THE International Sugar Journal

JUNE 1973

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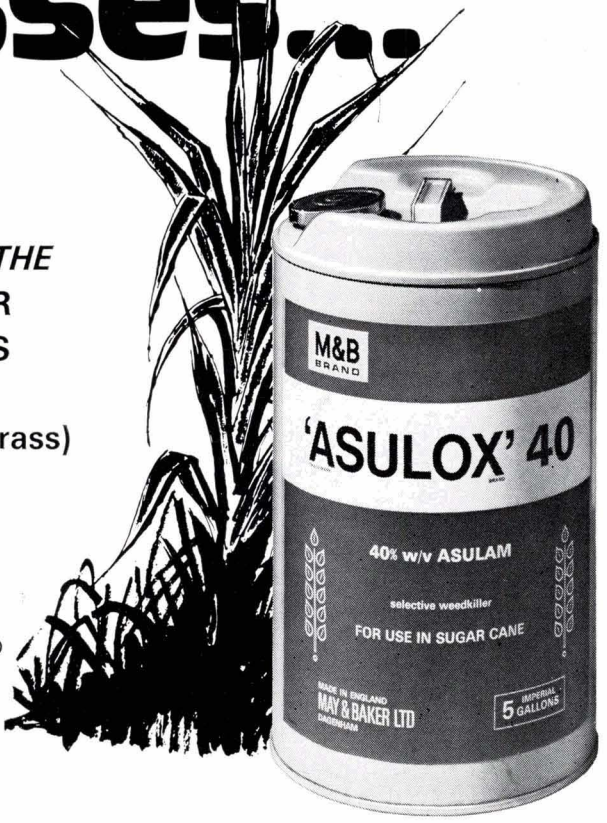

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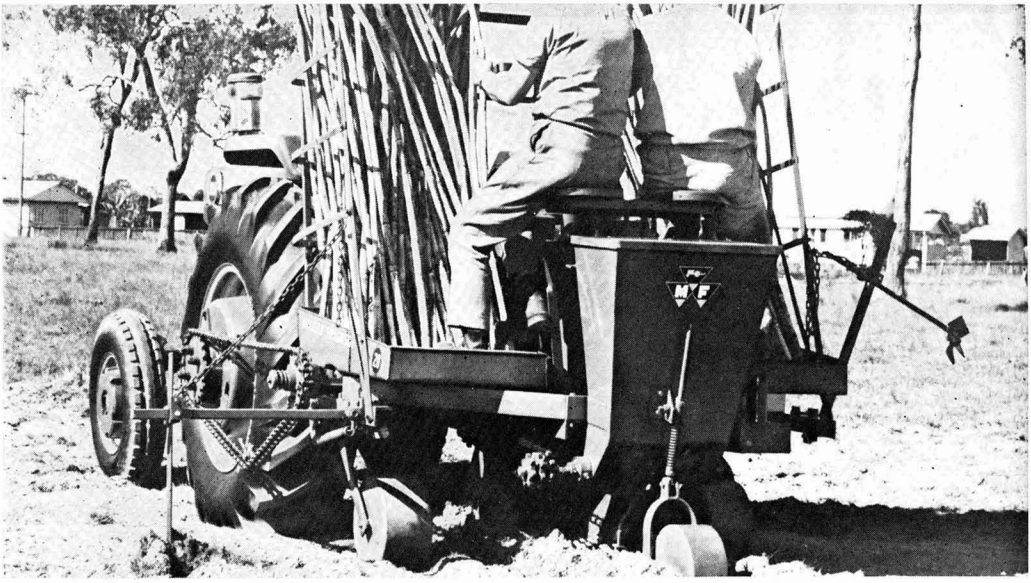

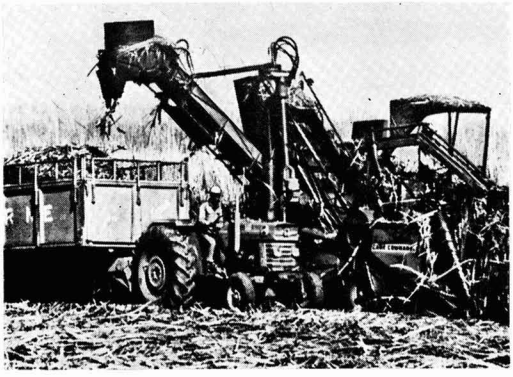

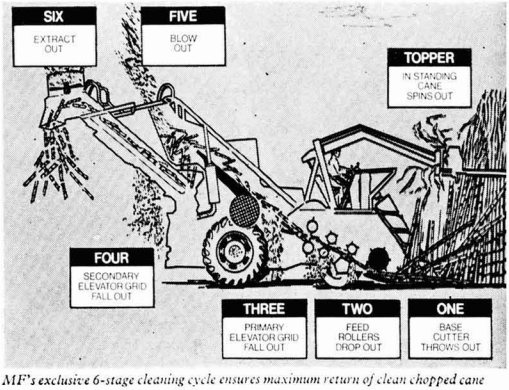

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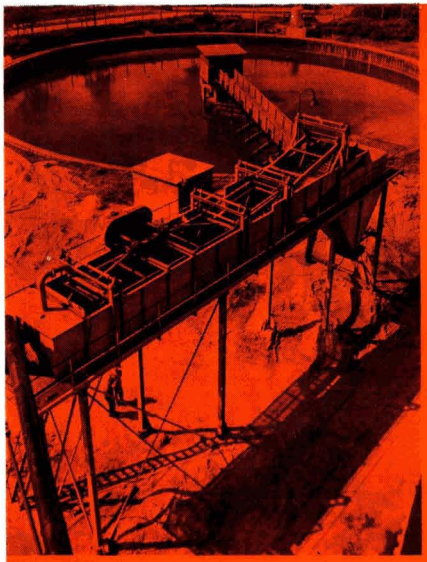

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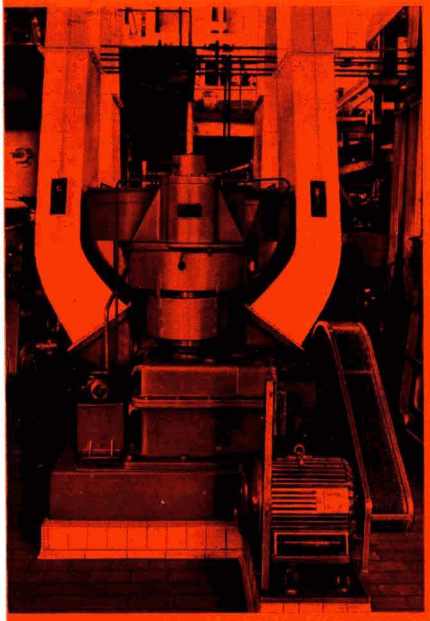

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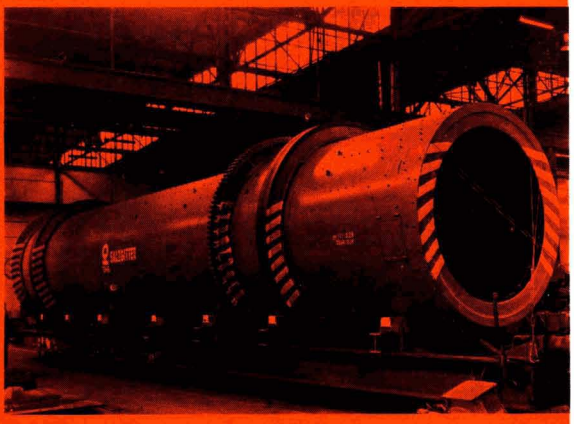

