	5000	4·2	1·9	0·45	0·37

Enzymic degradation and dialysis of dextran

To ensure that the dialysis tubing was fully permeable to the likely products of enzymic degradation of dextran, an aqueous solution (20 ml) of pure isomaltotetraose (1·96 mg, analysed as glucose by phenol-sulphuric acid) was added to a dialysis sack prepared as above and immersed in water (80 ml) in a 100 ml measuring cylinder. Carbohydrate analysis of the solution outside the sack showed an apparent glucose content (for the total 100 ml) of 1·48 mg after 5 hr and 2·10 mg after 9 hr.

In order to simulate the analysis of dextran in a sugar sample, aqueous solutions (10 ml) containing sucrose (5·0 g) and native dextran (0, 1, 1·5, 2, 2·5, 5 and 10 mg respectively) were dialysed against running water as described above for about 40 hr. The volume of solution in each sack was measured as above and a sample taken for carbohydrate analysis. Each sack was next immersed in water and toluene (2 ml) in a 100 ml measuring cylinder with a total of 100 ml water present (i.e. inside and outside the sack). An aqueous solution of dextranase (0·12 ml containing 0·06 mg of enzyme preparation, i.e. about 3·3 I.U.) was added and kept at 37°. Further similar additions of enzyme solution were made after 2, 30 and 55 hr and at intervals, after mixing, samples were removed from each measuring cylinder (outside the dialysis sack) for carbohydrate analysis. Only small increases in carbohydrate content of the outer solution occurred after 30 hr, corresponding to about 2–3% of original dextran for each addition of enzyme. In all subsequent work therefore the enzymic

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* To whom communications should be addressed.

[1] (a) KENIRY, LEE and DAVIS: *I.S.J.*, 1967, **69**, 330–333.
(b) LEONARD and RICHARDS: *ibid.*, 1969, **71**, 263–267 and references therein.
[2] SUTHERLAND and PATON: *ibid.*, 1969, **71**, 131–135.
[3] JAMES: *Proc. Queensland Soc. Sugar Cane Tech.*, 1972, 275–277.
[4] KENIRY *et al.*: *I.S.J.*, 1969, **71**, 230–233.
[5] IMRIE & TILBURY: *Sugar Tech. Rev.*, 1972, **1**, 291–361.
[6] BLAKE, MURPHY and RICHARDS: *Carbohydrate Res.*, 1971, **16**, 49.
[7] DUBOIS *et al.*: *Anal. Chem.*, 1956, **28**, 351.

dialysis was terminated at this stage without the third or fourth additions of enzyme. Subsequent use of "enzymic dialysis" therefore implies the addition of enzyme, incubation at 37° for 2–6 hr, a second addition of enzyme and further incubation to a total of 20–30 hr. Results in Tables II and III show the recovery of dextran after the first and second dialyses.

Table II. Recovery of dextran after dialysis of sucrose

Dextran added*	0	0·93	1·48	1·95	2·41	4·91	9·72
Total carbohydrate remaining after dialysis*	0·02	0·95	1·54	2·10	2·49	4·79	10·35
Recovery of dextran (%) (corrected for blank)		100	103	107	102	97	106

(* as mg glucose from phenol-sulphuric acid analysis)

Table III. Recovery of dextran after dialysis of sucrose followed by enzymic dialysis

Dextran added*	0	0·93	1·48	1·95	2·41	4·91	9·72
Total enzyme-dialysable carbohydrate*	0·09	0·97	1·46	1·92	2·31	4·58	9·18
Recovery of dextran (%) (corrected for blank)		95	93	94	92	91	94

(* as mg glucose from phenol-sulphuric acid analysis)

Efficiency of enzymic dialysis on dextrans from raw sugars

In the authors' laboratory, Mr. M. Covacevich is carrying out a structural survey of dextrans isolated from a wide range of raw sugars representing a diversity of locations and seasonal and other variables likely to cause problems such as grain elongation. Six such samples of isolated and purified dextrans were subjected to enzymic dialysis as described above, omitting the dialysis against running water. Each of the samples used gave glucose only on acid hydrolysis. Results are shown in Table IV and samples are numbered in accord with a detailed report in preparation by Mr. Covacevich. The dextran recovery values from the enzymic dialysis assume equilibration of the dextran degradation products inside and outside the dialysis sack, and are derived from the carbohydrate content of the solution outside the sack. The non-dialysable polysaccharide values are derived from the carbohydrate content inside the sack following enzymic dialysis, after allowance for dextran degradation products.

Table IV. Recovery of raw sugar dextrans from enzymic dialysis

Dextran sample	6	7	9	10	12	13
Recovery of dextran*	92	84	83	67	83	96
Non-dialysed polysaccharide*	4	7	16	38	13	2

(* expressed as % of original dextran)

Possible interference of starch and hemicellulose in enzymic dialysis

The following solutions (15 ml each) were subjected to enzymic dialysis: (a) starch (5 mg), (b) hemicellulose (5 mg), after prior dialysis of the solutions against running water for 2 days to remove any low molecular weight fraction. The apparent "dextran" content of each polysaccharide measured as glucose after the enzymic dialysis was (a) 2·5%, (b) 0·8%.

Application of the dextran analysis to raw sugars

Samples (5 g) of the raw sugars used for Table IV were dissolved in water (15 ml), dialysed against running water for at least 45 hr, then subjected to enzymic dialysis. Results are shown in Table V which includes "dextran" values determined by the alcohol "haze" method.

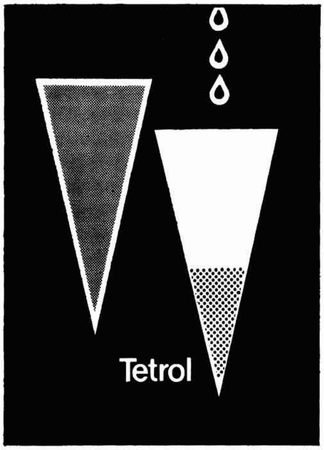
"Haze" analysis

The exact procedures described by Keniry, Lee and Mahoney[4] were applied to the sugar samples and the results shown in Table V are derived by reference to the standard "haze" curve prepared with dextran T110. The "haze" curves in Fig. 1 were determined using the dextrans isolated from raw sugars with dextran concentrations determined by phenol-sulphuric acid analysis. Normally, ion exchange, enzyme, and trichloroacetic acid treatments were omitted, but, since the samples had a small ash content, the curves for samples 9 and 13 were also repeated after ion exchange treatment of the original dextran solution, without effect on the "haze" curve.

Table V. Apparent dextran contents of some raw sugars

Sugar sample	*Alcohol "haze" method* — *Apparent dextran, ppm*	*Enzyme dialysis method* — *Apparent dextran, ppm**		*Enzyme dialysis method* — *Difference between duplicates, %*	*Difference between methods, %*†
1	420	542	496	8	26
2	1675	2307	2218	4	35
3	140	230	227	1	64
4	370	678	662	2	81
5	1335	1619	1590	2	20
6	965	1301	1194	8	29
7	1630	1912	1929	1	18
8	90	255	259	2	186
9	268	364	428	15	48
10	265	606	630	4	133
11	167	428	395	8	147
12	1280	1529	1608	5	23
13	1455	1551	1490	4	5
14	755	921	1049	12	30
15	1050	1257	1347	7	24

* duplicate analyses
† mean enzyme dialysis result minus "haze" result, expressed as a percentage of the latter


Tetrol


Antispumin

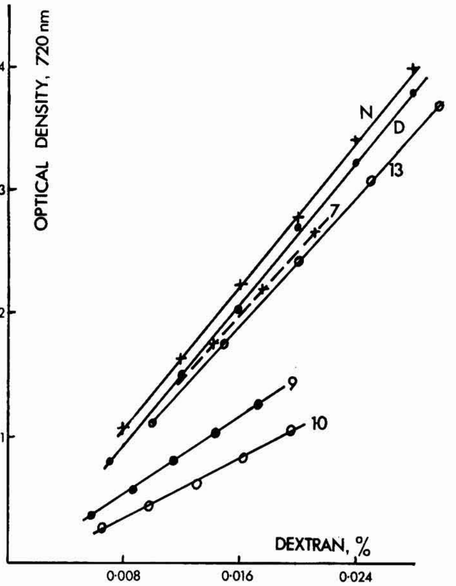


Fig. 1. "Haze" formation on addition of 1 volume of ethanol to aqueous solutions of various dextrans.
Numbers refer to dextrans in Tables IV and V;
D refers to Pharmacia T110 dextran;
N refers to Pharmacia native dextran.

RESULTS AND DISCUSSION

In any specific analysis for traces of dextran in sugar it seems desirable, despite the difficult nature of this operation, to remove the sugar before attempting to determine the dextran present. We have investigated the possible use of ultrafiltration to remove sucrose while retaining polysaccharides, but abandoned this method because of problems, in routine operation, of ensuring removal of all traces of sucrose from the filtration equipment. The dialysis method as described seems reliable in routine operation and of course requires no attention during the prolonged (45 hour) process. The dialysis tubing often contains traces of material which reacts with the phenol-sulphuric acid reagent so that the prior washing of the dialysis tubing with hot water is desirable. The concentration of sucrose in the dialysis sack approaches zero asymptotically during dialysis, but Table I indicates that for the systems of interest, dialysis of more than about 45 hours will reduce the sucrose adequately.

In the raw sugar system, after exhaustive dialysis we are left with all of the insoluble and macromolecular components inside the dialysis sack. These are likely to be predominantly dextran, starch, hemicelluloses ("gums"), protein and insoluble inorganics. The central concept of the present method is to use a specific dextranase to degrade the dextran component (only) from this mixture to produce fragments which will dialyse freely. The enzyme is placed inside the dialysis sack and of course remains there. The degradation products (oligosaccharides) reach an equal concentration inside and outside the dialysis sack by diffusion through the membrane. At the concentrations involved the other macromolecular components will not significantly affect this equilibrium and thus a measurement of total carbohydrate content in the solution outside the dialysis bag (by the phenol-sulphuric acid method) makes it possible to calculate the total dextran content.

We have confirmed that the commercial dextranase which we use will degrade the Pharmacia native dextran to a mixture of oligosaccharides in which there is no significant component containing more than 5 glucose units and have shown that isomaltotetraose will equilibrate across the dialysis membrane within 9 hours. Table II shows that the dextran is completely retained in the dialysis sack after removal of sucrose and Table III shows that on subsequent addition of enzyme to the sack the dialysable products correspond to a recovery of 91–95% of original dextran for a wide range of concentrations. These recoveries could be increased by further addition of enzyme.

In order to investigate the application of this method to dextrans actually occurring in cane sugar we have used a range of dextrans isolated from raw sugars. The recoveries of these dextrans from the enzymic dialysis method are shown in Table IV. Two samples showed 92 and 96% recovery respectively and it is probable that these are similar in structure to the Pharmacia dextran, which is known from methylation analysis[8,9] to contain 94·5% α-1,6-linkages and 5·5% 1,3-linkages. Three other samples showed 83–84% recovery and are probably significantly different in structure from the Pharmacia dextran. The sixth sample (No. 10 in Table IV) gave a very low recovery of 67% as dextran. We conclude that the dextran in sample 10 probably has a relatively large proportion (up to a third) of non-1,6-linkages. These conclusions will be further investigated in detail by Mr. M. COVACEVICH in these laboratories. In all cases where there was a low recovery of enzyme-dialysable dextran, there was an increased "surplus" of carbohydrate material left inside the dialysis sack owing to polymeric material remaining unattacked by the dextranase.

The method was next applied in duplicate to the original raw sugars from which dextrans had been isolated for the preceding experiment and these results are shown in Table V. The differences between duplicates varied from 1% to 15%. Differences between duplicate determinations by the "haze" method varied from zero to 5·6%. In all cases our method gave higher dextran values than the alcohol "haze" method with differences between the two methods ranging from 5% to 186% with the various samples. Despite this fact, we are of the opinion that any errors and uncertainties involved in our method result in net values *lower* than the true dextran content. The major factors influencing this

[8] LINDBERG and SVENSSON: *Acta Chem. Scand.*, 1968, **22**, 1907.
[9] LARM, LINDBERG and SVENSSON: *Carbohydrate Rev.*, 1971, **20**, 39.

opinion are the uniformly low recoveries in Table III and the low values in Table IV which probably result from non-1,6-linkages in the dextrans. In particular the true dextran content of sample 10 is evidently more than twice that indicated by the alcohol "haze" method. It has already been reported[10] that the "haze" method is "satisfactory provided the standard curve has been based on dextran from a similar species of *Leuconostoc* organism" and an experiment has been reported[10] which shows that the dextran from *L. dextranicum* gives a low apparent recovery based on the standard curve from *L. mesenteroides*. We have determined standard "haze" curves from several of the dextrans isolated from raw sugars (Fig. 1) and find that for two samples (9 and 10) corresponding to sugars in which the "haze" result was very different from our enzymic dialysis result (Table V), the "haze" curves were much lower than the usual standard with commercial dextran. We have shown that these curves are unchanged by deionization of the dextran samples and also that the commercial T110 dextran (which has been subjected by the manufacturer to partial acid hydrolysis and fractionation) gives a very similar curve to its parent "native" dextran. The capacity of a dextran to produce "haze" is probably highly sensitive to small variations in its chemical structure, but a proper understanding of this effect must await our study of structures of these samples. The enzyme-dialysis analysis is also sensitive to such variations, but apparently much less so than the "haze" method.

It must be emphasized that what we measure by enzyme-dialysis is the amount of polysaccharide which is degraded to oligosaccharides by a particular enzyme. The enzyme is specific for sequences of α-1,6-glucose linkages and the method therefore may be regarded as measuring the amount of α-1,6-linked glucan. Dextrans are normally defined as "predominantly α-1,6-linked glucans" (e.g. p. 292, reference 5) and in this sense our method may be said to measure dextran. It will include any *sequences* of α-1,6-linkages in polysaccharides of mixed linkage such as sarkaran[11] with 1,4- and 1,6-linkages, but other portions of such polysaccharide molecules will not be included in the analysis if they result in non-dialysable products. Isolated α-1,6-linked glucose units such as those in amylopectin also will not be included. However, the common 1,3-branch points in dextrans will often be included in the analysis since they are present after enzymic attack in branched oligosaccharides which will dialyse. If the number of branch points is unusually high, however, the probability increases that a number of branches may occur sufficiently close to each other to prevent enzymic attack on the intervening α-1,6-linkages. Such an effect may result in enzymic-resistant fragments too large to dialyse and hence not included as dextran in the enzymic-dialysis analysis.

Conclusions

Our results illustrate the complexity of the problem of analysis of dextran in sugar. Obviously much of this complexity arises from the question of definition of "dextran". If we were to define "dextran" as "portions of polysaccharides containing extended sequences of α-1,6-linked glucose units", then the method described above is probably unequivocal with an accuracy better than 10%. It is certainly the most specific method available to date. It seems likely that the method will frequently give results higher than the "haze" method owing to the fact that some dextrans in raw sugar will give much less "haze" than a corresponding weight of the usual reference dextran. Nevertheless, any uncertainties in the enzymic method are still likely to give results in which the error, if any, is on the low side.

Obviously the industry needs to know much more about the chemical nature of the dextrans which actually occur in juices and raw sugars and we intend to pursue this aspect so that we may be better informed as to the material which we have to measure. In practical terms there is need for much further study of the relationship between the amount and chemical nature of dextrans in sugars and consequent industrial nuisance values such as grain elongation, and poor filtrability and viscosity. There is some evidence for a general correlation between the dextran "haze value" and both grain elongation[1a] and filtrability[3] in industrial situations, although there are no doubt many exceptions to such generalizations. On the whole, however, the depth of information available on the relation between dextran structure and processing problems is relatively small and based on a structural method (periodate oxidation) which can be misleading[12].

Summary

An alternative to the "haze" method has been developed for analysis of dextran in sugar. The new method (the enzyme-dialysis method) consists of removal of all sucrose by exhaustive dialysis, followed by simultaneous enzymic degradation and dialysis of the products. Measurement of the dialysable products in the second step gives a measure of the content of α-1,6-linked polymeric glucose sequences present in the original sugar.

The method is not interfered with by any other likely polysaccharide constituent (e.g. starch, gums) nor by protein, salts or reducing sugars. When applied to raw sugars the enzyme-dialysis method tends to give higher dextran values than the "haze" method, sometimes several times higher. Nevertheless, all of the evidence indicates that errors if any in the new method will always be on the low side.