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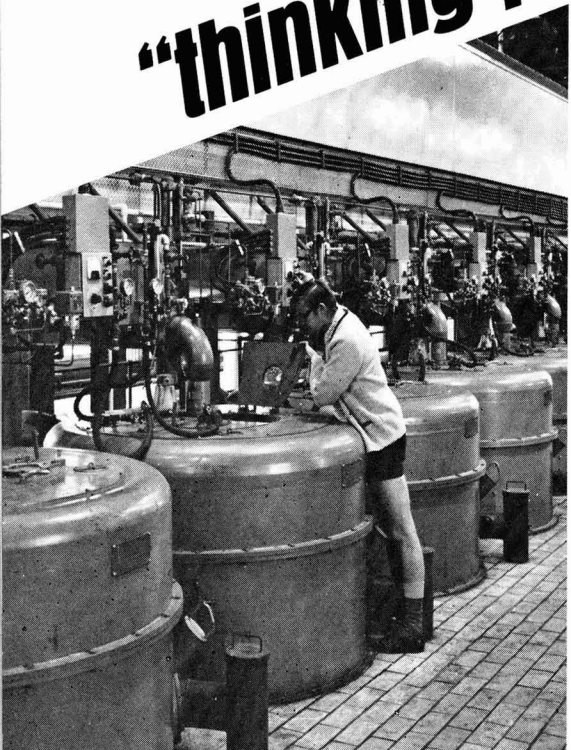

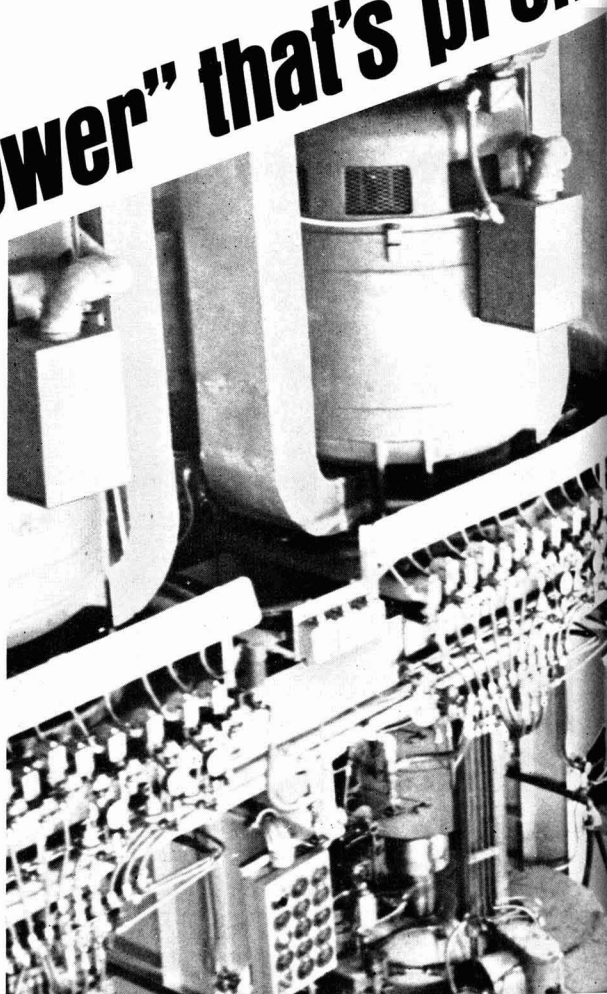

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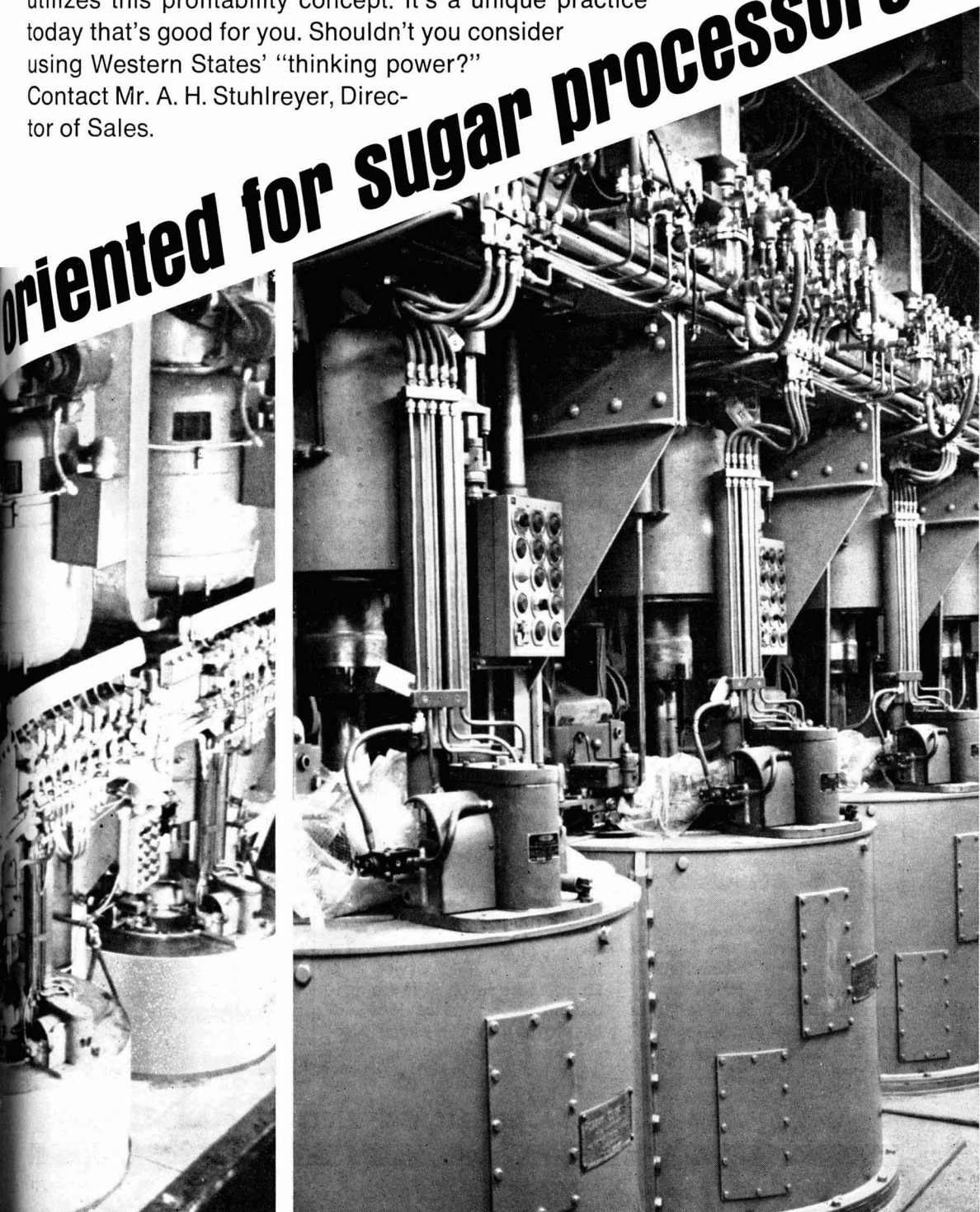

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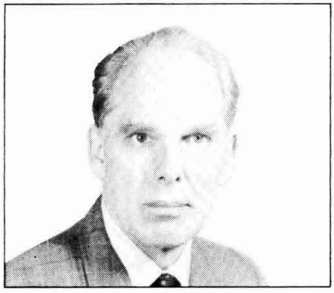