There is no suggestion, of course, that the method is suitable for development into any form of routine analysis for dextran because, although it is not

10 Nicholson and Horsley: *J. Agric. Food Chem.*, 1959, **7**, 640–643.
11 Bruijn: *I.S.J.*, 1966, **68**, 331–334.
12 Leonard: Ph.D. Thesis, James Cook University of North Queensland, 1973; Covacevich, private communication.

particularly labour intensive, the times involved in dialysis are inevitably prolonged. Its value, however, may be as a reference method which is an alternative to, and independent of, the relatively rapid "haze" method. It is highly probable that much greater speed could be achieved if the enzyme-dialysis method were modified by replacing one or both of the dialysis steps with ultrafiltration or gel filtration procedures.

ACKNOWLEDGMENTS

The authors are grateful to Dr. N. W. H. CHEETHAM for advice and helpful discussion in the formative stages of this project and to Mr. M. COVACEVICH for provision of samples and helpful discussion throughout. This work was financially supported by the Queensland Cane Growers' Council.

Fibre in Florida sugar cane

Analytical determination and the effects of several variables

By JOHN T. SNOW, Ph.D.
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Introduction

CONSIDERABLE attention has been focused on the development of a simple, expedient, reliable procedure for determining the fibre content of sugar cane. BOURNE[1], HEBERT and JAMES[2], HENDERSON *et al.*[3], PAYNE[4], SKINNER[5], and STEWART[6,7], have all reported efforts towards the development of such a method. Unfortunately, these procedures are rather complex and some require sophisticated equipment. Faster methods have been advanced by DAVIDSON[8], IRVINE[9], and STEVENSON *et al.*[10], but each is applicable to situations where only crude fibre information is needed for a large quantity of samples.

A method is now introduced which has been extremely successful in determining the fibre contents for a large number of samples in a short period of time. With this procedure it is possible for one person, working alone, to make up to ten separate fibre determinations per day with the aid of a Wiley Mill, commercial blender, and simple filtration devices. Application to many samples, obtained under diverse conditions, has established a reliable methodology. The effects of cane maturity, crop age, sample location, and soil type on the fibre of one variety, Cl 41-223, are discussed. The fibre contents of several important Cl and CP varieties are reported.

Experimental Procedure

A single fibre determination was made by selecting 8 whole stalks of cane from the desired location, taking care to choose representative mature stalks and not more than one stalk from a single stool. Each stalk was hand topped to normal harvest length and stripped of the leaf sheath. The cane was subsampled immediately by taking one half of each of the 8 stalks to provide 4 top halves and 4 bottom halves. The 8 halves were cut into equal thirds and each middle third discarded. The 16 remaining pieces were cut longitudinally and ground through a 5-mm mesh screen using a Wiley Cutting Mill (A. H. Thomas Co., Philadelphia, Pennsylvania). Duplicate samples of freshly ground cane (100 g) were weighed into 400-ml beakers, taking care to obtain representative samples. (At this point it would be possible to store the macerated cane at —20°C in a sealed container for an indefinite period of time if deemed desirable.) Next, a sample of unfrozen cane was transferred to a 4000-ml commercial Waring blender (Model CB-6, Waring Products Division, Dynamics Corp. of America, New Hartford, Connecticut) with 1200 ml of cool tap water and blended at low speed for 1 minute. The macerated material was filtered through 100-mm mesh screen and again blended for 1 minute with 1200 ml of tap water and filtered. The resulting fibre was blended a final 30 seconds with 1200 ml of water and then filtered through tared (to constant weight at 105°C) 18-cm Whatman No. 54 filter paper using a Buchner (Coors No. 5) filter funnel and 4000-ml filter flask. The pulped fibre was then washed with 3 portions (1000 ml each) of cold tap water and dried to constant weight at 105°C. The weight of the dried material in grams represents the % fibre for the sample. The mean of the duplicate determinations is the fibre value reported.

Results and Discussion

In establishing the optimum experimental laboratory technique outlined above, several interesting observations were made. First, it was essential to include all portions of the whole cane stalk in the subsampling procedure as the bottom third of a stalk contains significantly greater amounts of fibre than the top or middle third (data not included). Second, the recommended procedure uses cold water washings to avoid possible conversion of pentosans and pectins, constituents of the fibre, into soluble products, which would give reduced results in the weight of fibre[11]. Also, three washings ensure complete removal of all

1 Unpublished data.
2 *Sugar y Azúcar*, 1969, **64**, (9), 42–44.
3 *Sugar Bull.*, 1968, **46**, (13), 8–15.
4 "The Official Methods of the Hawaiian Sugar Technologists" Revised edn. (Elsevier, Amsterdam). 1968.
5 *Sugarcane Breeders' Newsletter*, 1969, **23**, 27–35.
6 *Proc. 13th Congr. ISSCT*, 1968, 1006–1012.
7 *Proc. 36th Conf. Queensland Soc. Sugar Cane Tech.*, 1969, 157–160.
8 *Proc. 13th Congr. ISSCT*, 1968, 1723–1728.
9 *Proc. 14th Congr. ISSCT*, 1972, 396–401.
10 *I.S.J.*, 1970, **72**, 70–75.
11 SPENCER and MEADE: "Cane Sugar Handbook" 9th Edn. (John Wiley and Sons, New York). 1963.

water-soluble materials and conveniently achieve the quantitative transfer of all bagasse from blender to filtration apparatus. Finally, a good correlation exists (data not included) between the fibre values obtained using the original SPENCER method[12], those reported recently by the factory control chemists using the indirect method[11], and those reported here. However, with the gradual conversion to mechanical harvesting, the current method of field sampling will probably have to be altered to retain this close agreement.

The effects of the numerous variables encountered in sampling a cane field on the fibre determinations have been established under Florida conditions. The seasonal variation of the fibre content within a single variety was determined by randomly sampling a field of 1st ratoon Cl 41-223 at regular monthly intervals for 7-month- to 12-month-old cane. The results of these 6 samples in 3 replicated trials show that there was no significant difference at the five percentile level between any of the samples (Table I). It may be concluded that young 7-month-old immature cane has approximately the same fibre content as year-old mature cane. These results agree with those previously reported by HEBERT and DAVIDSON[13] for Florida.

Table I. Fibre content of 7- to 12-month-old Cl 41-223

Date sampled	*Age in months*	*% fibre*
1st October 1972	7	8·43
1st November 1972	8	8·06
1st December 1972	9	8·63
1st January 1973	10	8·54
1st February 1973	11	8·46
1st March 1973	12	8·96
	L.S.D. (0·05)	N.S.

In a similar study the relationship between the fibre content and the crop age was established. This was achieved by determining the fibre content of cane of different crop age (plant or ratoon) taken from fields of similar location, maturity, soil type, and variety. Thus, five ages (plant, 1st, 2nd, 3rd and 4th ratoon) of 11-month-old Cl 41-223 were analysed for fibre content. The results of these 5 samples in 3 replicated trials show that there was no significant difference at the five percentile level between any of the samples (Table II). Evidently, the crop age of the cane does not dramatically affect the fibre content within a specific variety.

Table II. Effect of age on the fibre content of 11-month-old Cl 41-223

Field	*Age*		*% fibre*
1	Plant		8·40
2	1st ratoon		8·46
3	2nd ratoon		8·20
4	3rd ratoon		8·73
5	4th ratoon		8·59
		L.S.D. (0·05)	N.S.

To determine the variation in the fibre content with changes in soil composition and geographic location, the fibre contents of cane grown on fields that were high, medium, and low in mineral content and of average organic composition were compared with those of cane grown on sandy muck soil[14]. The fields selected were up to 65 km apart and all had 1st ratoon Cl 41-223 of 11-month maturity. These studies are summarized in Table III and indicate the likelihood that soil type influences % fibre significantly. Thus, cane grown on soil high in organic matter and low in silica was significantly lower in fibre content than cane grown on sand or high silica-low organic soil. The low moisture content found for cane grown on sandy soil in the present work indicates that the plant either is unable to store water in the sand environment or is changed somewhat physiologically by the growing conditions. However, there were no major differences in the fibre content of cane grown in different locations provided the soil type remained the same. It should be mentioned that HEBERT and DAVIDSON[13] have reported significantly differing fibre values for the same variety of cane grown in Louisiana and in Florida.

Table III. Effect of soil variation on the fibre content of 11-month-old 1st ratoon Cl 41-223

		Soil composition			
Field	*Soil type*[14]	*% mineral*	*% organic*	*% silica*	*% fibre*
6	Sandy muck	10	10	80	10·19
7	High mineral Average organic	45	46	9	8·99
8	Medium mineral Average organic	27	64	9	8·46
9	Low mineral Average organic	11	89	0	8·49
			L.S.D. (0·05)		0·92

In recent years some variation in cane fibre of certain varieties has been experienced at our mills from one season to the next. To allow for this variation, determination of the fibre content of each new variety is routinely made for three successive years. Variations between the three determinations usually do not amount to more than 1·0% absolute fibre. The three separate determinations are then averaged to provide a final value which is recorded as the fibre value for the particular variety. Fibre content values as large as 15·3% and as small as 8·9% have been found for different cane varieties using this procedure. Table IV summarizes the fibre contents of some of the commercially important Cl and CP cane varieties currently grown in Florida.

Table IV. Fibre contents of leading commercial varieties

Variety	*% fibre*	*Variety*	*% fibre*
Cl 41-191	9·9	CP 57-603	9·6
Cl 41-223	10·1	Cl 59-172	9·9
Cl 49-200	9·9	Cl 59-1052	10·3
Cl 54-312	10·1	Cl 59-1167	10·8
Cl 54-336	11·4	Cl 59-1332	11·3
Cl 54-378	11.0	Cl 61-5	9·5
Cl 54-405	9·1	Cl 61-205	9·0
CP 56-59	12·4	CP 62-374	10·5
CP 56-63	10·1	CP 63-588	9·9

The fibre data gathered in conjunction with this investigation have been extremely helpful in our varietal development process, general breeding programme, and evaluation of varietal performance in the mill.

[12] *idem ibid.*, 7th Edn. (John Wiley and Sons, New York). 1929.
[13] *Proc.* 13*th Congr. ISSCT*, 1968, 1018–1023.
[14] ANDREIS: Unpublished data.

Sugar cane agriculture

Drain outlets and the risk of erosion. M. A. HETHERINGTON. *Cane Growers' Quarterly Bull.*, 1973, **36**, 123–124.—Where water from cane field surface drains has to be conducted for some some distance down the sides of steep banks, there is risk of soil erosion at the drain outlet. One means of preventing this, which is described, is the construction of a rock- and concrete-lined channel which should be as wide and as shallow as the drain. With a steep gradient, a concrete breaker wall can be built at the bottom of the channel.

* * *

Irrigation ensures increased productivity. C. M. MCALEESE. *Cane Growers' Quarterly Bull.*, 1973, **36**, 129–131.—Factors to be considered when irrigation is contemplated and the chief aspects of water quality requiring examination are discussed. The advantages and disadvantages of furrow and spray irrigation are examined, and results given of a trial with two Queensland cane varieties in a very dry year. These showed that for both varieties one irrigation in late September increased cane and sugar yield compared with the unirrigated control, while the benefits were further improved by an additional irrigation in late November.

* * *

Pig fencing in Mossman. L. G. W. TILLEY. *Cane Growers' Quarterly Bull.*, 1973, **36**, 132–133.—Advice is given on constructing wire fencing to prevent wild pigs entering cane fields and causing damage, which has been appreciable in some areas of northern Queensland. A subsidy is paid by the Mossman Cane Pest and Disease Control Board if the fencing conforms to its standards (this area lends itself well to wild pig breeding, particularly since on the western side it is adjacent to National Park or State Forest land, where pigs are allowed to breed unmolested). Warning is given on the corrosive properties of certain herbicides which should be applied below the fencing only if the wire has been coated with sump oil.

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Linear bug damage in the Herbert River district. O. W. D. MYATT. *Cane Growers' Quarterly Bull.*, 1973, **36**, 134–135.—The biology and feeding habits of the linear bug (*Phaenacantha australiae*), normally responsible for only minor cane damage in Queensland but the cause of widespread loss in young cane in 1972 when drought conditions favoured its build-up, are described. The large number of microscopic punctures made by the insect in the cane leaf allows entry of disease organisms; however, natural predators and good field sanitation hold the pest in check, and the use of insecticides is considered unnecessary as well as undesirable.

* * *

Flood gates. I. J. STEWART. *Cane Growers' Quarterly Bull.*, 1973, 136–137.—Brief mention is made of the types of flood gates available commercially or which can be made locally for use where reclaimed land used for cane growing is just above normal river height so that the drainage outlet may be subject to tidal effects, an abnormally high tide being particularly disadvantageous.

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Pre-fertilization—a suggestion for improving cane germinations. G. R. CULLEN. *Cane Growers' Quarterly Bull.*, 1973, **36**, 138–139.—Application of an additional fertilizer mixture high in N and K to seed cane 4–8 weeks before the plants are cut is advocated as a contribution to more rapid germination and faster establishment of a vigorous stand. A small handful of fertilizer thrown on the base of each stool is recommended, preferably during a rainy period or followed by watering on irrigated farms.

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***Lepidiota grata* grubs at Proserpine.** A. A. MATTHEWS. *Cane Growers' Quarterly Bull.*, 1973, **36**, 139.—Infestation of cane stools by this grub, sometimes associated with *L. frenchi*, is reported. The economic importance of the pest and the effectiveness of its control with BHC dust have yet to be established.

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A home-made stone picker. J. F. USHER. *Cane Growers' Quarterly Bull.*, 1973, **36**, 140–141.—Rows of specially shaped arms carried on an endless conveyor driven from a tractor p.t.o. and mounted on a wheeled frame scoop up rocks which are then carried to the top of the unit and dumped onto a fixed rake whence they roll into a collecting bin at the rear of the unit. The rocks are then emptied by means of a lever which permits the bin to swivel downwards. The depth of the rakes entering the soil is adjustable by means of two turnbuckles; for transport purposes the machine is lifted above ground level by two hydraulic rams. The designer, Mr. RIDOLFI, has applied for a patent.

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Notes on farm hygiene. C. D. JONES. *Cane Growers' Quarterly Bull.*, 1973, **36**, 142–144.—Among aspects of cane farm hygiene discussed are the need to destroy volunteer stools which can spread disease, particularly

Fiji disease and ratoon stunting. Selection of disease-free plants is considered important, as is the use of hot water treatment (often inadequately applied) and sterilization of cane knives, planter cutter blades and harvesters to prevent the spread of ratoon stunting disease.

* * *

Bulk fertilizing is sequel to bulk handling of cane. J. P. TULLY. *Producers' Rev.*, 1973, **63**, (3), 73–75. Advantages of bulk delivery of fertilizers to cane farms are discussed by a representative of a fertilizer company. Bulk handling and ground application are examined; two methods considered are use of a tractor-mounted fertilizer box of 5/8 cwt capacity filled from the farmer's bulk storage bin, and use of a 4/6 ton capacity fertilizer box mounted on a tractor-towed trailer. In both cases the containers are filled under gravity. The larger capacity container is thought preferable.

* * *

Influence of different herbicides applied in sugar cane on the nitrification of urea. J. LEIDERMAN, F. A. FOGLIATA and J. M. HINOJO. *Rev. Ind. Agríc. Tucumán*, 1973, **49**, (2), 17–21.—Application of herbicides (TCA, 2,4-D, PCP, "Dalapon", "Ametryne", "Simazine" and "Atrazine") with urea to sugar cane did not produce antagonistic effects. After 50 days only the 2,4-D had reduced the speed of ammonification, while PCP reduced nitrate production by 19·6% after 70 days.

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Arsenic content in juice and bagasse from sugar cane treated with organic arsenical compounds. R. P. COSSIO. *Rev. Ind. Agríc. Tucumán*, 1973, **49**, (2), 51–57. Analysis of arsenic in cane juice and bagasse showed that the levels increased immediately after the cane had been treated with arsenical herbicides. The level reduced with time, reaching normal 5 months after the last treatment; thus there should be a period of at least 5 months between such treatment and harvesting of the cane.

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Situation of leafhoppers and borers in the cane fields of the State of Santa Catarina and discovery of a new cane pest. P. GUAGLIUMI. *Brasil Açuc.*, 1973, **81**, 182–185.—An inspection was carried out in November 1972 in representative areas of the state and observations compared with the previous inspection in March 1970. Levels of infestation were no worse owing to control measures adopted and the presence of entomogenous fungi and predators. A new borer, *Castnia* sp., was observed and is to be studied further, while cane was found to be an alternative host for a pasture leafhopper, *Deois flexuosa*.