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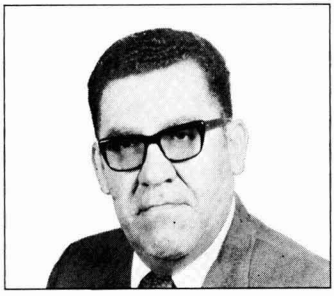

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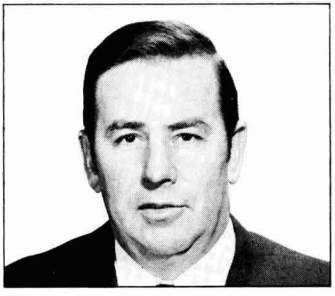

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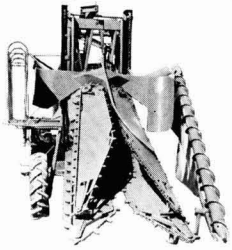

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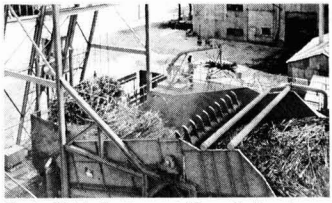

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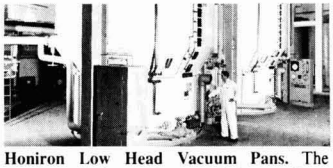

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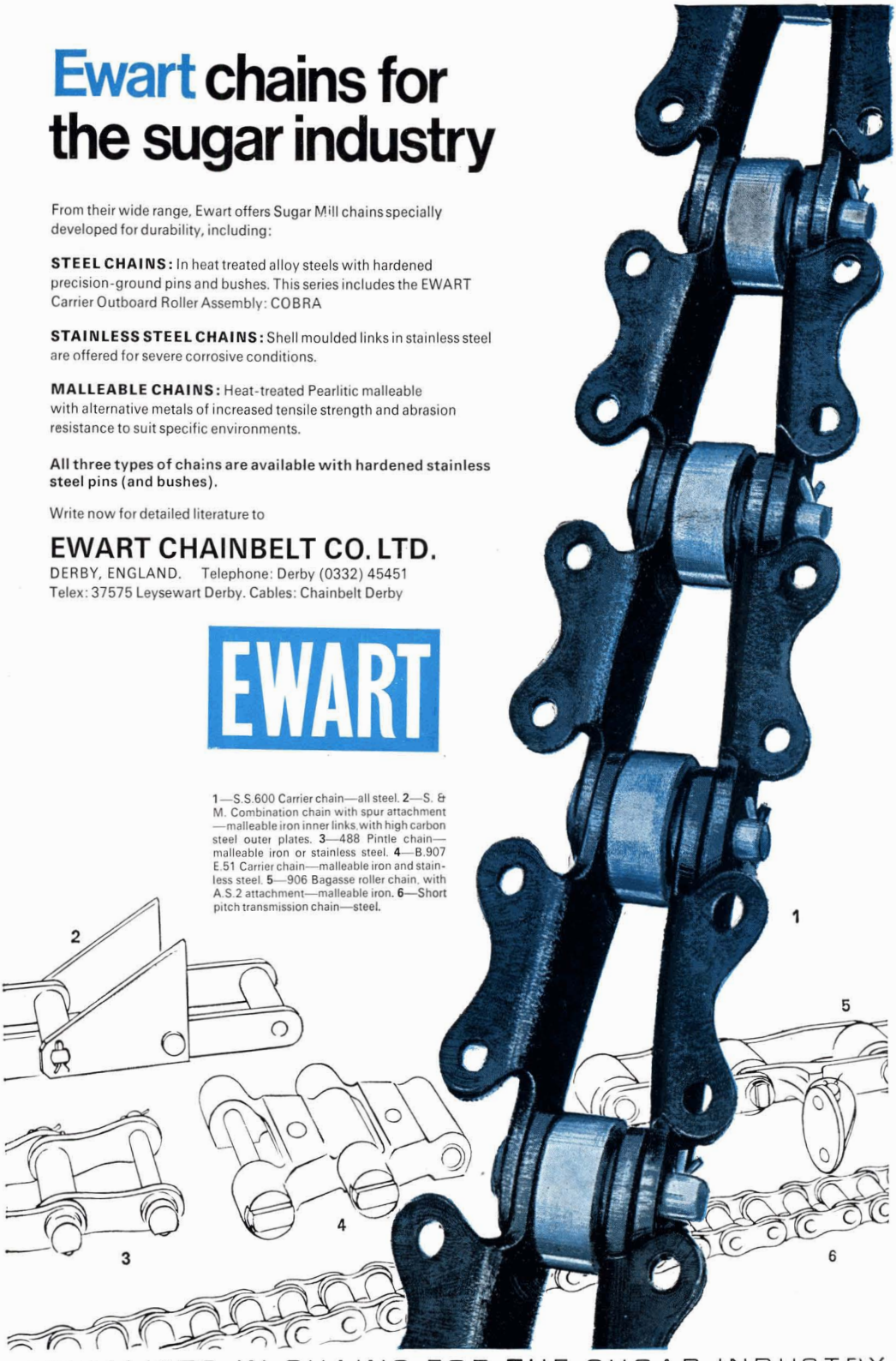

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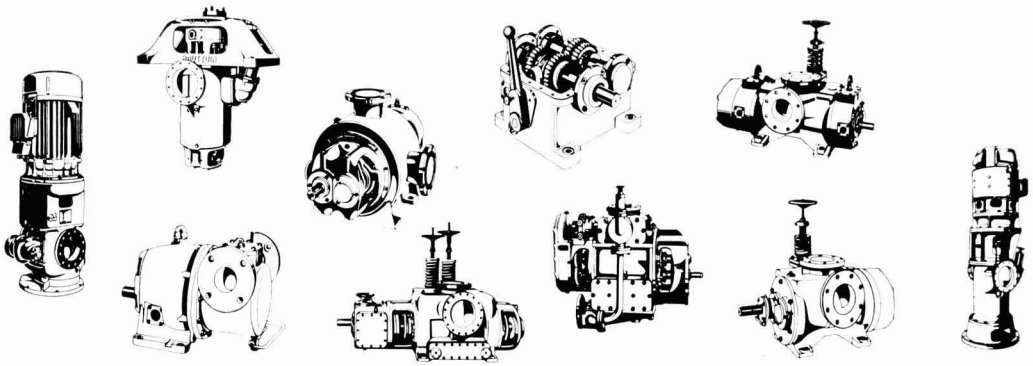

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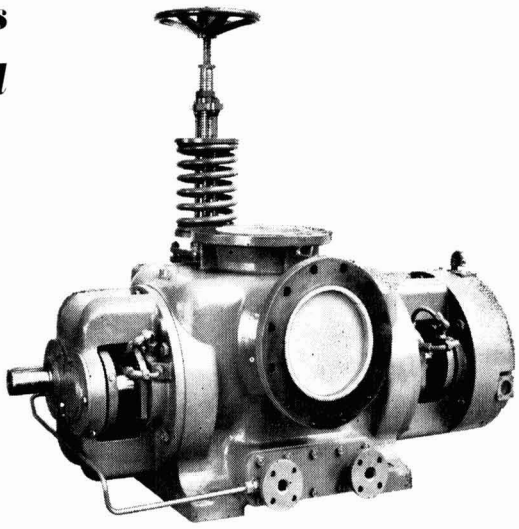

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Meanwhile to those who specialise in the production of sugar from cane or beet, we would modestly suggest that whether you require a new factory, the modernisation or extension of your existing factory or simply new unit equipment or spares, you approach the specialist's specialist.

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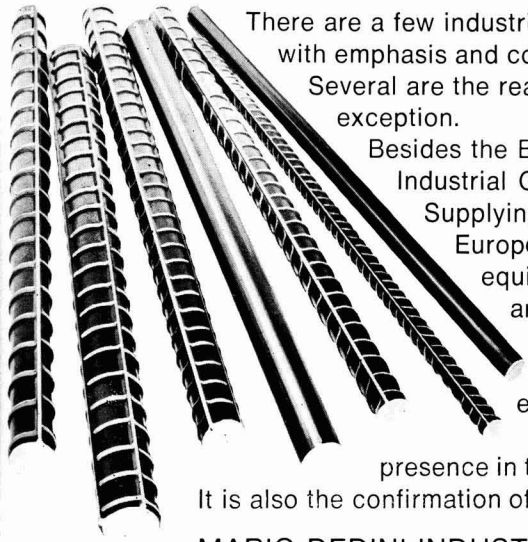

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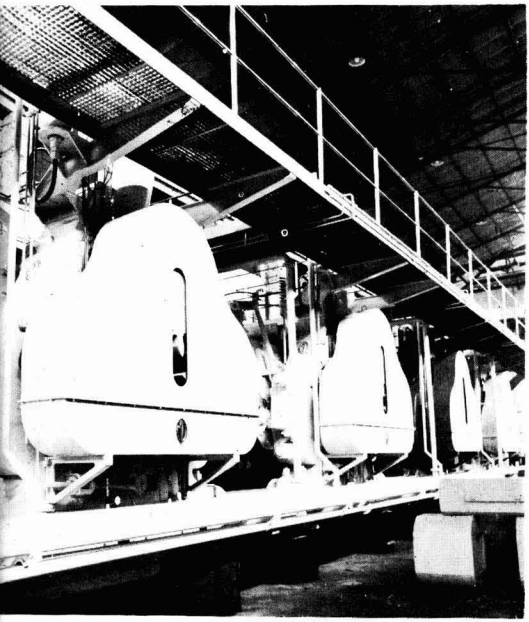

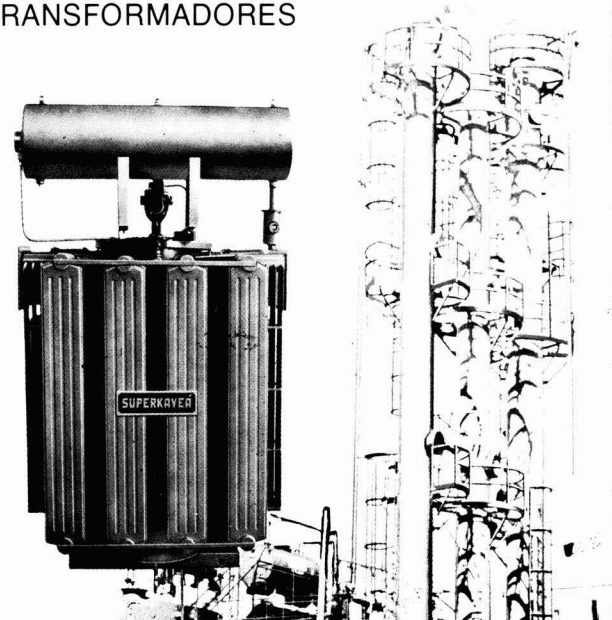

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**This is an average figure of total tons handled divided by hours worked. Densities are figured on average for bulk cane storage.*

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UK ISSN 0020-8841

International Sugar Journal

June 1973

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Application de l'ultrafiltration et de l'osmose inverse au jus de la canne à sucre. R. F. MADSEN. *p.* 163–167

Dans les tests sur le jus de la canne où l'on employait une unité de laboratoire, identique par son principe à une unité commerciale, l'ultrafiltration donnait un jus qui, soit pouvait être envoyé directement à l'evaporation, soit pouvait être epuré davantage avec de la chaux pour fournir après filtration un jus clair débarassé de colloïdes. L'osmose inverse permettait de concentrer le jus de la canne à condition qu'une méthode soit dévelopée pour enlever l'argile et les particules de "bagacillo". L'ultrafiltration et l'osmose inverse n'ont pas permis de traiter le jus clarifié, obtenu par simple défécation, à cause de la formation de dépôts, peut-être de cire, sur les membranes.

* * *

Effet de la sécheresse sur la canne à sucre. H. A. NAQVI et R. UL-QAYYUM. *p.* 168–169

Après un aperçu général des effets de la sécheresse sur la canne à sucre et de l'importance du rôle de l'eau dans la croissance de la canne, les auteurs décrivent leurs observations au Pakistan et aux Philippines où, à côté du rendement très bas de la récolte, la sécheresse a conduit à des pertes plus grandes en sucre et à des difficultés dans le traitement.

* * *

L'appareil à clarifier "Enviro-Clear" à l'usine de Peterborough, campagne 1971-1972. D. E. ASH. *p.* 170–172

Des détails sont donnés sur le fonctionnement d'un appareil à clarifier "Enviro-Clear", d'un diamètre de 15 pieds, qu'on a utilisé pour traiter le jus de première carbonatation, à l'usine de Peterborough de la British Sugar Corporation Ltd. durant la campagne 1971/72. Le jus sortant du décanteur était très clair et brillant et était moins coloré que le jus obtenu d'un décanteur Dorr, mais il contenait plus de sucre inverti. Le jus de 2e carbonatation contenait moins de sels de chaux que le jus sortant du Dorr. Le temps de rétention plus court (10 minutes comparé à 90 minutes dans le décanteur Dorr), donnait en effet une teneur plus basse en acide lactique et en acide pyrrolidone carboxylique suite à une dégradation moins importante du sucre inverti et de la glutamine.

Anwendung der Ultrafiltration und der umgekehrten Osmose auf Zuckerrohrsaft. R. F. MADSEN. *S.* 163–167

Bei Versuchen mit Zuckerrohrsaft, bei denen eine der inneren Gestaltung nach der technischen Apparatur gleiche Laboratoriumsvorrichtung benutzt wurde, lieferte die Ultrafiltration einen Mischsaft oder kalt gekalkten Saft, der sich direkt verdampfen oder erneut kalken und zu einem klaren, kolloidfreien Saft filtrieren liess. Die Konzentration von Rohrsäften ist durch umgekehrte Osmose möglich, sobald eine geeignete Methode zur Entfernung von Ton- oder Bagasseteilchen gefunden ist. Auf aus einem Eindicker nach einer einfachen Kalkung abgezogenem Saft liessen sich die Ultrafiltration und die umgekehrte Osmose nicht mit zufriedenstellendem Ergebnis anwenden, da sich auf den Membranen Ablagerungen, wahrscheinlich von Wachs, bildeten.

* * *

Die Auswirkung der Trockenheit auf Zuckerrohr. H. A. NAQVI und R. UL-QAYYUM. *S.* 168–169

Nach einem allgemeinen Ueberblick über die Auswirkungen der Trockenheit auf Zuckerrohr und die Bedeutung, die das Wasser für das Rohrwachstum hat, berichten die Autoren über ihre Beobachtungen in Pakistan und auf den Philippinen, wo die Trockenheit ausser niedrigen Ernteerträgen Safteigenschaften hervorrief, die sich in grösseren Zuckerverlusten und Schwierigkeiten bei der Verarbeitung auswirkten.