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Sugar cane in the valley of the River Cauca, Colombia. A. TORRELLAS G. and A. BEJARANO. *Azúcar y Productividad*, 1973, **3**, (1), 10–16.—The area devoted to cane in the Cauca Valley is 98,000 ha, yielding 7,400,000 tons of cane, most of this being processed to sulphitation white sugar. The cane is 90% POJ 2878 although other varieties are being tested. Cane cultivation in the area is described and illustrated from the manual planting of setts to irrigation, application of herbicides and fertilizers, manual harvesting and topping, and transport to the mills.

* * *

Increase sugar recovery by maturity-wise harvesting of sugar cane. A. P. GUPTA. *Proc. Seminar Sugar Tech. Assoc. India*, 1970, 5–20.—See GUPTA & SHUKLA: *I.S.J.*, 1971, **73**, 273.

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Increase in recovery due to proper harvesting schedule of sugar cane. P. ARAVAMUDHAN. *Proc. Seminar Sugar Tech. Assoc. India*, 1970, 21–25.—Among measures advocated in order to increase cane sugar yield are: payment on a quality basis; harvesting only mature cane; efficient varietal selection; rational fertilizer application; elimination of suckers, dry and dead cane from the cane supplied to the factory; and minimizing losses by reducing the harvesting-process interval, pre-harvest spraying with ripeners and chemicals to check deterioration with rising temperatures, and post-harvest spraying with water to prevent moisture loss.

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Difficulties experienced in Brix survey maturity scheme. K. D. PURI. *Proc. Seminar Sugar Tech. Assoc. India*, 1970, 27–28.—A scheme in which the Brix of cane on some 14,000 acres was determined before harvesting and at the factory after harvesting as an approach to the problem of cane immaturity proved unsuccessful for a number of reasons which are discussed.

* * *

Harvesting programme based on the maturity of sugar cane crop. K. S. THIRUMALAISAMY. *Proc. Seminar Sugar Tech. Assoc. India*, 1970, 29–38.—The advantages of harvesting on the basis of cane maturity are discussed and results from the harvesting programme conducted by the author's sugar factory are cited, showing a variation in Brix from 11° to 21° in cane of the same age.

* * *

A note on the pre-harvest maturity service. S. C. GUPTA. *Proc. Seminar Sugar Tech. Assoc. India*, 1970, 48–51.—The scheme developed at the National Sugar Institute, Kanpur, and which is available at cost to all sugar factories to assist in determining cane maturity and drawing up harvesting schedules based on this, is described and some guidance given on how to conduct a survey.

* * *

Trend of lower sugar recovery in different states of India. A. P. GUPTA. *Proc. Seminar Sugar Tech. Assoc. India*, 1971, 5–20.—The sugar recoveries in Punjab, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andhra Pradesh, Mysore, Tamil Nadu and Gujarat for the period 1961–1971 and for Haryana for 1966–1971 are discussed and details of these as well as cane areas, yields/ha, amount crushed, number of factories in operation, average length of season, losses, cane fibre and molasses yield are tabulated, showing a general fall in recovery. Reasons for the poor performances are suggested under cane varieties, irrigation, fertilization, harvesting and factory equipment, which is considered to be old and uneconomical to run, since it consumes excessive quantities of fuel.

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Is Co 740 really deteriorating ?] G. K. ZENDE. *Proc. Seminar Sugar Tech. Assoc. India*, 1971, 21–39.—See *I.S.J.*, 1973, **75**, 342.

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Decline in sugar recoveries in Maharashtra. D. P. KULKARNI. *Proc. Seminar Sugar Tech. Assoc. India*, 1971, 41–46.—Reasons for the fall in cane sugar recoveries in Maharashtra since 1964 are discussed and measures considered necessary to remedy the situation are listed.

* * *

Problems of low recovery in North Bihar. S. C. SHARMA. *Proc. Seminar Sugar Tech. Assoc. India*, 1971, 47–59.—Reasons for the decline in recovery in the 24 factories in North Bihar (out of a total of 29 for Bihar, which at one time produced half of the total sugar manufactured in India) are discussed and remedial measures suggested.

* * *

The never-ending quest for a new and better variety. L. M. ARCEO. *Sugarland* (Philippines), 1973, **10,** (1), 6–18.—The various activities involved in cane breeding work at Victorias Milling Co., which started its programme in 1967, are described by means of a number of photographs.

* * *

Cane harvester field trials in Florida. ANON. *Sugar J.*, 1973, **35,** (11), 8–9.—Details are given of the cane harvesters demonstrated during the 7th Annual Sugarcane Harvesting Field Demonstrations held on 7–8th March 1973 and of other equipment shown.

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The sugar industry in Mauritius. V. GURUSWAMY. *Sugar News* (India), 1973, **4,** (10), 4–12.—A survey is presented of cane agriculture and processing in Mauritius.

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Rôle of phosphorus in sugar cane production. M. V. DAHIPHALE. *Sugar News* (India), 1973, **4,** (10), 13–18. The importance of phosphorus for cane growth and the forms of phosphatic fertilizers available are discussed as well as time and method of application. Results obtained in phosphorus trials with cane and recommended quantities of N, P and K in Maharashtra are indicated.

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Ratoon treatment tests with "Temik" show encouraging growth rate response. J. WILSON. *S. African Sugar J.*, 1973, **57,** 194.—Best growth response in ratoon cane to nematicide applications was obtained with "Di-Tropex", followed by a combination of "Temik" and EDB, "Temik", EDB and a soil-plus-foliar application of DPX 1410. Although 28 kg of "Temik" per ha gave as good results as did 56 kg/ha, the smaller quantity did not have any residual effect. DPX 1410 applied only as a foliar feed gave moderate results and may be applied satisfactorily to growing ratoons.

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The Agricultural Experiment and Research Station of Victorias Milling Company Inc. H. A. NAQVI. *Sugar y Azúcar*, 1973, **68,** (3), 16–18.—A survey is presented of recent research conducted at VMC in the Philippines.

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The rôle of Co 997 sugar cane variety in the economy of the sugar industry in India's Thandava factory zone. P. V. V. G. KRISHNAMURTY. *Sugar y Azúcar*, 1973, **68,** (3), 20–22.—Details of rainfall, factory recovery and varietal yield in this area of Andhra Pradesh are tabulated for 1969/70 when a recovery of 10·29% was achieved. The results are attributed to the increased growing of Co 997 cane, first introduced in 1966/67 and constituting 72% of all cane in 1969/70.

* * *

Ratoon cultivation treatments. F. BRIEGER. *Brasil Açuc.*, 1973, **81,** 295–298.—In contrast to the prepared soil available for planting of setts in a first crop, the soil for a ratoon crop is compacted. Thus it is necessary to use cultivation practices to ensure proper growth of the cane, i.e. breaking up the inter-row with small subsoilers and discs and burying the residues from the previous crop, and application of chemical and organic fertilizer and herbicides, followed by normal control treatments for pests, etc. Practices adopted at Usina Santa Lydia, São Paulo, are tabulated.

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Artificial breeding in the laboratory of parasites of the sugar cane borer *Diatraea* spp. A. F. MENDONÇA. *Brasil Açuc.*, 1973, **81,** 299–312.—Details are given of the laboratory rearing of the larvae of the borer *D. saccharalis* and their use for breeding of parasites (*Lixophaga diatraeae*, *Metagonistylum minense* and *Paratheresia claripalpis*).

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Correct soil sampling. PHILIPPINE SUGAR INSTITUTE. *Sugarland* (Philippines), 1973, **10,** (2), 21, 26.—Advice is given on the correct procedure to adopt in soil sampling on cane plantations.

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Save some of your CAC 57-11. L. M. ARCEO. *Sugarland* (Philippines), 1973, **10,** (2), 22–23.—While CAC 57-11 cane variety is trashy, susceptible to drought and smut and has short and slender stalks, so that growers on Negros are eliminating it from their fields, the author emphasizes the high sugar yield of the cane, which at 10–11 months has the highest sugar yield:tons cane ratio of all varieties grown in the Philippines. The variety is briefly described and some Brix and yield values compared with those of other varieties.

Sugar beet agriculture

Evaluation of herbicides for weed control in sugar beets in Manitoba. M. KLASSEN and G. GUCCIONE. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 552–560. Results are given of tests involving pre- and post-emergence herbicides applied to weeds in beet fields. The effects on Barnyard grass, green foxtail (*Setaria viridis*), redroot pigweed (*Amaranthus retroflexus*), lambsquarters and a number of broadleafed weeds including ladysthumb (*Polygonum pensylvanicum*) and wild buckwheat (*Polygonum convolvolus*) of TCA, "Herbicide 273", C 15935, BAS 3502, "Delachlor", "Phenmedipham" and "Dalapon" are recorded in tables, and yields obtained in treated plots are compared with those in hand-weeded plots.

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Hot water treatment for elimination of seed-borne *Phoma betae* and other microbial contaminants from sugar beet seed. L. J. HERR. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 568–574.—Experiments are reported in which seeds of a number of varieties were tied in cheesecloth bags and immersed for 15 minutes in water heated to 60°C, dried overnight at 28°C, again treated with hot water, and finally surface-sterilized in a 1:4 dilution of 5·25% sodium hypochlorite. While the treatment controlled both *Phoma betae* (a black root pathogen) and other microbial contaminants, not all the beet varieties tested were heat-tolerant to the same extent, and for these a shorter treatment time of 8 minutes was tried. However, since the commercial seeds involved were not infested with *P. betae*, only the "other" contaminants had to be controlled and 8 minutes was adequate for this. No correlation was established between seed weight and heat tolerance. The effect of treatment on germination varied in the heat-tolerant varieties, but the percentage of seed germinating was generally high.

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Powered auger aids in planting mother beets. R. C. ZIELKE and G. J. HOGABOAM. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 605–606.—The use of a 3-hp, engine-powered auger to replace a spade or shovel in the digging of holes in small seed plots for the transplanting of mother beets used for seed production is described.

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Hand-weeding: when it can be avoided. D. M. JONES. *British Sugar Beet Rev.*, 1973, **41**, 29–32.—The importance of post-emergence weed control in beet fields is emphasized and the advantages of herbicide application by band spraying are discussed. Recommendations regarding the various herbicides and their costs per acre relative to row width are given.

Functions of soil moisture in the seedbed. W. G. ANNAL. *British Sugar Beet Rev.*, 1973, **41**, 35–37. Advice is given on optimum seedbed preparation to ensure an adequate moisture content for maximum germination and beet plant growth and to provide for contact between the developing seedling and the moisture.

* * *

Initial experiments with NC 8438 applied in sugar beet cultivation. J. M. BELIEN, A. NOLF, L. DETROUX, J. F. SALEMBIER and M. GOMAND. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1972, 125–147.—Application of NC 8438 ("Nortran"—2-ethoxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methane sulphonate) a product of Fisons Ltd., as a pre- and post-emergence herbicide to beet was tested on its own and combined with other herbicides. At the various doses applied, NC 8438 was not effective in controlling dicotyledonous (broad-leaved) weeds, *Matricaria chamomilla*, *Lamium purpureum*, *L. amplexicaule*, *Capsella buras pastoris* and *Chenopodium album* proving particularly resistant. On the other hand, highly satisfactory results were obtained with all the combinations, with one exception, applied before and after emergence, while the grasses, particularly *Alopecurus myosuroides*, were easily controlled by the combinations. Best results as regards weed control and beet and sugar yields were obtained with 1·5 kg NC 8438 + 3·2 kg "Pyrazon" per ha as pre-emergence herbicides, and 1·5 kg NC 8438 + 1·2 kg "Phenmedipham" per ha, the NC 8438 being applied either as a pre- or as a post-emergence herbicide and the "Phenmedipham" as a post-emergence herbicide. Pre-emergence application followed by soil incorporation gave good results with 2·88 kg "Cycloate" and 2 kg NC 8438 per ha. While the NC 8438 caused serious leaf injury, this phytotoxicity had no effect on final yield.

* * *

Sugar beet cultivation in Daurala Zone during 1969/70 and 1970/71. A. K. GARG. *Proc. 38th Ann. Conv. Sugar Tech. Assoc. India*, 1972, 71–76.—An account is given of trials over two seasons in which sugar beet of various origins was successfully grown and processed to sugar.

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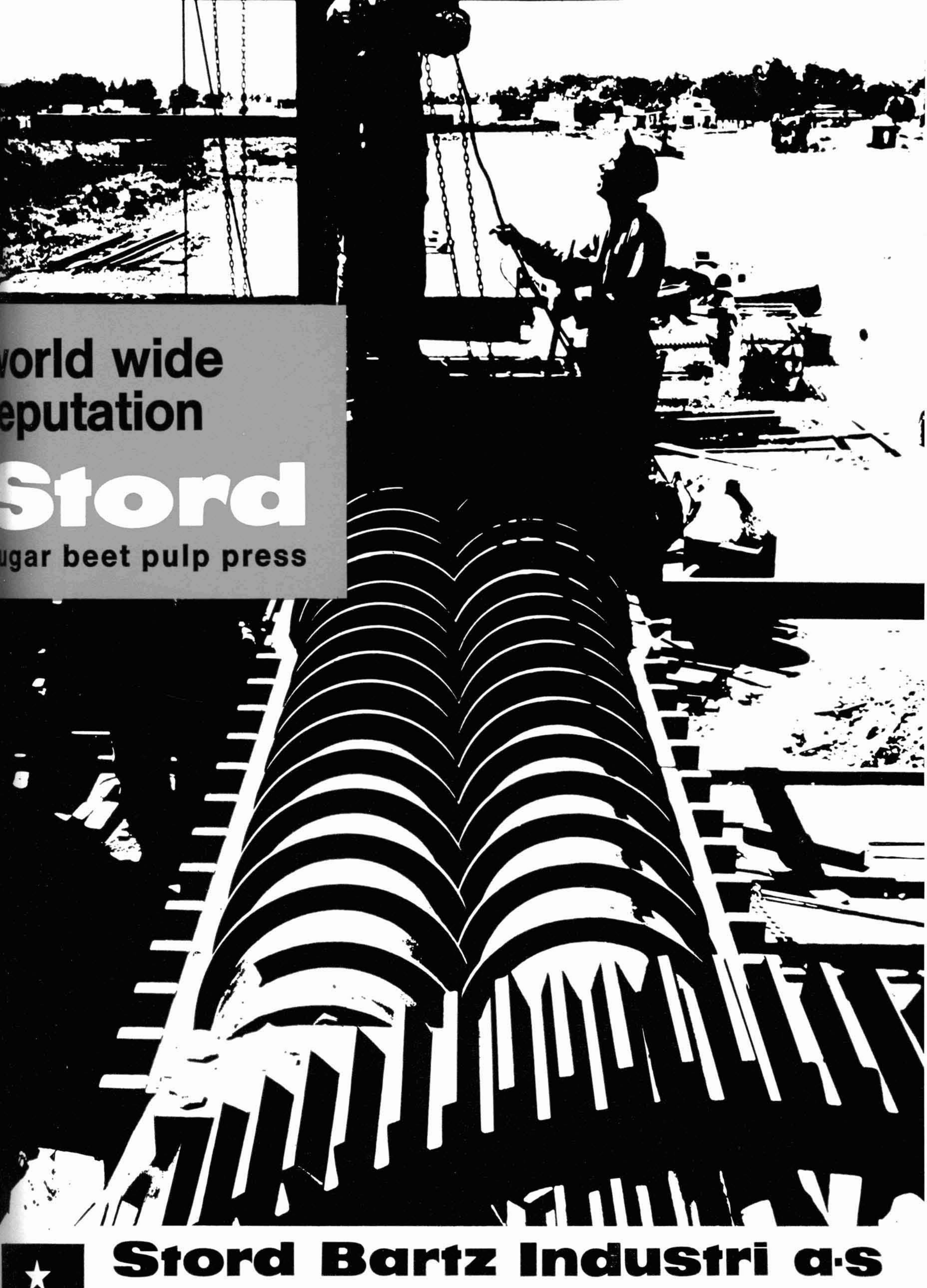
Yield, sugar content and α-amino-nitrogen in sugar beet as reflected in four-year test results. H. BRONNER. *Zeitsch. Zuckerind.*, 1973, **98**, 183–187.—In tests in West Germany during 1967–1970 it was found that N fertilizer and soil exchangeable ammonium as well as K and carbonate contents increased yield. K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fixation also had an increasing effect on yield while organic matter had a decreasing effect, both findings being against expectation. N, exchangeable ammonium, K (determined by the CAL method) and P_2O_5 (determined by the method of TRUOG) caused the sugar content to fall, while P_2O_5 and K determined by the DL method caused it to increase. N and K fertilizer increased the α-amino-N content.