* * *

Der Enviro-Clear-Eindicker in der Zuckerfabrik Peterborough während der Kampagne 1971/72. D. E. ASH. *S.* 170–172

Es werden Einzelheiten über die Leistung eines Enviro-Clear-Eindickers mit ca. 4,5 m Durchmesser mitgeteilt, der während der Kampagne 1971/72 zur Behandlung von Saft der 1. Carbonatation im Werk Peterborough der British Sugar Corporation Ltd. eingesetzt war. Der Oberlauf aus dem Eindicker war sehr klar und brillant und zeigte eine geringere Farbe als Saft aus einem Dorr-Eindicker, hatte aber einen höheren Invertzuckergehalt. Der Saft der 2. Carbonatation enthielt weniger Kalksalze als der Saft aus der Dorr-Eindickung, da sich die kürzere Aufenthaltsdauer (10 min gegenüber 90 min im Dorr-Eindicker) in einem auf Grund der geringeren Invertzucker- und Glutaminzersetzung niedrigeren Gehalt an Milchsäure und Pyrrolidoncarbonsäure auswirkte.

Aplicación de ultra-filtración y ósmosis invertida a jugo de caña. R. F. MADSEN. *Pág.* 163–167

En experimentos con jugo de caña usando un equipo de laboratorio interiormente idéntico con un equipo de escala comercial, ultra-filtración ha dado un jugo mezclado o un jugo alkalizado en frío apto al transporte directo al evaporación o al alkalización adicional y filtración para obtenir un jugo clarificado, libre de coloides. Osmosis invertida puede usarse para concentrar jugo de caña con tal que un método se desarrolla para eliminar arcilla y partículas de bagacillo. Ultra-filtración y ósmosis invertida no tuvieron éxito en el tratamiento de jugo clarificado que trae su origen de defecación sencilla; posiblemente fue una resulta de depósitos, quizás de cera, que se forman sobre las membranas.

* * *

Efecto de sequía sobre caña de azúcar. H. A. NAQVI y R. UL-QAYYUM. *Pág.* 168–169

Despues de un examen general de los efectos de sequía sobre caña y la importancia del papel de agua en el desarrollo de la caña, los autores presentan sus observaciones en Pakistán y las Filipinas, donde, además de bajos rendimientos de la cosecha, causó sequía características en el jugo que dieron como resulta perdidas más grande de azúcar y dificultades en el proceso de fabricación.

* * *

El clarificador marca "Enviro-Clear" a la fábrica de Peterborough, campaña 1971-72. D. E. ASH. *Pág.* 170–172

Se presentan detalles del cumplimiento de un clarificador marca "Enviro-Clear" de 15 pies de diámetro que se ha usado para tratar jugo de carbonatación en la fábrica de la British Sugar Corporation Ltd. a Peterborough en 1971/72. El jugo que ha rebosado del clarificador fue límpio y brillante, tuvo un contenido de color menos que ello de jugo de un clarificador marca Dorr pero tuvo un contenido más alto de azúcar invertido. El jugo de 2a carbonatación tuvo un contenido de sales de calcio menos que ello del jugo del clarificador Dorr porque el tiempo más breve de retención (10 minutos en comparación que 90 minutos en el clarificador Dorr) causó un contenido menor de ácidos láctico y pirolidona-carboxílico como resulta de degradación disminuida de azúcar invertido y glutamina.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXXV JUNE 1973 No. 894

Notes & Comments

International Sugar Agreement

The International Sugar Council held its tenth session in London on the 3rd May 1973. It received a number of reports on routine matters from the Committees of the Organization, including a report from its Statistical Committee which showed that the revised estimate of import requirements of the free market in 1973 amounted to about 11·3 million tons.

Delegates to this tenth session of the Council were to attend the United Nations Sugar Conference which opened in Geneva on the 7th May for the purpose of negotiating a new International Sugar Agreement to come into effect on the 1st January 1974.

It had been reported[1] that Thailand was sending a four-man delegation to the session, under the leadership of the Under-Secretary for Industry, to re-apply for membership of the Agreement and to discuss the sugar export quota to be allotted in the current year. Thailand resigned from the ISA about two years ago because it was dissatisfied with the small quota allotted to it while the country was experiencing a heavy surplus of sugar.

* * *

United Nations Sugar Conference

The first part of the UNCTAD Conference to produce a new International Sugar Agreement commenced on the 7th May in Geneva. Invitations were sent to all members of the United Nations and this includes all signatories to the present agreement with the exception of the Nationalist Government of China, in Taiwan. It has been reported[2] that the UK would take all practical steps to encourage the EEC to take part in the negotiations and was aware of the importance of an effective International Sugar Agreement for the developing countries of the British Commonwealth and the importance of taking these into regard in negotiations between these countries and the Community.

The EEC, however, was to make a strong bid to have the current ISA extended for up to two years, according to reports from Brussels[3]. The aim of this extension would be to give the EEC, which did not join the present Agreement, time to sort out its own major difficulties in the sugar sector. These arise from both its commitment to British Commonwealth producers and also to its internal production system. Because of these difficulties, the Community argues that it will have little chance of fixing its negotiating position before the current ISA expires at the end of this year.

* * *

British Commonwealth sugar consultations

Representatives of the Governments of Barbados, British Honduras, Fiji, Guyana, India, Jamaica, Kenya, Mauritius, St. Kitts-Nevis-Anguilla, Swaziland, Tanzania, Trinidad and Tobago, Uganda, and the United Kingdom, and of the Commonwealth Sugar Exporters' Association met in London on 28th and 29th March 1973 for consultations on the arrangements for Commonwealth sugar exports to the European Community after 1974, when the Commonwealth Sugar Agreement will be replaced by arrangements to be worked out between the exporting countries concerned and the Community as a whole.

The discussions took place against the background of the Community's undertaking on imports of sugar after 1974 from the developing Commonwealth sub-exporting countries, as set out in Part III of Protocol 22 to the Treaty of Accession, the Joint Declaration of Intent, and the Communiqué issued after the London discussions on 2nd and 3rd June 1971, which was subsequently placed on record with the Community. The Protocol, which covers all the developing countries except India, records that the Community will have as its firm purpose the safeguarding of the interests of the countries concerned whose economies depend to a considerable extent on the export of primary products and particularly of sugar. India's sugar interests are covered by the Joint Declaration of Intent in the Treaty of Accession.

[1] *The Times*, 25th April 1973.
[2] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (12), 6.
[3] *Public Ledger*, 28th April 1973.

In accordance with the 1971 Communiqué, all the Governments affirmed that they would continue to regard the Community's undertaking as "a firm assurance of a secure and continuing market in the enlarged Community on fair terms for the quantities of sugar covered by the Commonwealth Sugar Agreement in respect of all its existing developing member countries". The United Kingdom Government re-affirmed that it stands by its assurances contained in that Communiqué without reservations, and that it will continue to do so. The exporting countries present made it clear that they had accordingly already planned the future of their sugar industries on the strength of those assurances of long-term access to the enlarged Community and that they would continue to do so.

The Governments of the Commonwealth sugar-exporting countries present affirmed their determination to pursue at all stages a unified approach to the forthcoming negotiations on sugar with the Community.

They stressed the importance they attached to the necessity for the negotiations on sugar to be entirely separate from those on other products covered by Part III of Protocol 22 and from those concerned with the options extended by Part I of that Protocol. For these reasons the sugar negotiations required a separate timetable, and the exporting countries expressed their intention to seek to open these negotiations with a view to reaching an early conclusion.

* * *

Brazilian sugar plan, 1973/74[1]

Brazilian plans for the 1973/74 sugar crop call for a total production of 115 million bags (6,900,000 metric tons) and have been studied by the Instituto do Açúcar e do Alcool. The plan is due to come into force on the 1st June. The north-east could turn out 38·5 million bags (2,310,000 tons) and the remaining 76·5 million bags (4,590,000 tons) would be produced in São Paulo and the rest of the south-central region. The overall production figure for the 1973/74 crop is 15% higher than the authorized 1972/73 crop.

* * *

European beet area, 1973

F. O. Licht K.G. have recently published their second estimates of the areas to be planted to beet in Europe for the 1973/74 campaign[2] and these appear elsewhere in this issue. Sowings had not yet begun at the time of their first estimates which were necessarily preliminary and have now been changed, although not markedly since the areas are planned or contracted. Increases are expected in all EEC countries except Ireland, Sweden and Holland, the most striking being a rise of 12% or 50,000 hectares in the French beet area.

Small increases or the same areas are planned in other West European countries, while only small increases are forecast for East Europe except for the USSR where the beet area is estimated to be 65,000 hectares higher—and this is only a 2% rise. The total for the whole of Europe is set at 6,880,320 ha as against 6,645,206 ha in 1972, an increase of 235,000 hectares or just about 3½%; since Europe produces about a third of the world's sugar, good crops and high yields would be necessary on the basis of the forecast areas for Europe to make a significant contribution to increased sugar availability and improvement of stocks in 1973/74.

* * *

Record South African sugar crop[3]

The 1972/73 season in South Africa has been an historic one for the sugar industry of that country because a record amount of sugar was produced, a record amount of foreign currency was earned from exports and record milling performances were achieved by ten sugar mills. Furthermore, domestic sales of sugar were at record levels in the season which ended 30th April 1973.

The 1972/73 sugar production reached 1,914,601 metric tons, tel quel, compared with 1,864,665 tons produced in 1971/72, which was the previous record. The crop harvested (16,806,517 metric tons) was not a record; this was established in 1967/68 when 16,913,450 tons of cane were crushed.

A feature of the record production in the 1972/73 season was a more favourable cane:sugar ratio; in previous record cane crops (16,913,450 tons in 1967/68 and 16,751,114 tons in 1971/72) the ratio was 9·28 and 8·98 tons of cane per ton of sugar, respectively. In the 1972/73 season, however, the ratio was 8·77 tons of cane per ton of sugar.

* * *

Dominican Republic sugar statistics

Details of sugar movement in the Dominican Republic during the calendar year 1972 have been published by C. Czarnikow Ltd.[4] and appear elsewhere in this issue. Not only has more than 700,000 tons been shipped to the USA in both 1972 and 1971 but there has been a ready response to the increased demand for sugar from the world market. There has been an expansion in the number of destinations to which sugar has been shipped while in 1972 no less than 480,000 short tons of sugar was exported to countries other than the United States.

Czarnikow note that: "Something of the problem which will face delegates when they meet to draw up a new International Sugar Agreement can be gleaned from these statistics. Under the 1968 Agreement the Dominican Republic had a basic export tonnage of 186,000 metric tons but in 1973 the country has supply commitments under the Agreement for a quantity exceeding that tonnage. If these are all called for, the supply commitment, should such a provision be included in the new Agreement, will exceed her current quota. This problem is not peculiar to the Dominican Republic, of course, and it would seem that several countries will demand a reappraisal of their quota structures".

[1] *Public Ledger*, 28th April 1973.
[2] *International Sugar Rpt.*, 1973, **105**, (12), **1–4.**
[3] F. O. Licht *International Sugar Rpt.*, 1973, **110**, (11), **8.**
[4] *Sugar Review*, 1973, (1123), 69–71.

Application of ultrafiltration and reverse osmosis to cane juice

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Introduction

During recent years the purification and concentration of industrial liquids through semipermeable membranes—the processes known as ultrafiltration and reverse osmosis—have been increasingly used.

Within The Danish Sugar Corporation the development of these processes was started in 1964, and in 1969 a commercial plate-and-frame system was presented together with a range of membranes for ultrafiltration as well as for reverse osmosis[1,2].

Ultrafiltration is the filtration of a solution through a semipermeable membrane, which rejects big molecules but allows smaller molecules, such as sugar, salt, and water, to pass.

Reverse osmosis is the filtration through a semipermeable membrane which rejects also these smaller molecules and allows only water (and possibly other very small molecules) to pass.

Our main reason for the development of the process was to improve juice purification and steam economy within the beet sugar industry. Although the DDS equipment is now in industrial use for a great variety of other processes, the development of the process for the beet sugar industry[3] has been very slow, because the pectins in the juice and the pH conditions cause problems which are difficult to solve.

Within the cane sugar industry we did not try the process until Spring 1972, when a number of tests were made at The Tanganyika Planting Company. The tests were very promising for different applications, although some problems such as earth removal from the juice have to be solved, and membrane life time and cleaning procedures have to be proved satisfactory during long-term tests before the processes can be used in practice.

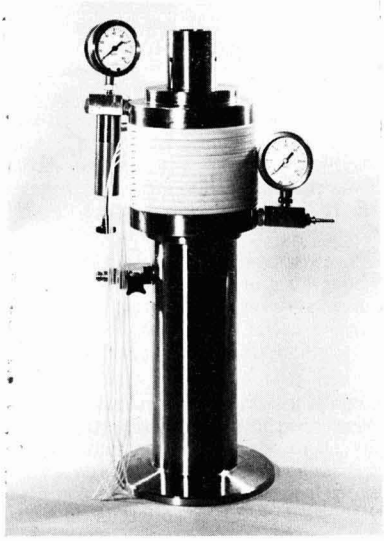

Fig. 1. Laboratory unit

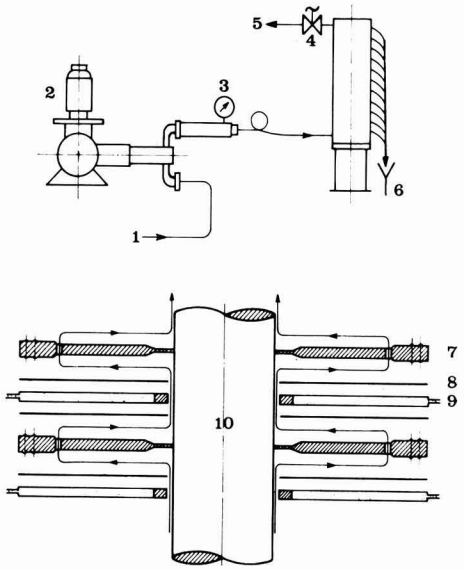

Fig. 2. Commercial unit. 1—inlet; 2—pump; 3—manometer; 4—pressure relief valve; 5—concentrate outlet; 6—permeate outlet; 7—membrane spacer; 8—membrane; 9—membrane support plate; 10—centre bolt

Equipment

For the experiments an 0·2–0·4 m² laboratory unit was used (Fig. 1). The internal construction is exactly the same as in the commercial unit (Fig. 2), but the unit can be dismantled for membrane change in a few minutes.

Construction

The construction of the filter is a one-bolt plate-and-frame construction, with unit sizes of 1·8, 5·4, 7 and 28m² filtering area.

The solution enters one end of the module and flows in and out in series over all the membranes. Membrane supports and spacers between the membranes are plastic moulded ("Hostaform") and give an effective, cheap construction.