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Planning for increased sugar production in Iran. J. FRIEVALDS. *Sugar y Azúcar*, 1973, **68,** (2), 20–24. Details are given of the Government projects for increasing beet and cane sugar production in Iran with the aim of achieving self-sufficiency by 1975, i.e. 600,000 metric tons of sugar to be produced from beet and 100,000 metric tons from cane. Mechanization on 120,000 ha of beet fields is planned by 1978. A number of aspects of the Iranian sugar industry, beet and cane agriculture, by-products utilization and finance are discussed.

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The distinction between *Aphanomyces laevis* **and** *Aphanomyces cochlioides*. W. R. SCHÄUFELE and U. BEISS. *Zucker*, 1973, **26,** 246–250.—From examination of the mycelium, zoospore and oospore formation and reactions to antibiotics of cultures grown on various media, clear distinctions have been drawn between *Aphanomyces euteiches* (not harmful to beet roots), *A. laevis* and *A. cochlioides*, the last two having been probably incorrectly identified in the bulk of European literature on the subject of beet root rot. Pathogenicity tests indicated that while *A. laevis* caused slight discoloration of the root, *A. cochlioides* caused complete browning within a few days and led to decomposition of the complete root tissue.

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Sugar beet cultivation in England today. A. MITCHELL. *Zucker*, 1973, **26,** 251–254.—Latest developments in beet mechanization in the UK are described, with mention of cultivators, rotary hoes, drills, harvesters, band sprayers for herbicides, etc.

* * *

A serious outbreak of strains of *Cercospora beticola* **resistant to benzimidazole fungicides in northern Greece.** S. G. GEORGOPOULOS and C. DOVAS. *Plant Disease Reporter*, 1973, **57,** 321–324.—Failure of "Benomyl" and other benzimidazole and thiophanate derivatives to control *Cercospora* leaf spot in beet growing on about 25,000 acres in northern Greece is reported. Foliage destruction in experimental treated plots was similar to that in untreated plots. Tin compounds continued to give satisfactory control in experimental plots under identical conditions. The problem is attributed to a resistant fungal strain, since "Benomyl" has given excellent results in previous years.

* * *

Density trials with genetically monogerm types of sugar beet on the Bologna plain. C. ANTONIANI. *Ind. Sacc. Ital.*, 1973, **66,** 7–11.—Densities of 7, 12, 17 and 22 plants per m^2 were tested, using three types of monogerm sugar beets. No diminutions of yield, root weight or sugar content with increasing densities were observed; on the contrary, with one type of beet there was an increase, and the qualitative characteristics showed an improvement. At the highest initial plant densities there is a reduced number of beets per m^2 at harvest. The plant densities studied are related to determining the maximum which will not cause inconveniences since high-density sowing is considered a possible method of reducing the risks involved in precision drilling.

* * *

Observations on beet rhizomania. G. C. BONGIOVANNI. *Ind. Sacc. Ital.*, 1973, **66,** 11–16.—The literature on the geographical distribution, aetiology, symptoms and damage, and control of rhizomania in sugar beet are reviewed (with 52 references) and the danger to sugar beet in Italy assessed. A table shows the results of treatment with a number of fumigants, and a number of aspects suitable for further study are summarized.

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Weed control in sugar beets. ANON. *Sugar J.*, 1973, **35,** (11), 17–19.—The herbicides used to control grasses in Californian beet fields, the treatments used and results obtained are discussed generally.

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Prospects of a sugar beet crop in Punjab. R. S. KANWAR. *Sugar News* (India), 1973, **4,** (10), 19.—A brief discussion of the prospects for beet growing in the Punjab is presented on the basis of results obtained at Jullundur.

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The wind also kills. ANON. *Sugar Beet J.*, 1973, **36,** (3), 2–3.—Photographs are presented to show the damage caused to beet by prolonged strong winds where no protection is provided. An illustration showing a field of beet protected by strips of rye is reproduced as a contrast.

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The mechanics of chemical weed control. R. A. FOGG. *Sugar Beet J.*, 1973, **36,** (3), 4–6.—The equipment for use in herbicide application is briefly described, including tanks with or without agitators, pumps, screens (to prevent clogging of nozzles and protect the pump and pressure regulator), pressure regulators and gauges, and nozzles. Adjustment of the sprayer for even distribution and of nozzle height for a given band width is discussed, as is the nozzle wear resulting from the use of wetting agents—the life of a nozzle is governed by the type of material used in its construction.

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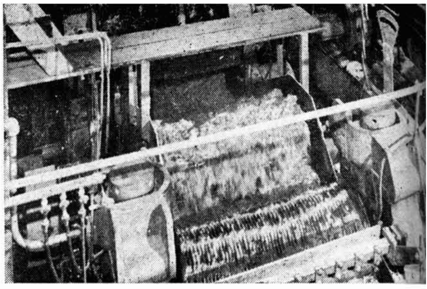
Results of comparative tests on sugar beet varieites in Belgium from 1970 to 1972. N. ROUSSEL, R. VANSTALLEN and W. ROELANTS. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1973, (1), 1–51.—Detailed results are given of three randomized block trials involving 39 beet varieties (20 of them monogerm) grown at three localities in Belgium.

Cane sugar manufacture



Some effects of trash in cane on milling results. G. ARCENEAUX and L. G. DAVIDSON. *Sugar J.*, 1973, **35**, (10), 33–41.—See *I.S.J.*, 1945, **47**, 136–137.

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Cooling of low-grade massecuites in crystallizers containing modified elements. L. L. NIELSEN and E. K. PERSAUD. *Paper presented at* 1973 *Meeting W. Indies Sugar Tech.*, 12 pp.—Details are given of tests on low-grade massecuite cooling in a crystallizer modified so that the cooling water flowed longitudinally and latitudinally throughout the trough. The performance was compared with that of the original straight-tube crystallizer and showed that better results could be expected from the modified design. One advantage would be the cooling of hottest massecuite with hot water and the use of low-temperature heating media, with less danger of crystal re-solution, where the elements were used in massecuite re-heaters.

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Training of sugar factory technologists and technicians in Jamaica. I. SANGSTER. *Paper presented at* 1973 *Meeting W. Indies Sugar Tech.*, 20 pp.—Information is given on measures taken in Jamaica to train technical staff for the sugar industry in view of a general shortage of such personnel.

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Quality control in the sugar industry in Taiwan. C. C. CHEN. *Taiwan Sugar*, 1973, **20**, 6–8.—The system of statistical quality control used by the Taiwan Sugar Corporation from 1957 is discussed and the total quality control system which has gradually replaced it is described; while the earlier system controlled only the process, the total system extends from the design stage through production to customer service. Specific areas of control, including that of the cane as well as factory processing, are cited as examples.

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Compendia for quality control circle programme. T. Y. CHENG, Y. C. YEN and H. W. TSAI. *Taiwan Sugar*, 1973, **20**, 9–17.—Activities, objectives and organization of a quality control circle programme (described as management participation of a small group or circle, organized voluntarily or under management supervision, consisting of employees whose job characteristics and targets are the same or whose jobs are interrelated) are set out in some detail. The value of the system in solving process problems, improving methods and helping reduce production costs, as in the Taiwan Sugar Corporation, is underlined.

Sugar cane quality control and sugar yield. M. C. TSAI. *Taiwan Sugar*, 1973, **20**, 18–20.—The use of quality control in reducing cane trash content, controlling cane maturity and reducing cane staleness at Nanchow sugar factory is described.

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The Hsin-T'ang quality control circle activity report. H. M. KAO and M. S. TSAI. *Taiwan Sugar*, 1973, **20**, 21–27.—The 2nd milling tandem oil consumption was found to be more than half of the overall consumption for the whole of this Taiwan sugar factory. The problem was narrowed down to an excessive bearing oil temperature (averaging 74°C) at the shredder, which resulted in a high bearing failure rate. Details are given of the modifications introduced which brought the bearing temperature down to below 65°C and increased oil life while maintaining its quality.

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The practice of TQC from SQC and some illustrations of its accomplishments in Huwei. T. S. CHIN. *Taiwan Sugar*, 1973, **20**, 28–32.—Examples of total quality control at Huwei sugar factory are described, covering cane planting costs, cane maturity, trash content and freshness, sugar weighing and bagging, and examination of the effect of milk-of-lime addition to clarifier mud on filtration (found to reduce filter cake pol as well as increasing the filter cake formed provided the mud pH was held at 8).

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Simulation of bagasse pre-drying in dryer-steam generator systems. F. GROBART and Y. A. TERENTIEV. *Sobre los derivados de la caña de azúcar*, 1972, **6**, 27–34.—Mathematical models have been developed for closed-circuit steam generator/dryer systems in which the bagasse is pre-dried with exhaust gases and with air pre-heated by the exhaust gases. The models have been applied to a water-tube steam generator as an aid to determine possible fuel economy and design data.

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Manufacture of sugar without molasses. A. BARRETO. *Brasil Açuc.*, 1973, **81**, 186–188.—The process, which has been tried on a small scale at Usina Santa Adelaide in São Paulo, involves the treatment of mixed cane juice with an enzymatic inhibitor, "Melox-san", and fermentation of the reducing sugars with yeast to produce alcohol. The juice is contrifuged to recover the yeast, the alcohol recovered by distillation, and the resultant juice purified by liming, sulphitation, heating, settling, filtration, evaporation and crystallization. The absence of reducing sugars permits crystallization of almost all the sucrose present; the small amount of mother-liquor remaining after centrifugalling is returned to the fermentation stage.

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Mills and milling. II. C. BAYMA. *Brasil Açuc.*, 1973, **81** 200–207.—Aspects of milling which are reviewed include hydraulic pressures and imbibition, with calculations of absolute juice extraction with and without imbibition.

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New cane washing method. C. J. DAIGLE. *Sugar J.*, 1973, **35**, (11), 21–22.—A cane feeder table comprising two sections and on which the cane is washed before being fed to the cane carrier at Lula factory, Louisiana, is described. The first section is a 35-ft chain conveyor having an angle of slope of 18° and travelling at 21 or 10·5 $ft.min^{-1}$; the cane falls from this onto the second section, which is about 26 ft long and is set at an angle of 45°, the chains travelling at 94 $ft.min^{-1}$. The two conveyors can be driven independently of each other or as one unit. Wash water is fed to the cane at the top of the second conveyor at the rate of 3,000–7,000 $gal.min^{-1}$. Each conveyor has a solid bottom beneath the chains, so that the wash water in the second section has to travel the full length of the conveyor. The angle of 45° ensures that the cane mat is kept to 12–18 inches thick. Advantages of the system are briefly discussed.

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Reducing evaporator scaling. J. DORNIER. *Sugar J.*, 1973, **35**, (11), 23–24.—Some information is given on an experimental unit operated as a 2nd and a 4th evaporator effect at a Louisiana sugar factory with the aim of reducing scaling. It comprises a horizontal shell-and-tube heat exchanger to which juice is fed by a centrifugal pump. The heated juice flows to a flash tank in which it passes down the throat of an inverted conical collector and is either recycled to the heat exchanger or is discharged from the unit. Apparent overall heat transfer coefficients and evaporation rates ranged from 600 to over 1600 $B.Th.U.ft^{-2}.{}^{\circ}F^{-1}.hr^{-1}$ and from 8 to 14 $lb.hr^{-1}.ft^{-2}$, respectively, for 2nd effect conditions, while for 4th effect conditions the corresponding values were 320–380 $B.Th.U.ft^{-2}.{}^{\circ}F^{-1}.hr^{-1}$ and 10–18 $lb.hr^{-1}.ft^{-2}$. No boiling out was necessary during 800 hours' operation as a 2nd effect and during 300 hours as a 4th effect. However, although the capacity as a 4th effect was greater than that of a conventional unit, as a 2nd effect it was the same. Difficulties were experienced in condensate removal.

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Entrainment and performance levels of a pan with an internal condenser. R. E. LIONNET. *S. African Sugar J.*, 1973, **57**, 183–190.—Details are given of tests at Amatikulu factory with a pan having an internal condenser and built by Delville Engineering (Pty.) Ltd., a member of the Hulett Group. The experiments covered both *A*-massecuite boiling and syrup boiling to simulate evaporator working, the unit being used as No. 2 pan and having a heating surface of 516 m^2 and a massecuite capacity of 85 m^3. Condenser performance was evaluated on the basis of the approach temperature (vapour saturation temperature —temperature of tail-pipe water) which averaged 4°C over six tests compared with 18°C for external condensers tested under identical conditions. Other advantages of the internal condenser pan were found to be good circulation throughout the boiling process and appreciable savings in condenser water requirements. Entrainment was 250 ppm sugar in vapour in massecuite boiling and 280 ppm in syrup boiling.

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Mills and milling. III. C. BAYMA. *Brasil Açuc.*, 1973, **81**, 61–66.—Aspects of milling which are discussed include capacity and efficiency, and steam consumption and power required.

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Advances in the automation of boiling processes in the sugar industry. A. JOSEPH. *S. African Sugar J.*, 1973, **57**, 234–240.—For control of massecuite boiling where, for various reasons, conductivity cannot be used as basis, the Siemens viscosity/consistency meter is of advantage[1]. The fundamentals of this system and the suitability of viscosity as a measure of supersaturation are explained.

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Report back meeting on visit to Dominican Republic. ANON. *S. African Sugar J.*, 1973, **57**, 251–257.—A survey of the Dominican Republic sugar industry, as compiled by representatives of South Africa who visited that country, is presented, with brief reference to factory practices and results as well as alcohol and rum production from molasses and furfural manufacture from bagasse.

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Determination of the efficiency of centrifugals on a basis of the polarographic determination of the chloride ion in the products. J. BURIÁNEK and S. MORALES. *CubaAzúcar*, 1973, (Jan./March), 15–22.—The efficiency of a centrifugal may be evaluated on a basis of the quality and yield of the separated crystals, and a method developed for comparison of different machines is to treat a quantity of massecuite having a known (added) chloride content and measuring the chloride content of the sugar obtained. Equations for the calculations are presented with two examples of application of the method.

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Generalized corrosion on the steam side of copper evaporator tubes. H. SHIMBOR, J. A. DOMÍNGUEZ and S. MÜLLER. *CubaAzúcar*, 1973, (Jan./March), 23–26. The corrosion of copper evaporator tubes as a consequence of ammonia in the vapour is discussed with reference to studies on the mechanism of such corrosion in the beet sugar industry. In view of the need to use nitrogenous fertilizer, it is considered inevitable that there will be N compounds in cane juice which can give rise to ammonia, and various methods of overcoming the problem are suggested, while a call is made to research bodies in Cuba to study the question.

[1] *See* BOHM: *I.S.J.*, 1974, **76**, 26.

Integral study of cane chains. G. FERNÁNDEZ L., A. EXPÓSITO C., J. F. DE LA ROSA L. and M. GONZÁLEZ B. *CubaAzúcar*, 1973, (Jan./March), 27–34.—Studies are reported on the breakage characteristics of chains of different materials and design, and experiments to determine the breaking resistance of links with punched and bored holes show the latter to be stronger. Plastic models with photoelastic properties were used to determine the best design of sideplate.

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Combined production of heat and electrical energy in sugar factories. J. M. DEL PORTILLO V., C. TOMÉ P. and A. PÉREZ C. *CubaAzúcar*, 1973, (Jan./March), 35–48.—Analyses are reported of systems for combined operation of a sugar factory with an auxiliary bagasse pulp and paper plant for generation of surplus electricity. It is noted that electric interconnexion costs may be decisive and that creation of an agricultural-industrial complex, including electrification of cane irrigation, may influence costs favourably.

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Production of raw sugar from sorghum juices. B. A. SMITH, R. V. ROMO, R. C. SMITH, R. A. DE LA CRUZ and B. J. LIME. *Sugar J.*, 1973, **35**, (12), 22–27.—Pilot-plant tests involving crushing of the sorghum, clarification of the raw juice, concentration to 35°Bx "semi-syrups", liming to remove aconitic acid (a major constituent of sorghum juice) boiling and centrifugalling gave an *A*-sugar of 98·94 pol containing 0·38% carbonate ash, 0·003% starch and 0·04% aconitic acid (on dry solids). The sugar also contained more KCl but less CaO, MgO and SO_4 than most cane raws, while in other respects it did not differ markedly from commercial cane raw sugars.

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Staff training. G. R. NIELSON. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 11–15. Training of sugar factory personnel for Australian factories is discussed, particularly requirements, objectives and types of training programmes. The system used at Inkerman is described as an example.

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Computer control of a high-grade pan. R. J. BATTERHAM, J. A. FREW and P. G. WRIGHT. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 71–80. After listing the constraints imposed on pan boiling and the factors that must be taken into account in automatic boiling control, the authors list measurable variables and give details of methods for measuring supersaturation, crystal content and purity. Use of a digital computer which collected analogue outputs from the different instruments and fed back digital outputs for a crystal content meter as well as analogue outputs is described. Of the techniques tested, the most satisfactory with a high-grade pan at Mackay was that incorporating a pan refractometer, level and temperature measurements and a newly designed crystal content meter which measures the crystal volume ratio by compressing a sample of massecuite in a porous cylinder until a compacted bed of crystals is formed, the volume of which is measured by a position transducer. Accuracy of the system was adequate and the method simple. The crystal content meter was not suitable for use with a method involving measuring crystal mass ratio, which however is closely related to the volume ratio.

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Direct digital control of evaporators. A. A. MOONEY, G. E. MITCHELL and D. B. BATSTONE. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 87–95.—A description is given of a direct digital control system (one in which the computer is linked directly to measuring instruments, control devices, valves and motors analogously to the controller in a conventional control loop) applied to a quintuple-effect evaporator. Generally, only three switches were needed for adequate level control, while four switches at the final effect controlled the level to within ± 50 mm of the set-point for practically the whole of the time. Brix was maintained within + 1·5° of set point for 64% of the time or within ± 4° for 97% of the time. The advantages of automatic control are combined with those of low cost of instruments, converters and actuators. The juice flow control valve actuators are low-speed (120 sec from open to close) and a slow scan of 20 sec has been adopted to match the slow response of plant and valves. These factors have helped reduce the requirements of computer data processing, storage and input/output facilities.

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The rheology of primary mud. K. J. NIX. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 121–131.—The rheological properties of primary mud (from clarifiers) have been experimentally determined under very limited conditions for use in calculating pipeline and pump parameters. Primary mud is shown to belong to the Bingham plastic fluids which cannot flow until a stress or pressure is applied which overcomes the natural rigidity of the fluid and causes its deformation, after which the fluid becomes a Newtonian fluid.

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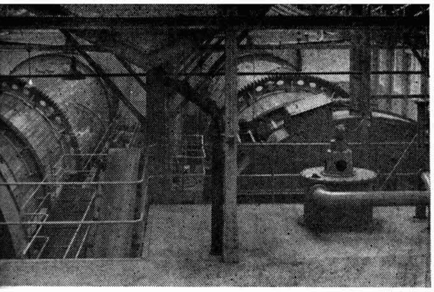
Recycling—or reclamation? D. BEVAN. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 133–139.—The reclamation of spillage material, e.g. mill juice to the mills and heavy liquors to remelt tanks, as carried out at a number of Queensland sugar factories, is discussed. While bacterial counts in such material have been surprisingly low, so too is purity which would result in increased molasses were it not that the quantities involved are low in proportion to the normal factory material. However, rapid recycling is necessary because of this. Composition, e.g. dextran in juice, also has to be considered, but again volumes are low. Results achieved in reducing effluent are discussed and the possibility of reducing losses, particularly entrainment losses to avoid pollution of cooling water, examined. Types of drains for reclamation schemes and methods of operating the systems are described.



Beet sugar manufacture

Polar beet silos at a Dutch sugar factory. H. KÜHNL and R. ERMISCH. *Zeitsch. Zuckerind.*, 1973, **98**, 280–282.—Details and illustrations are given of a polar beet silo having a capacity of 22,000 tons and ancillary equipment (conveyors, unloading platforms, etc.) supplied by FMW Förderanlagen und Maschinenbau GmbH to a Dutch beet sugar factory.

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The effect of beet processing and juice purification rhythm on juice purity. B. SOLTYSIAK. *Gaz. Cukr.*, 1973, **81**, 58–63.—Investigations were conducted at the author's sugar factory because of a number of processing difficulties. Studies were made of the effects of beet quality on raw juice quality, of press-water quality on thick juice quality, white sugar colour and yield and molasses yield, of raw juice invert content on lime salts, of liming temperature on invert content in thick juice, white sugar colour, pH in carbonatation, invert content in sugar house products, etc. Among the findings, which are given in table and graph form, was a maximum diffusion efficiency at a cossette load 110% of the nominal (for a DDS-type diffuser) while a load below 90% had an adverse effect on diffusion, carbonatation and sugar house processing.

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Effect of sucrose content of the milk-of-lime on efficiency of beet juice purification. J. VAŠÁTKO and A. DANDÁR. *Sugar J.*, 1973, **35**, (11), 10–13.—See *I.S.J.*, 1972, **74**, 117.

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Beet washing and the new washing station at Quévy. A. BAUSIER. *Sucr. Belge*, 1973, **92**, 185–192.—Details are given of the RT beet washer[1] at Quévy sugar factory, where the dirt content in 1972 was reduced to 0·06–0·17% from an initial 12–27% at an hourly throughput of 105–125 metric tons of beet and an hourly water consumption of 192 m^3. Sugar losses are calculated at 0·0062% on beet.

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Water conservation in the beet sugar industry. J. N. SMITH. *Chem. and Ind.*, 1973, 546–548.—The beet sugar manufacturing process is described and the treatment and recycling of various waste waters explained to show how, in the British Sugar Corporation, a reduction from 1200 to 30 tons of total effluent per 100 tons of beet has been effected. Press water, flume water and condenser water are all recycled, while the use of continuous vacuum filters and advances in pump design have enabled carbonatation mud to be pumped to sludge ponds without the need for dilution with water.

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Determination of the optimum parameters of sugar extraction using aluminium sulphate. A. A. LIPETS and I. A. OLEINIK. *Izv. Vuzov, Pishch. Tekh.*, 1973, (2), 140–141.—The use of aluminium sulphate as an aid in beet diffusion is discussed as are laboratory procedures for determining raw juice colloid content and for establishing the optimum amount of aluminium sulphate to add as a function of colloid and sugars contents, Brix and purity. Optimum diffusion pH, at which aluminium hydroxide solubility is minimum, was found to be 6. Increase in the quantity of aluminium sulphate from 0·015% to 0·10% on weight of beet led to increase in juice purity from 88·21 to 91·40 and reduction in colloid content from 3·9% to 2·2% by volume, while without aluminium sulphate the purity was 87·23 and the colloid content 4%.

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Measurement of heat losses in evaporators. S. ZAGRODZKI and A. SOKOLOWSKI. *Gaz. Cukr.*, 1973, **81**, 81–85.—Measurements showed that heat losses from the vapour space of a 2nd evaporator effect were reduced from 2·99 $kcal.m^{-2}.hr^{-1}.°C^{-1}$ (equivalent to 0·15%) to 1·79 $kcal.m^{-2}.hr^{-1}.°C^{-1}$ (0·09%) when a 60–70 mm insulation layer was applied to the wall.

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Technical progress in the Belgian sugar industry. S. NIKIEL. *Gaz. Cukr.*, 1973, **81**, 85–92.—A survey is presented of latest developments in equipment and processes within the Belgian sugar industry.

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Losses in raw material during harvesting and transfer of beet. I. E. BAKOWSKA. *Gaz. Cukr.*, 1973, **81**, 101–105.—The various sources of losses in beet between harvesting and processing and the levels of these losses are examined with reference to results obtained by other authors.

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Shaft lime kilns—compressed air or induced draft operation? H. SCHNEIDT. *Zucker*, 1973, **26**, 318–319. The advantages and disadvantages of the two types of operation mentioned in the title are discussed and the salient differences in kiln design and air/waste gas control described. Induced draft is considered preferable for low to medium outputs of about 100 tons of CaO/day at a waste gas CO_2 content of 30–38%,

[1] *I.S.J.*, 1973, **75**, 230.

while compressed air is better for capacities greater than this and gives a waste gas CO_2 content of up to 42% or even higher.

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Mixed processing of beet and raw cane sugar. E. WOLFF. *CubaAzúcar*, 1973, (Jan./March), 3–7.—See *I.S.J.*, 1974, **76**, 55.

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Effect of physiologically active chemical substances on sugar loss reduction during sugar beet storage. P. STATICESCU *et al.* *Ind. Alimentara*, 1972, **23**, 540–544, 552; through *Abs. Rom. Sci. Tech. Lit.*, 1973, **9**, 483. Results obtained in Rumania on laboratory and pilot plant scale showed that 6°Bé milk-of-lime and dipyridyl reduced daily sugar losses by 25% and 25–31%, respectively, compared with the control, while nitrogen and CO_2 fed under pressure into well-covered piles reduced losses by 22–30%. Maleic hydrazide yielded good results only in the northern region of Rumania, while SO_2 and $CaCl_2$ had no effect on beet sugar losses during storage.

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Experiments with continuous deliming of thin juice. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1973, **89**, 107–113.—Laboratory and pilot-scale tests in which cation exchange resin in a "fluidized" state passed down a column against an ascending stream of thin juice are described, and the methods used to measure the speed of fall of the resin beads and the fluidization threshold velocity are reported. The tests showed that the process consumes more resin than does the fixed bed process and that the four operations (deliming, sweetening-off, regeneration and washing) are very complex and labour-consuming.

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Mathematical model of a sugar factory forward-feed evaporator working with a climbing film. V. URBAN. *Listy Cukr.*, 1973, **89**, 114–118.—The mathematical model presented refers to a triple-effect evaporator with concentrator operating on the climbing film principle, and is designed to give optimum conditions in each effect as a means towards automatic control.

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Moses Lake—largest sugar beet factory in the Western Hemisphere. R. A. MCGINNIS. *Sugar J.*, 1973, **35**, (12), 19–21.—Information is given on this sugar factory, which expanded its daily slicing capacity from 2000 tons of beet in 1952 to 11,500 tons in 1972 (with a sugar end capacity equivalent to 6500 tons of beet/day).

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Curico sugar factory in Chile. E. WOLFF. *Zeitsch. Zuckerind.*, 1973, **98**, 321–322.—Some information is given on this new beet sugar factory, planned for a daily slice of 3000 tons expandable to 4500 tons. The white sugar produced is sold in 40-kg and 5-kg bags. Most of the equipment, including beet washer, tower diffuser, centrifugals and pulp and sugar dryers, was built by BMA.

Electrical resistance heaters for massecuite. R. J. BASS, J. S. HOGG and N. W. BROUGHTON. *Zeitsch. Zuckerind.*, 1973, **98**, 323–329.—See *I.S.J.*, 1973, **75**, 10–14, 40–44.

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The water problem. G. I. STASEEV. *Sakhar. Prom.*, 1973, (6), 8–10.—The poor situation in the Russian Federation regarding waste water treatment at sugar factories is examined and successes achieved at individual factories, particularly with the use of algae, are mentioned.

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Status of the water economy at sugar factories and prospects of improving it. A. P. PARKHOMETS. *Sakhar. Prom.*, 1973, (6), 11–17.—After a brief examination of the waste water situation at Soviet sugar factories and mention of the situation in sugar industries outside the USSR (where the author considers the best treatment schemes to be those used in the UK), requirements of an efficient scheme are discussed and details then given of proposed systems for handling Class I, II and III waste waters.

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Means of improving the water economy at sugar factories. V. N. BAZLOV. *Sakhar. Prom.*, 1973, (6), 17–21.—An experimental scheme is described which incorporates use of treated flume water of pH 11–12 to wash the beet and recycling of water from a settling tank to fluming. Two varients of a scheme for handling Class III waste water (heavily polluted water and muds) both include biological treatment and are designed to replace conventional lagooning. Quantities and costs involved are set out.

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Major trends in the development of a water economy for beet sugar manufacture for 1971-1975. B. D. SADYREV. *Sakhar. Prom.*, 1973, (6), 22–25.—Trends in methods and equipment for waste water treatment at Soviet sugar factories and future prospects for solving the effluent problem are discussed.

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Efficient water supply schemes and effective methods of beet sugar factory waste water treatment. B. M. SHAKHNOVICH. *Sakhar. Prom.*, 1973, (6), 26–32. Details with diagrams are given of schemes proposed for treatment of Class I, II and III waste water and of the equipment required.

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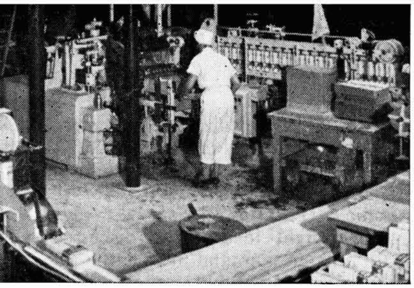
Steam treatment of 1st carbonatation juice. A. F. YAKIMOV. *Sakhar. Prom.*, 1973, (6), 35–37.—Treatment of 1st carbonatation juice with an unspecified quantity of steam before clarification at the author's sugar factory has increased the settling rate and reduced the mud volume and filtration coefficient to such an extent as to justify the increased steam consumption in evaporation resulting from the greater juice dilution. The effect of the steam treatment on juice purity and colour could not be investigated.



Sugar refining

Processing scheme for raw sugar treatment at Uspensk sugar factory. S. I. NEDZVEDSKII and M. E. SHOSTENKO. *Sakhar. Prom.*, 1972, (11), 32–33.—Information is given on the treatment of imported raw sugar at this factory which in 1972 produced from it nearly 23,000 tons of white sugar of 0·74°St colour at a yield of 94·5% (by weight). Raw sugar pol was over 97, and molasses sugar was 1·8% by weight.

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Study of the movement of colouring matter and invert sugar during sugar processing at Krasnopresnensk sugar refinery. N. K. KVACHEVA, O. V. DOVNAR and G. N. MIKHATOVA. *Sakhar. Prom.*, 1973, (3), 31–32. Investigations of the 3-massecuite boiling scheme used showed that maximum inversion occurred in the remelt tanks. However, by omitting decolorization of 1st massecuite syrup, the quality of the boiling house products was improved (despite the greater accumulation of colouring matter) and the pH maintained at a level at which sucrose was more stable; syrup concentration was also increased, thus reducing processing costs. A diagram is presented showing the movement of colouring matter throughout the boiling house.

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The pressure at which refined sugar is pressed. A. N. STEPANOV. *Sakhar. Prom.*, 1973, (3), 32–35.—Tests with an experimental press are reported, which showed that the main factor affecting the required pressure for tablet sugar production was the bulk density of the solid phase in the moist sugar, i.e. the ratio of the mass of the solid phase to the volume occupied by the sugar or tablet. Curves are plotted of pressure on the die and on the bed plate as a function of sugar slab density, which was also correlated with tablet strength. The moisture content of the sugar did not affect the form of the pressure-density relationship within the range tested, although with increased moisture the amount of dissolved sucrose was greater and hence so too was the amount passing into solid phase with tablet drying. Therefore, the greater the moisture content the lower is the pressure required for tablets of identical mass.

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The waste treatment facility at the Crockett refinery. P. J. LANGLEY and C. J. BOHLIG. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 19–30.—Details are given of the scheme used at Crockett to treat acid and alkali wastes (neutralized to pH 8 before transfer to a surge tank) and waste from the upper char house and de-ashing column (also fed to the surge tank). Phosphoric acid and lime are added before the combined wastes are fed to a flash mixing tank, in which chlorine and sulphuric acid are added; polyelectrolyte is added between the mixer and a flocculator, the waste from which is treated in an Eimco thickener and finally filtered by an Eimcobelt filter. The mud, of 50–55% moisture content, is taken in a tote bin to a disposal site. An average of 700,000 gal of effluent is treated daily, only a slight trace of settleable solids being present after treatment compared with more than 20 ml/litre/hr in the upper char house waste before operation of the system. pH is maintained within 7·6–8·4, and fish survival averages 90–100%, so that the results are in conformity with legal requirements.

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New ideas for old problems in St. Lawrence Sugar's shipping warehouse. D. M. DERWORIZ. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 31–33.—The automatic palletizing system used at St. Lawrence Sugar Division of Sucronel Ltd. in Canada for handling various types of packaged sugar products for despatch by road and rail is described.