The solution flows in a narrow channel (0·3 mm) of a special construction disturbing the parallel

[1] MADSEN: *Dechema-Monographien*, 1970, **64**,
[2] MADSEN *et al.*: *Paper presented at Filtech*-71, London, 1971.
[3] MADSEN: *Zeitsch. Zuckerind.*, 1971, **96**, 612-614.

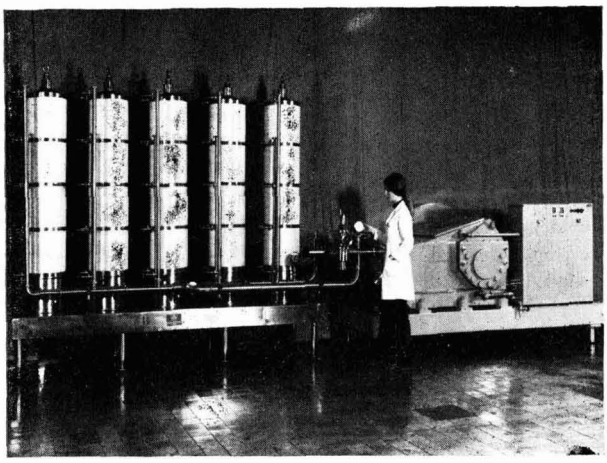

Fig. 3. Commercial ultrafiltration plant

laminar flow along the membrane. This construction effectively prevents most scale or deposit formation. The filtrate (permeate) leaves the module through slots in the membrane support ending in one small tube for each pair of membranes, making it possible to close one pair of membranes if a membrane defect occurs. Fig. 3 shows a commercial ultrafiltration plant.

Membranes

All experiments were made with membranes of our own construction. Table I gives the main characteristics of the membranes used.

All membranes used except EC 5·7 are commercially available, and are of cellulose acetate. The pH range for such membranes is between 3 and 8, and the maximum temperature is normally given as 30°C.

EC 5·7 is an ethylcellulose membrane which is more alkali-resistant than the other membranes.

Experiments with clarified juice from simple defecation

Short-term experiments were made on ultrafiltration with membrane 600 and reverse osmosis concentration with membrane 985 on cooled clarified juice of about 80 purity and pH 7·0. In both experiments the capacity started at about 500 litres permeate per m^2 filtering area per 24 hr, but dropped within a few minutes to below 200 litres per m^2 per 24 hr, and within 2 hours to below 100 litres per m^2 per 24 hr. The experiments were not continued because the capacities were too low. An inspection of the membranes showed a yellowish-red deposit which could be wax.

Ultrafiltration of 1st expressed juice, mixed juice and diffusion juice

A total of 6 experiments were made. Before the ultrafiltration the juice was screened on a centrifugal screen or filtered through "Neotex 3670" filter cloth.

In each experiment 40–60 litres juice were treated.

Membranes of type 600 were used in all experiments, but membranes of type 500, 800, and EC 5·7 were tested simultaneously in some of the experiments. Table II gives results for the comparison of the different membranes operated at 6 $kg.cm^{-2}$ filtering pressure.

From the comparative tests, membrane 600 was selected as the most promising. Membrane 500 was too open. The juice had high colour and a little turbidity. Membrane 800 had so high a sucrose

Table I

Membrane	*Water flux (at 15°C)*		*Rejection sucrose*	*Pressure, atm*	*99% rejection at MW ⩽*
	litres per m^2 per 24 hr	*pressure, atm*			
500	4000	6	0%	6	40,000
			0%	18	
600	3000	6	1%	6	20,000
			8%	18	
800	1400	10	15%	20	6,000
985	1550	42	100%	42	200
EC 5·7	1400	6	20%	20	10,000

Table II

Membrane	500	600	800	EC 5·7
Capacity* (litres per m^2 per 24 hr at 6 atm)	710	510	400	130
Maximum capacity* (litres per m^2 per 24 hr at 6 atm)	850	810	800	210
Pol ratio†	0·91	0·85	0·66	0·83
Colour in permeate, °St, measured at pH 5·4	20·0	6·5	2·7	6·0
Conductivity ratio‡ at 6 atm	1·00	1·00	0·94	1·00

* After filtration of 50% of the juice.
† pol ratio = pol in permeate/pol in unfiltered juice.
‡ Conductivity ratio = conductivity in permeate/conductivity in unfiltered juice

rejection that it would be difficult to minimize sucrose losses, and EC 5·7 had too low a capacity.

Figs. 4a, 4b show the pol ratio and permeate flux* with different membranes for increasing pressures.

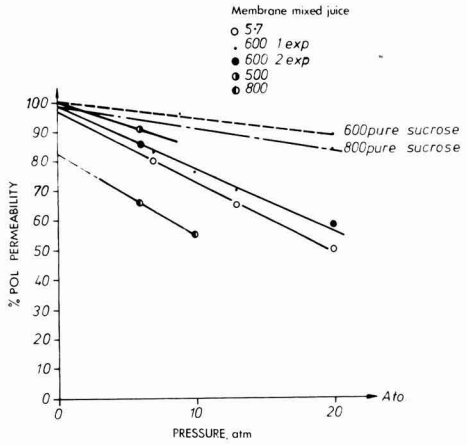

Fig. 4a. Pol permeability (pol in permeate/pol in juice × 100) *vs.* pressure

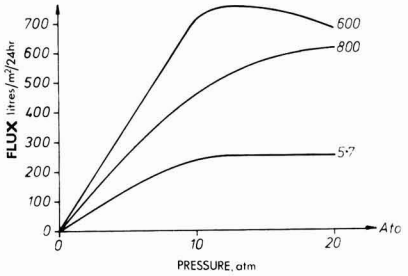

Fig. 4b. Permeate flux *vs.* pressure. (Capacity on mixed juice of 12·6°Bx and 74·7 purity)

Comparative results are also given for pure sugar solutions. The pol permeability is lower with cane juice, showing that the membrane characteristics are changed by dynamically formed membranes on the surface or a reversible "plugging" of the membranes.

The experiments show the importance of limiting the pressure and flux in order to get a good sucrose permeability. If high flux and pressure are used, the sucrose is concentrated. This makes sweetening-off difficult and reduces the capacity at the end of the concentration.

In order to increase the pol ratio it is necessary to decrease the pressure. Increase of pressure beyond a certain limit does not increase the capacity because boundary layer formation on the membranes prevents capacity increases. This is a normal problem in almost all ultrafiltration processes.

Fig. 5 gives the filtration rate for 3 experiments with membrane 600. The experiments were all made

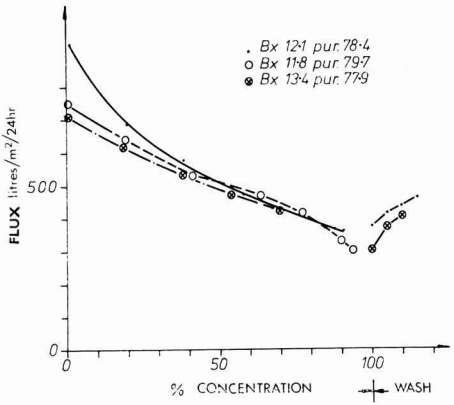

Fig. 5. Flux *vs.* mixed juice ultrafiltration with membrane 600 at 6/5 atm

at about 6 kg.cm^{-2} filtration pressure, and at temperatures varying between 30°C and 33°C. All experiments were made on mixed juice. The same membranes were used, and between the experiments the modules were cleaned with a detergent, with alkalase enzyme and a water flush. The experiments did not show any sign of irreversible decrease in flux.