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Selecting the ideal environment for packaging. M. A. MUNIZ. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 34–41.—Information is given on the air conditioning system at the packaging plant in the refinery of the National Sugar Refining Co. at Philadelphia. The indoor temperature ranges from a minimum of 65°F in the winter (compared with an outdoor temperature of 0°F) to a "normal" of 75°F in the summer (in contrast to 78–95°F outside), while relative humidity is normally kept within 30–50% (winter-summer). Noise is also effectively controlled.

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Controlling maintenance costs. J. D. CARMICHAEL. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 42–48.—A saving of 10% per year on the maintenance budget at the Montreal refinery of Redpath Sugars Ltd. over a period of 3 years was effected by a combination of four methods: reduction of work force, increase in supervisory staff, encouraging the supervisory staff to suggest methods of cost reduction, and introduction of a preventive maintenance scheme. The system is briefly examined.

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Silo conditioning and warehousing of granulated sugar at the British Columbia Sugar Refining Company Limited, Vancouver, B.C. ANON. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 49–65.—At the refinery in question, the sugar discharged from the bulk silos at any time is free from lumps, the breaking down of agglomerates increases the sugar bulk density by 4–6%, and there is no problem in the annual emptying of the silos at stocktaking, i.e. the sugar flows freely from the silo with manual labour being required only to shovel and sweep loose sugar left on the floor at the angle of repose between the outlets. How these conditions were achieved is the subject of this article, which describes the original problems, how they were solved and the present method of operation; this involves conditioning warm sugar by aerating with dehumidified air during sugar circulation. The sugar temperature is thus reduced from 42°C to 30°C and the moisture content from 0·05% to 0·03%.

* * *

Palletized shipping in the sugar industry. B. J. Jones. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 67–70. Aspects of palletizing, as practised at Savannah refinery, where 60% of the sugar shipments are in this form, are discussed and guidance given on pallet types and dimensions. A pallet exchange pool, whereby pallets between user points are exchanged, is advocated, although some problems are briefly mentioned.

* * *

Shrink wrap protection. L. F. Tworek. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 71–74.—The possible use of polyethylene and polyvinyl chloride as films for shrink wrapping pallet loads of bagged sugar is discussed with the aid of diagrams, and advantages are listed.

* * *

Automatic warehousing. R. Valkers. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 75–80.—Details are given of the system and equipment used at the Montreal refinery of Redpath Sugars Ltd. to pack in one 8-hour shift all the sugar produced in a day. Palletizing and depalletizing is used, one palletizer being used for six different loads made up of 50-lb box or bale items, while another palletizer handles 50- and 100-lb bags of sugar. Control is divided into two parts—"peripheral control" covering sensors, actuators, remote control stations, information translation and control data input and output, and "central control" which is responsible for sequencing, data handling, decision making and memory using a magnetic drum.

* * *

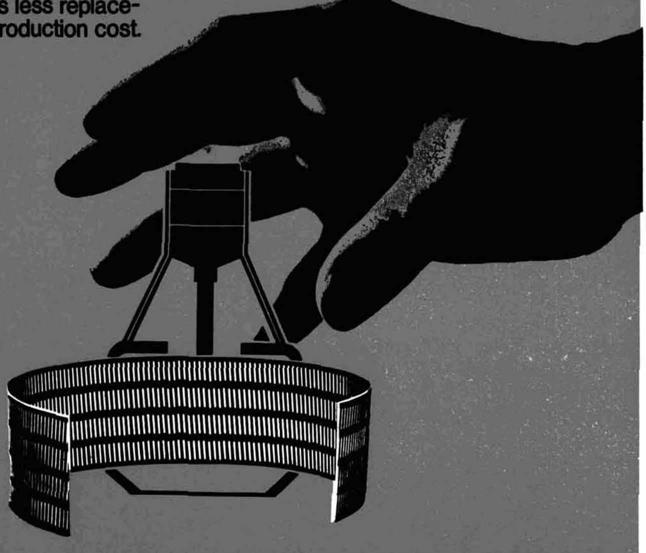
Modern calandria vacuum pan design criteria. D. E. Tippens. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 81–97.—The research programme at Amstar Corporation concerning vacuum pan design has yielded a number of facts which have influenced the types of pans used by the company and led to incorporation of fully-automatic control of the pan station at Boston refinery. Most of the pans in service are standard calandria pans with a flared body for reduction of boiling head (strike elevation), short calandria tube length and mechanical agitators. The central downtake diameter is 40% of the calandria diameter. A low charge volume:strike volume ratio (30%) is achieved by reducing the slope of the bottom cone from 27° to 22·5°. A tube heating surface (ft^2): massecuite volume (ft^3) ratio of 1·4 is used. Advantages of a vertical, straight-sided pan are discussed in comparison with a flared pan, and include the possibility of: shortening calandria tubes to allow reduction in massecuite circulation resistance; reducing the pan diameter with only small increase in elevation, thus saving materials and floor space and reducing construction complexities; and increasing downtake diameter to allow for a larger and more efficient agitator. Full details are given of construction and operation parameters for both flared and straight-sided pans, and some relationships governing cycle time and daily massecuite output are tabulated.

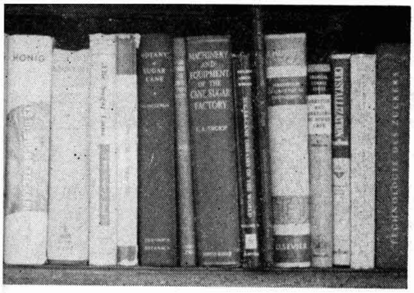
* * *

Recovery of filter aid from filter cakes using liquid cyclones. G. R. S. Smith. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 98–100.—A 3-stage hydrocyclone system developed by Johns-Manville Products Corp. for recovery of filter aid from filter cake is described which is claimed to be capable of recovering up to 70% of the filter aid depending on its type and grade. The cake is made up to a 3–5% slurry and fed to stage 1, from which the underflow of 12–15% solids is diluted with overflow from stage 3 to 3–5% solids for stage 2. The underflow from this contains 15–20% solids and again must be diluted for stage 3, the slurry from which (containing about 16% solids) is pumped to process for re-use. Problems encountered in experiments include the danger of excessive water consumption, difficulty in separating carbon and phosphatation floc from filter aid, and disposal of the overflow. Some answers to these problems are suggested.

* * *

Decolorization of carbonatated raw liquor by resin. E. W. P. Cunneen and D. T. Hawkins. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 101–110.—Details are given of a 3-column decolorizing plant for treatment of carbonatation raw liquor using fixed beds of anion exchange resin at Adelaide refinery in Australia. Throughput is rated at 1·1 million lb of liquor per week of 120 hr in 2 cycles. The liquor is fed to each column in turn, and the resin is moved in the opposite direction, one column at a time, when performance falls below a specified level; the process is expected to be economical if resin replacement does not exceed one bed every 33 cycles. The average fine liquor colour during 36 cycles handling an equivalent of 0·56 million lb per cycle rose from 40–50 Eel units with fresh resin to 80–100 units by the end of the period, compared with raw liquor colour ranging from 430 to 1780, but normally about 640–655 units. A fine liquor colour not exceeding 50 units is the target in CSR refineries using bone char. Difficulties involving blockage of the underdrains by fines in the resin when liquor flow was stopped have been overcome and the quantity of resin increased, so that throughput per cycle is set at 0·84 million lb.





New books

Australian sugar year book, Volume 32, 1973. Ed. J. J. O'Brien. 354 pp; 18 × 24·5 cm. (Strand Press Publishing Pty. Ltd., 236 Elizabeth Street, Brisbane, Queensland, Australia.) 1973. Price: $Aust. 6.50.

Like its predecessors, the latest Australian Year Book is a book for enjoyable browsing. It has an index but no contents page and it is made up of many bits and pieces ranging from less than half a page to several pages. Interesting papers are reprinted from the *Producers' Review*, *Australian Sugar Journal*, etc., as well as a number presented to the 39th Annual Conference of the Queensland Society of Sugar Cane Technologists. A full report of the Conference is given while a "Sugar Industry Directory" gives details of the various organizations involved in the Australian industry from the A.S.P.A., the Bureau of Sugar Experiment Stations, C.S.R. Co. Ltd., Q.C.G.C., etc. to local mill suppliers committees, etc. A large amount of information is provided in tabular form while the second half of the book is a detailed survey of Australian sugar mills and districts which is not limited to information about the factory equipment and personnel, but also describes the geography and other features of the areas.

* * *

Zuckerwirtschaftliches Taschenbuch 1973/74 (Sugar economic pocket book). G. Janeba, E. Krenz and G. Bruhns. 256 pp; 10 × 15 cm. (Verlag Dr. Albert Bartens, D-1000 Berlin 38, Lückhoffstr. 16, Germany.) 1973. Price: DM 24,--.

The 20th edition of this pocket-book contains 72 tables, 6 graphs and 2 maps covering world, West European and German (both West and East) sugar production, consumption, imports and exports, beet and cane areas, prices, etc. Details are given of EEC trade regulations (with an English-French-German glossary of terms connected with sugar marketing) and of sugar factory addresses as well as those of official organizations, trading concerns and institutes. The information is updated to 1971/72, with estimates for 1972/73. Headings and captions are in English, French and German as are the EEC trade regulations, but notes to the tables and names of the countries are only in German. Despite this, however, the book is an extremely useful guide, particularly to the sugar economies of the EEC countries, and is certainly to be recommended to those interested in the subject.

F. O. Licht's Internationales Zuckerwirtschaftliches Jahr-und Adressbuch 1973 (International sugar economy yearbook and directory). H. Ahlfeld. 400 + 64 pp; 20·5 × 29 cm. (F. O. Licht K.G., P.O. Box 1220, 2418 Ratzeburg, Germany.) 1973. Price: DM 55,--.

The latest edition of this valuable compilation shows a great improvement in print quality over its predecessor. The system of separate section pagination is retained, while the general layout remains as before. Thus, after an introduction and contents list, in both German and English, there follows a name directory for sugar company executives in the German sugar industry and a section of details of EEC legislation governing sugar and addresses and members of international organisations such as the I.S.O.

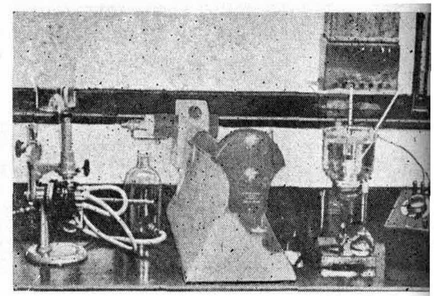
A very detailed section provides a large amount of information on the West German sugar industry, from the level of Government department and industry associations to sugar traders and accounts of the individual factories with technical information on the equipment used as well as personnel and production figures. The next section provides similar information in less or much less detail as regards beet sugar industries of other countries, while similar treatment is afforded the cane sugar industries of the world in the subsequent section.

Four technical articles follow: they include a review of the desugaring of molasses, by Dr. H. J. Delavier, two papers on irrigation of sugar beet by Dr. A. von Müller and Ing. Agr. H. Buchholz, and a discussion of the modern control of technical operations in cane sugar factories, by Dr. M. Matic.

A survey is presented by Dr. H. J. Delavier of the companies offering equipment and services to the sugar industry, ranging from complete sugar projects to individual pieces of apparatus. This is followed by a section of short articles describing equipment offered by the suppliers advertising in the book, and finally a Buyers' Guide.

In a pocket in the back of the book is a separate booklet in which are collected world sugar statistics for 1972/73, comprising data from the German, European and world sugar economies, with further information for individual countries, including sugar imports and exports, retail and world market prices, and a number of details on molasses production and trading.

Laboratory methods & Chemical reports



Variation of unfermentable reducing substances in cane molasses. A. C. Sturion and J. P. Stupiello. *Brasil Açuc.*, 1973, **81**, 192–199.—Samples of molasses from two factories using different boiling processes were examined at intervals and variations recorded in tables. Unfermentable reducing substances % molasses and % Brix in molasses were lower than values reported in the literature and were independent of the process employed. It is concluded that using an average value will lead to an incorrect assessment of fermentation efficiency and that the value should be measured at intervals to provide a current basis for the assay.

* * *

The measurement of colour in refinery liquors and sugars. C. V. Rich, J. T. Rundell and G. W. Vane. *Proc. 31st Meeting Sugar Ind. Tech.*, 1972, 111–123. Methods of colour measurement used in the sugar industry are briefly examined, with particular attention to the combined effect of colour and turbidity on the intensity of a light beam passing through a sugar solution. Requirements of an efficient colorimeter are listed, and details given of a photocolorimeter, the "Talameter", developed by Tate & Lyle Ltd. This incorporates an interference filter having a peak transmission at 420 ± 1 nm and a bandwidth at half peaks less than 12 nm. The cell holder can accept cells from 0·5 to 16·3 cm long; a length of 16·3 cm allows for a noticeable needle deflection and thus increases scale reading accuracy when the colour of dissolved refined sugar, which has a very high transmission, is being measured. A ground glass screen immediately before the detector provides for illumination of the whole of the photocathode irrespective of exact size or position of the light beam, which is made as near to parallel as possible by being contained within a 7-mm diameter cylinder, giving a maximum deviation of about 2°. A means for collecting most of the scattered light and adding it to the transmitted light is embodied. Test results indicate excellent sensitivity and reproducibility, while maintenance problems are avoided through the simplicity of the instrument.

* * *

Boiling point elevation of sugar factory solutions and their supersaturation. III. Table for direct calculation. G. Vavrinecz. *Cukoripar*, 1973, **26**, 92–97.—Tables for sugar solution purities in the range 78–96 and Brix of 50–87° are presented for direct reading of supersaturation as a function of the boiling points of water and of the solution.

Chemical criteria for grading of gur. D. N. Gupta and S. V. Balyan. *Sugar News* (India), 1973, **4**, (10), 20–22.—The colour, pol, purity, invert and ash contents of gur from 13 cane varieties were determined and are compared.

* * *

The shape of sucrose crystals. A. VanHook and J. Brown. *Ind. Sacc. Ital.*, 1973, **66**, 46–47.—The influence of temperature, degree of supersaturation, crystal size and presence of raffinose on the shape factor of the growing crystal are discussed.

* * *

Physico-chemical bases of sugar technology. S. E. Kharin. *Izv. Vuzov, Pishch. Tekh.*, 1973, (2), 18–24. The theory of nucleation is explained in terms of the relationship between the change in thermodynamic potential of the molecules in a supersaturated solution when a nucleus is formed and the size of the nucleus, the relationship being described by a curve with a maximum; while nuclei may form having a radius smaller than the critical radius corresponding to the maximum on the curve, they should disappear. The probability of formation of a new phase increases with fall in surface tension, molar volume of the crystallizing solution and rise in temperature and supersaturation. In the case of sucrose, the first stage in formation of a new phase is accompanied by formation of highly dispersed sucrose compounds. The kinetics of nucleation have been studied in laboratory experiments, details of which are given, and work carried out by other authors is briefly mentioned.

* * *

Thermodynamic and kinetic parameters of sucrose crystallization. A. V. Zubchenko and A. I. Vyval'tsev. *Izv. Vuzov, Pishch. Tekh.*, 1973, (2), 82–83. Reaction rate constant K was calculated for sucrose crystallization at temperatures of 30–70°C and supersaturation of 1·3–1·61. From the Arrhenius equation relating K to temperature, gas constant and activation energy E, further equations were developed by means of which the change in molal concentration due to entropy, enthalpy and free activation energy were calculated as well as E for 1·3–1·6 supersaturation. Tabulated values show the reduction in all four factors as well as degree of hydration with increase in supersaturation. The crystallization rate was found to be determined not by E but by the molal change due to free activation energy. The rate of diffusion of sucrose molecules also falls with increase in supersaturation and a condition occurs where crystallization is affected equally by the kinetics of the system and by diffusion.

* * *

Nucleation phase and energy pattern. H. THIELE and A. LANGEN. *Zucker*, 1973, **26**, 315–317.—The nucleation stage during massecuite boiling is examined from the aspect of the energy level between the molecules in the sucrose-water system. The saturation *vs.* time curves of KUKHARENKO and MCGINNIS are compared with the graph of rheometer value *vs.* time, the course of nucleation being described in detail in each case. Tests on shock seeding, in which the rheometer was used to control white sugar massecuite boiling, showed that there was no difference in the nucleation stage between the use of a slurry of predominantly fine crystals and seeding with large crystals, although the number of micro-crystals present at the end of nucleation was decisive for the size of the final crystals. Hence, the energy levels in nucleation have a "pre-programme" natural pattern, to which the rheometer control system can be adapted.

* * *

Equilibrium moisture and thermodynamic parameters of white sugar. M. A. VOLKOV, O. B. TSEREVITINOV and V. D. MIKHAILOV. *Sakhar. Prom.*, 1973, (6), 43–45. The absorption and desorption of moisture was determined for sugar of 0·068–0·11% ash content at 273–293°K and relative humidity of 30–80%. Deviation between values obtained by drying and by means of an instrument incorporating a thermistor and a teraohmmeter did not exceed ± 0·005% absolute with change in moisture content between 0·05% and 0·20%, the classical method with a desiccator being used as control. Isotherms for five samples are presented, showing the poor relationship between the form of isotherm and temperature, attributed to the low energy available for moisture adhesion to the sugar. On the other hand, high correlation was found between equilibrium moisture and the chemical potential of water vapour mass transfer, based on air temperature, relative humidity and universal gas constant.

* * *

Differentiated determination of calcium salts in sugar factory products. I. F. BUGAENKO. *Sakhar. Prom.*, 1973, (6), 56–57.—Details are given of a method involving the use of EDTA to determine calcium salts which, in the case of cane raw sugar and cane and beet molasses, gave results in close agreement with values given by the conventional EDTA method, although the new method has the advantage of separating the total quantity into high- and low-molecular lime salts.

* * *

Ash per cent impurity in raw sugar. L. J. FINGER and G. E. MITCHELL. *Proc. 40th Conf. Queensland Soc. Sugar Cane Tech.*, 1973, 211–215.—The relationship between pol and ash % impurity in raw sugar produced at Fairymead during 1968–72, whereby increase in pol was accompanied by increase in ash % impurity, is represented by regression equations for each year. Removing sludge from *B*-molasses by centrifugalling before adding the molasses to high-pol washed sugar had only marginal effect in reducing the ash % impurity. Analysis showed that the molasses ash % impurity was higher than that predicted by regression analysis for the syrup removed from the crystal, whereas it should be lower for any effect to be obtained by this approach.

* * *

Increase in reducing sugars after cutting. N. MILANÉS. *ATAC*, 1973, **32**, (2), 44–48.—Thirty stalks of 16-month cane of six varieties were cut and analysed daily for Brix, sucrose, purity, theoretical yield, and reducing sugars % on juice. The results over 15 days are presented in graph form and discussed, while the relationship between sucrose drop and increase in reducing sugars is similarly illustrated. The variety suffering least deterioration was My.54130 which was one of the richest varieties in initial sucrose content.

* * *

Some aspects of carbohydrate analyses by GLC techniques. R. M. SEQUEIRA. *J. Amer. Soc. Sugar Beet Tech.*, 1972, **17**, 80–89.—Application of gas liquid chromatography to analysis of corn syrup blends is described.

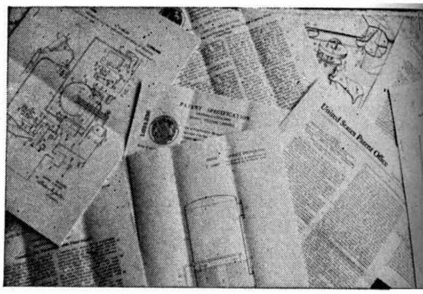
* * *

Relationships between juice purification and colour in solution. H. PREY and F. ANDRES. *Zeitsch. Zuckerind.*, 1973, **98**, 373–376.—Gel filtration has revealed two prominent colorant fractions in molasses, factory juices and alkaline decomposition products of sucrose, glucose and fructose; one has a molecular weight of 300-400 and contains chromophores having double bonds, diene-carbonyl groupings and reducing groups, while the other of > 5000 molecular weight is formed from the first by condensation and is the final stage in alkaline decomposition. Studies in which invert solution was heated under varying conditions of pH and temperature are reported, and the fate of the hexoses and formation of the above-mentioned colorants with time at constant temperature explained.

* * *

Density and refractive index measurements of the binary systems water-sucrose and water-glycine and of the ternary system water-glycine-sucrose. C. A. ACCORSI and G. MANTOVANI. *Paper presented at 2nd Int. Conf. Chem. Tech. Sugar*, 1973.—The authors have studied the effect of glycine on sucrose solution density and refractive index. Equations for calculation of density as a function of molalities have been developed with the aid of pycnometric data obtained with aqueous sucrose and glycine solutions and glycine-sucrose solutions of varying concentrations at 20°C. The equations permit calculation of the apparent molal volumes and the molar volume of the solvent. Values obtained and molar refractions calculated from density and refractive index determined with a Pulfrich refractometer show that glycine has a specific effect on sucrose solutions. The results are interpreted in terms of variations in the structure of the solvent under the effect of the solutes.

Patents



UNITED KINGDOM

Sucrose esters of fatty acids. DAI-NIPPON SUGAR MFG. CO. LTD., of Tokyo, Japan. **1,308,234.** 11th May 1970; 28th February 1973.—Sucrose is mixed and melted (over 2–20 min) with a non-saccharide (glyceryl, methoxyethyl or methoxyethoxyethoxy) ester of a C_2–C_{22} fatty acid (to give a fatty acid equivalent of 0·5–8·0 moles per mole of sucrose) in the presence of, as catalyst, (1–40% on sucrose of) an alkali-free metal (K or Na unsaturated or saturated or Li unsaturated) soap and the mixture transesterified at 160–190°C (at the same temperature as the mixing and melting) (under reduced pressure) (over 2–20 min). The reaction mixture is cooled and purified by removing uncombined sucrose and either removing the soap or acidifying the soap and removing the alkali metal salt of the acid.

* * *

Treatment of beet molasses (for sugar recovery). RAFFINERIE TIRLEMONTOISE, of Brussels, Belgium. **1,310,255.** 2nd July 1970; 14th March 1973.—Lime is added to diluted molasses under cold conditions to precipitate a sucrose-lime combination which is recovered by filtration. The filtrate is subjected to a hot precipitation stage to recover further sucrose-lime precipitate. Several [3–7 (4–5)] volumes of unfiltered treated molasses are recycled and mixed with one volume of untreated molasses before adding the lime. The last is added continuously downstream of the point where the fresh molasses is mixed with recycled molasses, so as to create an alkalinity gradient between these two points. Up to 60% of the water used to dilute the molasses is replaced by filtrate from the cold precipitation or by precipitate wash water. Up to 50–60% of the lime is added as milk-of-lime and the remainder as powdered quicklime. The reaction is carried out in a tank provided with stirring, (internal or externable adjustable) recirculation and cooling. (See also US Patent 3,687,727[1].)

* * *

Beet topper. K. V. PEDERSEN, of Frankfri pr. Fangel, Denmark. **1,310,287.** 17th June 1970; 14th March 1973.

* * *

Regeneration of spent active carbon. DEGREMONT SOC. GENERALE D'EPURATION ET D'ASSAINISSEMENT, of Rueil-Malmaison (Hauts de Seine), France. **1,311,014.** 18th June 1970; 21st March 1973.—The spent carbon is contacted in a column with an alkaline solution (aqueous KOH, NaOH or NH_4OH) (0·5—2·5% NaOH) at 20–130°C [25–90°C (70–80°C)] for $\frac{1}{2}$–2 hr under stationary conditions and then circulating in the column (at approx. boiling point) an aqueous solution containing at least one organic solvent [acetone, dichlorethane, methanol, ethanol, propanol, *iso*-propanol or butanol (20–75% *iso*-propanol)], the solvent for the second step being removed by injection of a hot fluid (hot air, steam or hot water under pressure) into the column, and the carbon washed with an acid solution (HCl, H_2SO_4, H_3PO_4, acetic or formic acid). If the treatment is continuous, the alkali liquid flow over the carbon is $\ngtr$ 1 metre per hour, while the elution solvent flow is 1–10 metres per hour. An aqueous alcoholic solution may be used for both stages, the flow velocity during the second being five times as fast as during the first. The organic materials separated from the regenerated carbon are recovered by (azeotropic) distillation from the solvent.

* * *

Extraction of sugar from beet. SOC. ITALIANA PER L'INDUSTRIA DEGLI ZUCCHERI S.P.A. of Genoa, Italy. **1,313,078.** 25th August 1971; 11th April 1973. (Press) Juice is extracted from beets, acidified (to pH 3·5–4·0) (with an inorganic acid or by recycling cation exchanger-treated juice) and the precipitates formed are separated (by decanting, filtration or centrifuging). The juice is then cooled (to 8–18°C) treated with [a (weak) anion exchange resin followed by] a cation exchange resin (in H^+ form) (to give a pH of 1·0–2·5) and then a (strong) anion exchange resin (in OH^- form) (to give a pH of 6·0–8·0), concentrated and sucrose crystallized from the resultant syrup.

* * *

Sugar cane juice production without oxidation. P. GRAU Y TRIANA, of Monte Carlo, Monaco. **1,314,630.** 2nd November 1971; 26th April 1973.—Cane juice taste, flavour and aroma are preserved by addition of (1·5 g per gallon of) ascorbic acid which may be added during the milling process. The juice may be concentrated (to 96–98% by weight) by freezing or

[1] *I.S.J.*, 1973, **75**, 292.

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evaporation at no higher than ambient temperature in order to crystallize the sugar; alternatively the juice may be mixed with an ascorbic acid-containing fruit juice.

* * *

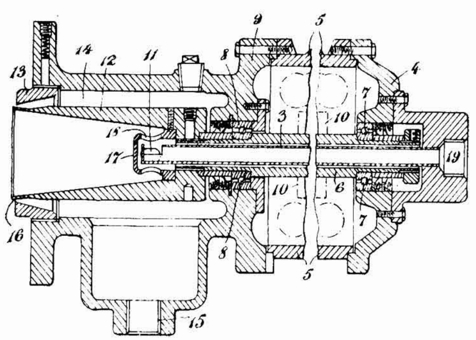
Beet harvesters. RANSOMES, SIMS & JEFFERIES LTD., of Ipswich, Suffolk. **1,314,821.** 3rd February 1969; 26th April 1973.

* * *

Molasses feed blocks for animals. C. O. MCKENZIE, of Fullerton, Calif., USA. **1,315,174.** 6th August 1970; 26th April 1973.—An animal lick block comprises at least 50% of hard solidified molasses as well as medicament, growth enhancing and/or other animal feed or supplement material [including up to 10% salt, up to 30% fat, 10–40% protein (urea) or an ammonium salt, up to 1% P as phosphate, etc.] and is made by heating the molasses mixture at 221–321°F (270°F) for 3–12 min (5–7 min) under at least 24 in (at least 29 in) Hg vacuum, breaking the vacuum and pouring the material into a mould and allowing to cool and solidify.

* * *

Sprayer for molasses. THE ALBANY ENGINEERING CO. LTD., of Lydney, Glos., England. **1,315,157.**—The sprayer, for applying molasses to other animal fodder constituents, includes an injector tube 3 through which the molasses passes from the inlet 19. The tube is surrounded by a hollow shaft 6 coupled to the rotor 10 of electric motor 5, and carry-



ing a thrower cup 12. Molasses leaves tube 3 through ports 11 into the nozzle 17 and this it leaves through slots 18 and enters the cup 12. Compressed air admitted through inlet 15 and leaves through the narrow annular gap 16 between the rim of cup 12 and nose cone 13 and, entraining the molasses, produces a fine spray.

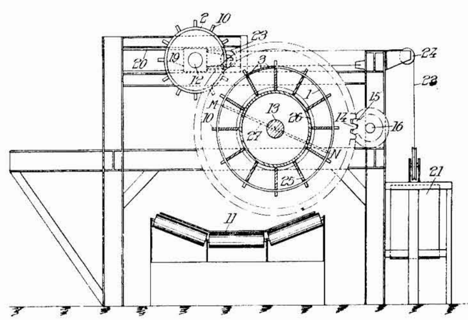
* * *

Regulation of crystallization in a continuous vacuum pan. FIVES LILLE-CAIL, of Paris, France. **1,316,706.** 19th April 1971; 16th May 1973.—In a pan comprising a number of cells, equipped with steam heating assemblies and traversed by the solution undergoing crystallization, and supplied with sub-saturated solution, with a concentrator upstream of the first cell and provided with a steam heating assembly, crystallization is controlled so that the rate of flow of sub-saturated solution fed to the last cell is such that the sugar content of the material extracted is kept constant, and the total amount fed to the (first and) intermediate cells and possibly the concentrator is kept equal to a control value calculated as a function of the amount of heating steam condensed by the cells and concentrator and of the concentration of the feed solution, the control of the rates of flow ensuring that a mixture of crystals and solution of substantially constant sugar content enters the last cell. The concentration of the sub-saturated solution is kept constant by admixing if necessary a quantity of juice from the concentrator.

* * *

Bagasse press. SOCIÉTÉ SUCRIÈRE DE L'ATLANTIQUE (ENGINEERING), of Paris, France. **1,319,365.** 1st December 1970; 6th June 1973.

Wet bagasse from a hopper 9 falls between two cylinders 1, 2 and is carried through the gap between them by the action of projections or blades 10. Cylinder 2 and its driving motor are mounted on sliders 19 and move horizontally under the action of weights 21, linked to the cylinder shaft 12 by cables 22 and pulleys 23, 24. Alternatively, jacks, springs or other means may be used to maintain pressure on the bagasse passing between the cylinders.



Cylinder 1 has perforations in its periphery and juice expressed from the bagasse passes through these and enters chambers formed by axial partitions 25 and frustro-conical member 26 which directs the juice to an exit spout, while the pressed bagasse falls onto the conveyor 11 which removes it from the press.

* * *

Beet harvesters. S. A. HERRIAU, of Cambrai (Nord), France. **1,319,472.** 1st September 1970; 6th June 1973.

* * *

Purification of raw sugar juice. SYNDICAT NATIONAL DES FABRICANTS DE SUCRE DE FRANCE, of Paris, France. **1,320,632.** 25th August 1971; 20th June 1973.—Raw beet juice is (cooled to prevent inversion and) passed through a strong cation exchanger, neutralized with (3g per litre of) lime, (reheated to 65–90°C,) filtered, (re-cooled) and passed successively through a second strong cation exchanger and a weak anion exchanger. It is then treated with phosphoric acid and filtered, the filtrate being passed through a weak cation exchanger and a strong anion exchanger. The first cation exchanger is eluted with an alkaline solution (ammonia) before regeneration with strong acid (nitric acid). The alkali used is at least partly the regenerant used for the anion exchange resin.

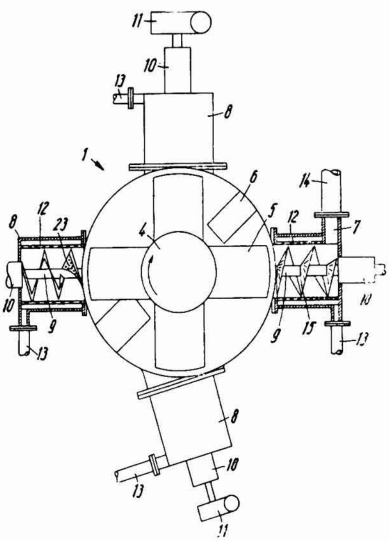
* * *

(Fermented molasses) Animal feed. INDUSTRIAL MOLASSES CORPORATION, of Leona, N.J., USA. **1,321,521.** 12th January 1971; 27th June 1973.—(35–45 parts by weight of) Blackstrap molasses is mixed with (55–65 parts of) water and yeast (5–100 parts per 2000 parts by weight of molasses plus water) and fermented to convert the sugars present into ethanol, thereby giving a product containing 10–13% alcohol.

* * *

Beet diffuser. BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT, of Braunschweig, Germany. **1,323,651.** 17th January 1972; 18th July 1973.

Beet cossettes, carried by hot recirculated juice, are fed through pipe 14 to the housing of screw conveyor 7 which carries them into the base of the tower 1. They are carried upwards through the tower by the action of the screw blades 5 mounted on the driven central shaft 4, in cooperation with the adjustable stationary blades 6 mounted on the inside of the tower wall.



Sugar is extracted by a counter current of water which is added at the top of the tower and becomes richer as it passes down to the bottom of the tower. It is removed through the casings of the conveyors 7, 8, passing through the perforated casings 12 into ducts 13 from which part is sent for heating and use for scalding and carriage of fresh cossettes while the remainder is sent to process. The surface of the casings 12 is kept clear by means of the scrolls 15 which are mounted on shafts 9, supported by bearings 10 and driven by gear trains by 11. The scrolls 15 of conveyor 7 have to carry the cossettes into the tower and are solid, while those of conveyors 8 have no such function and have perforated sections 23 for the first 360° of arc to aid passage of juice.

* * *

Absorptiometer (for measuring sugar liquor optical density). TATE & LYLE LTD., of London, E.C.3. **1,323,662.** 18th February 1971; 18th July 1973. The lamp source of the absorptiometer is arranged to direct radiation onto a radiation-sensitive device and means are included to measure the electrical output obtained, thereby deriving a measure of the optical density of a sample when interposed between the source and the device. For initial setting purposes, a standard sample is located in the radiation path and the lamp source energization automatically varied to give a pre-determined value in the radiation-sensitive device, this energization value being maintained for subsequent measurements.

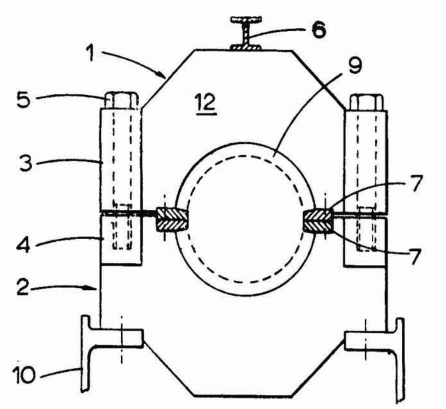
* * *

Separation of fructose from glucose in an invert sugar. SUOMEN SOKERI OY., of Helsinki, Finland. **1,323,754.** 4th August 1970; 18th July 1973.—See US Patent **3,692,582**[1].

* * *

Bagasse screw press. O. G. BRATEN, of Stord, Norway. **1,324,186.** 28th August 1970; 18th July 1973.

The cage comprises an upper part 1 and lower part 2 having an aperture for the drain tube 9 in which the screw of the press turns as well as for the tube supports 7. Parts 1 and 2 are constructed of



vertical plates linked by bolts 5 which pass through the tubular parts 3 and 4; the latter may be integral with the plates or may be welded to them and are welded together to form a rigid row of plates which are additionally stiffened by the longitudinal beam 6 and mounted on the frame supports 10.

[1] *I.S.J.*, 1973, **75**, 293.

United Kingdom sugar imports and exports, 1973[1]

IMPORTS	1973	1972	1971
	(long tons, tel quel)		
Australia	315,209	450,560	598,089
Barbados	110,126	99,283	114,869
Belize	20,445	25,302	20,452
Fiji	114,331	139,858	129,659
Guyana	182,444	216,058	196,382
India	25,148	25,011	30,358
Jamaica	258,786	231,758	227,497
Leeward Is.	14,798	15,602	27,962
Mauritius	377,744	413,336	313,455
Swaziland	72,236	86,914	84,928
Trinidad & Tobago	129,791	151,940	135,674
Other Commonwealth	41	8	9
Total Commonwealth	1,621,099	1,855,630	1,879,334
Argentina	40,027	—	—
Belgium	11,888	11,360	385
Brazil	73,974	18,362	—
Costa Rica	5,200	—	—
Cuba	126,176	40,474	35,921
Czechoslovakia	2,005	27,208	35,053
Denmark	—	3,923	—
Dominican Republic	40,637	29,840	—
Finland	—	17,410	—
France	47,719	3,170	3,043
Germany, East	9	148	—
Germany, West	43	20	—
Guatemala	33,814	10,892	—
Holland	1,788	14,835	31,023
Irish Republic	10,535	10,179	9,270
Mozambique	—	12,696	—
Norway	15	4	30
Poland	—	492	1,888
Rumania	—	—	—
Salvador	—	11,520	—
South Africa	4	18,205	—
Spain	—	—	—
Sweden	1	2,489	—
Switzerland	15	10	2
USA	30	402	25
USSR	—	—	87,163
Venezuela	—	24,764	—
Other Foreign	764	2	14
Total Foreign	394,644	258,405	203,817
TOTAL IMPORTS	2,015,743	2,114,035	2,083,151

EXPORTS	1973	1972	1971
	(long tons, refined value)		
Bahamas/Turks & Caicos Is.	296	1,160	1,289
Bahrein	118	59	163
Barbados	131	208	1,240
Belize	174	685	1,217
Bermuda	236	807	540
Canada	106	162	158
Cyprus	11,992	6,522	6,936
Gambia	175	121	230
Ghana	730	499	2,066
Gibraltar	859	963	1,211
Guyana	3	—	21
Indian Ocean Islands	33	223	45
Jamaica	372	4,350	586
Kenya	42,632	31,505	410
Leeward Is.	771	2,518	1,304
Malaysia	48	20	96
Malta	236	1,268	345
Nigeria	23,067	16,340	18,607
St. Helena	79	152	157
Sierra Leone	1,968	2,499	2,466
Sri Lanka	36	8	72
Trinidad & Tobago	713	421	859
Trucial States	232	244	286
Windward Is.	602	3,073	2,715
Zambia	—	10	161
Other Commonwealth	305	154	262
Total Commonwealth	85,914	73,971	43,442
Algeria	20,126	35,484	12,265
Azores	2,032	—	—
Belgium	76	57	9
Burma	100	94	205
Dutch West Indies	—	140	2
French Pacific	87	275	486
French West Indies	204	146	—
Germany, West	3,987	2,106	2,498
Greece	39,216	82	436
Holland	2,093	6,675	4,371
Honduras	7	150	—
Iceland	3,045	4,684	3,769
Iran	536	369	346
Irish Republic	8,061	5,240	1,070
Israel	20,193	10,080	3,324
Kuwait	671	150	81
Lebanon	915	654	647
Liberia	165	291	400
Libya	705	20	5
Madeira	—	935	4,650
Malagasy Republic	—	—	—
Mozambique	—	6	—
Muscat & Oman	86	89	117
Norway	49,054	56,164	47,412
Portugal	6,413	10	11
Saudi Arabia	254	1,126	1,164
Spain	2	2,393	13,461
Sudan	—	9,350	4
Sweden	288	320	300
Switzerland	58,521	38,830	49,031
Tunisia	27,640	34,075	34,354
USA	2,574	14,157	10,992
Yugoslavia	9,601	—	2
Other Foreign	412	390	250
Total Foreign	257,064	224,542	191,662
TOTAL EXPORTS	342,978	298,513	235,104

Brevities

Trinidad sugar difficulties[2].—The Trinidad Sugar Manufacturers' Association is predicting that the country will not be able to export sufficient sugar to Britain and the US to meet its share of the West Indies quotas. Continued labour problems during the first harvest month restricted sugar production to 8239 long tons, about 25% of production in the same period of the previous crop. By the end of February the island's stocks were at an all-time low of 1200 tons, while normal distribution to meet domestic needs takes up 1000 tons a week. Caroni Ltd. has ordered 600 tons of sugar from Canada, and it is reported that imports could reach 5000 tons this year. The workers have returned to their jobs after a week's absence but were working so slowly that two of the three Caroni factories were not producing much sugar. Field workers were refusing to cut cane or handle cane cut by contractors. Forres Park Ltd.'s factory is not in production this crop, while the Orange Grove factory has not yet started operations. The President of the Cane Farmers' Union has said that farmers were suffering tremendous losses through deliberate cane fires in their fields.

[1] C. Czarnikow Ltd., *Sugar Review*, 1974, (1167), 34.
[2] *Public Ledger*, 7th March 1974.

Brevities

Venezuela exports suspension[1].—Venezuela will suspend her sugar exports to the US during 1974 and 1975, according to the President of the Council of Sugar Distributors. The decision had been taken because increased domestic consumption would account for total production during the two years. The Council is instructing its representative in Washington to inform the US Government that it will be unable to meet its allotted quota for 1974 and 1975, although exports will be resumed in 1976. Venezuela's current US sugar quota has been set at 61,000 tons but a US Congressional Committee is holding hearings on a new Sugar Act and a possible reduction in Venezuela's share may result; this is because drought has affected production over the past two years and has prevented Venezuela from meeting her commitments.

* * *

US sugar refinery closure[2].—Revere Sugar Refinery, in Charleston, Mass., USA, was to close from the 1st March as a consequence of high raw sugar prices and a slump in the refined sugar market in the USA.

* * *

Yeast plants for Cuba.—On the 31st January, SPEICHIM signed an agreement with the Cuban Enterprise for Industrial Construction for the supply of six complete plants which will produce a total of 240 tons of Torula yeast per day, containing 50% protein. The yeast will be produced by aerobic fermentation on cane molasses and is to be used in animal fodder. The plants are expected to go into operation between November 1976 and November 1977 and will involve a total of 192 million francs (£16.3 million).

* * *

Pakistan diversification programme.—The Pakistan Government proposes to set up a number of plants for diversification and utilization of sugar industry by-products. These include a 10 tons/day plant for mono-sodium glutamate to be made from molasses; a 10 tons/day citric acid fermentation plant also using molasses; a plant for manufacture of newsprint by recycling of de-inked used newsprint with addition of bagasse pulp; a kraft paper plant for bag-making, based on bagasse pulp and partly-imported kraft pulp; and plants for fodder and edible yeast production from the slops of two distilleries. Further plant is to be set up for the manufacture of phosphatic fertilizers based on imported ammonia and phosphoric acid, a sodium tri-poly-phosphate plant, a solvent extraction plant for edible oil extraction from seed cake, and plants to manufacture glass and polyester fibres. Manufacturing concerns among our readers who are interested in supplying equipment for these projects should contact Mr. MUSHTAQ ACHMED, Technical Manager—Chemical, Board of Industrial Management, P.O. Box 5570, Karachi, Pakistan.

* * *

Swiss sugar expansion[3].—The Government of Switzerland plans to increase sugar production; it is intended to increase the area sown to beet by 20%, from 10,000 hectares to 12,000 hectares. The Beet Growers' Association had wanted an increase of 40% in sugar production; however, it is feared that such an increase might entail considerable subsidy payment.

* * *

German sugar factory closure[4].—The Oestrum sugar factory of Nordharzer Zucker A.G. is to be closed after the 1973/74 campaign. Beets from the Oestrum area will be sent for processing to the Baddeckenstedt factory which is to be expanded.

Hungary sugar expansion[5].—It is hoped that within two years, sugar production will be expanded to cover domestic requirements in Hungary; the area contracted for beets in 1974 has already been set at 94,000 hectares. However, it is feared that there may be processing difficulties in 1976 because of limited capacity.

* * *

Panama sugar production[6].—Raw sugar production in Panama in the 1972/73 crop was about 102,500 tons, compared with 92,100 tons from the previous crop. Exports reached approximately 52,500 tons against 40,695 tons in 1971/72, with almost all continuing to be shipped to the USA.

* * *

Colombia sugar project[7].—Preparatory studies are being undertaken by Tate & Lyle staff into the establishment of new sugar cane estates and the erection of a new sugar factory in Colombia. The factory will have a designed daily crushing capacity of 3000 tons of cane. Annual production of the project is expected to be about 78,750 tons and the total project is understood to involve 190 million pesos (£3,200,000).

* * *

New sugar factory in Bolivia[8].—The Cía. Azucarera Boliviana proposes to construct a 4000 t.c.d. sugar factory in Saravia, near Puerto Linares in the Alto Beni region of Bolivia. The machinery will be supplied by Maschinenfabrik Buckau R. Wolf A.G. and financing will be through the firm FUSAG and spread over 10 years. The industrial part of the project is estimated to cost $21,500,000.

* * *

Pakistan sugar expansion[9].—The Government of Pakistan has concluded talks on the erection of eleven sugar factories to increase sugar production. Four factories are to be built in the Punjab, six in Sind Province and one in the North-West Frontier Province. The Sarhad Development Authority in Peshawar is to erect the last of these factories with the aid of Belgium; designed capacity of the factory is around 46,000 tons and the factory is to be put into operation by 1975. Up to now, Premier Sugar Mill is the biggest factory, with an annual capacity of 45,000 tons.

* * *

Costa Rica sugar expansion[10].—The Central Bank of Costa Rica has granted 11 million colones ($1,300,000) for the development of the sugar industry, including increasing the area cultivated and the purchase of agricultural machinery.

* * *

New sugar factory for Saudi Arabia[11].—The erection of a sugar factory and refinery by the Saudi Sugar Company has now been approved. The designed capacity is 100,000 tons per year.

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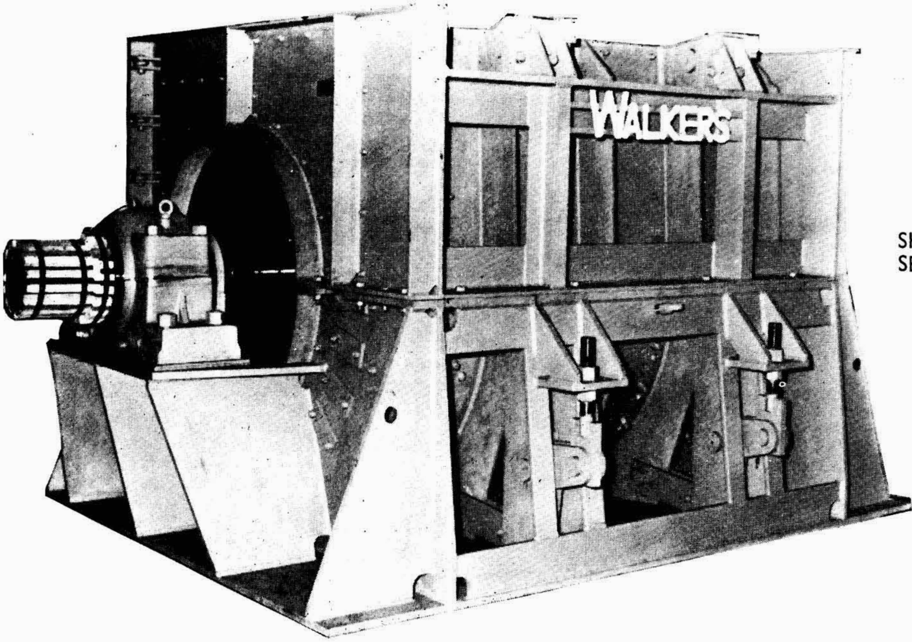
[1] *The Times*, 23rd February 1974.
[2] *Zucker*, 1974, **27**, 64.
[3] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (34), 10.
[4] *Zeitsch. Zuckerind.*, 1973, **98**, 707.
[5] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (35), 6.
[6] *Public Ledger*, 22nd December 1973.
[7] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (36), 7.
[8] *Amerop Noticias*, December 1973, 17.
[9] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (35), 8.
[10] *Amerop Noticias*, December 1973, 17.
[11] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (35), 8.



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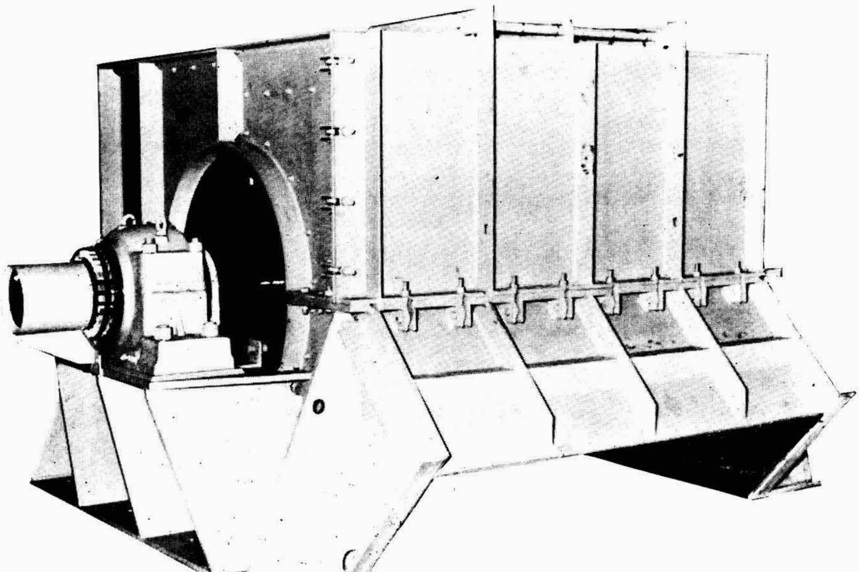
SECTOR ADJUSTMENT



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