The difference between the initial flux in the first experiment and the other two is normal and arises because the membranes are compressed during the first 1–2 hours of operation.

After filtration of 90–93% of the juice an addition of water to the concentrate was started, and the ultrafiltration was continued. The sugar losses in the experiments were higher than necessary in practice, because at least 3 litres liquid was necessary in the system for continuous operation. At the end a concentration to about 2 litres was possible.

Table III

		Mixed juice
Original sample	Brix	17·1
	Pol %	14·45
	Purity	84·3
	Conductivity	0·55
Average permeate	Brix	16·12
	Pol %	14·08
	Purity	87·3
	Conductivity	0·56
	Colour	0·4
Average wash	Brix	10·53
	Pol %	8·79
	Purity	83·5
	Colour	0·4
Average wash + permeate	Brix	15·0
	Pol %	12·96
	Purity	86·2
	Colour	0·4
	Conductivity	0·53
Concentrate after wash	Brix	10·82
	Pol %	5·30
	Purity	49·0
	Sugar loss, % total Pol	1·46

*Permeate flux is the amount of water passing through a given membrane area in a given time, and is here expressed as litres per m² per 24 hr.

Table III gives average figures for the experiments with mixed juice.

The reason for the very low purities in all samples was that the experiments were made at the start of the rainy season, when cane quality is very bad.

Cold limed juice

Although the results with clarified juice were disappointing, some experiments were made with ultrafiltration of limed juice before heating and clarification.

At first a long-term test (30 hr) was made, in which the limed juice (pH 7·2) was recycled and permeate sent back to the concentrate in order to show if a steady flux was possible.

Fig. 6 shows the time-flux relationship. The capacity decreased with time, but could be restored by stopping the plant for ¼–1 min (releasing "scale" on the membrane).

Fig. 7 and Table IV give results from a concentration test for 60 litres limed juice. In all respects the purification is better than with simple defecation. The juice is perfectly clear after ultrafiltration.

The colour of the juice is about 10% lower than that of a normally clarified juice filtered on a 4 μm membrane filter.

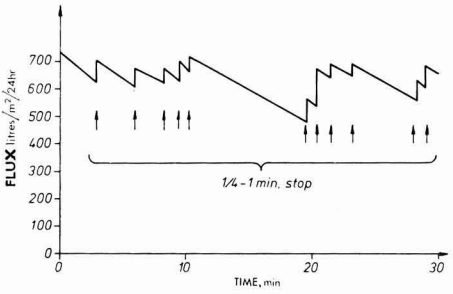

Fig. 6. Flux *vs.* time (cold limed juice treatment on membrane 600)

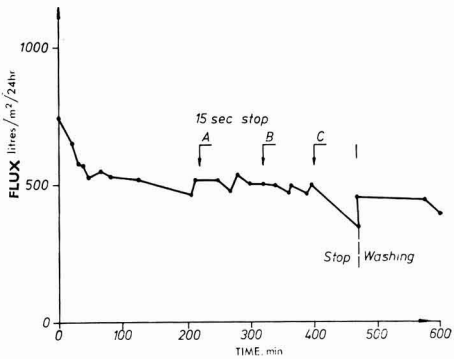

Fig. 7. Flux *vs.* time (cold limed juice treatment on membrane 600)

An experiment with membrane 800 shows a better purification, but the membrane is difficult to use because of sucrose rejection.

The purification method gives directly a juice which can go to the evaporators or to a reverse osmosis plant, and there is a very good chance that the juice can be used for white sugar production without further purification. Remelting is of course necessary when the purity is as low as in this factory.

Reverse osmosis tests

Reverse osmosis experiments were made on membrane 985 with mixed juice, diffusion juice, and permeate from membrane 600 after ultrafiltration of cold limed juice.

The capacities at various Brix levels are shown in Fig. 8.

The capacities are in all cases satisfactory, and without doubt reverse osmosis can be used for the concentration of these juices when a satisfactory method for the removal of clay and small bagacillo particles has been developed.

Table IV. Results from the ultrafiltration of cold limed juice

	Normal clarified juice	*Average permeate membrane* 600	*Average wash water membrane* 600	*Concentrate after wash*	*Average wash + permeate membrane* 800
Total amount % on limed juice		93·0	17·3	4·0	
Pol	8 84	8·14	5·70	3·76	5·60
Purity	72·4	73·4	74·9	41·2	75·7
Colour % sucrose at pH 7	8·94	8·44	5·60	3·72	5·40
Loss of total pol %				1·8	
Colour E 420 on 100 Bx	10·5*	9·7	8·8		6·5
% *on* 100 *Bx of*					
Ash	9·6	8·6	9·5	36·5	7·5
Protein	3·0	2·0	2·8	23	1·9
Ca	0·91	0·72	1·24	16	0·58
Mg	0·073	0·039	0·079	0·88	0·022
Na	0·30	0·18	0·41	0·92	0·29
K	3·6	2·7	3·2	3·5	2·4
P_2O_5	0·18	0·20	0·42	6·4	0·31
Fe	0·004	0·003	0·004	1·15	0·002

* Filtered on 4 μm membrane

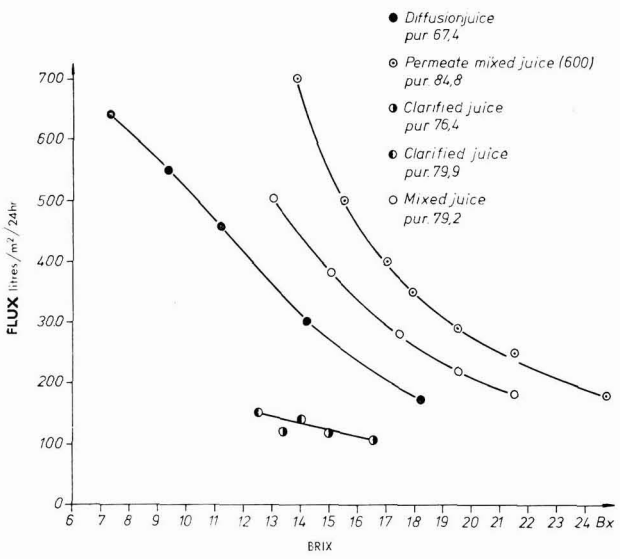

Fig. 8. Flux *vs.* Brix (Permeate pol with clarified juice is 0·2–0·4 and with other juices <0·1 on membrane 885)

Cleaning

In all cases the cleaning of the membranes seemed to be rather easy (except after clarified juice treatment).

A short stoppage of the plant gave a reasonably efficient cleaning, and a wash with detergent seemed to restore the original membrane performance completely. However, only long-term tests can show whether the cleaning procedures are efficient.

Economic aspects

The ultrafiltration process can treat about 500 litres mixed or cold limed juice per m² per 24 hr, which means that, making a reasonable allowance for capacity decrease, etc., for each 1000 tons cane processed per day, about 2500 m² ultrafiltration area must be installed, equivalent to an investment of approximately £200,000.

The running expenses for the system are primarily those for electricity (probably approx. 130 kW/1000 t.c.d.) and replacement of membranes.

A membrane life of at least 1 campaign is not unrealistic. The expenses for replacement of membranes/1000 t.c.d. are approximately £60 assuming a membrane life of 250 days of operation.

Although the investment costs are relatively high, the gain can easily pay for this investment, if white sugar can be produced directly, and all micro-organisms etc. are removed so that the losses in final molasses are reduced.

For the use of reverse osmosis a capacity of about 350 litres permeate per m² per 24 hr should be possible with a reasonable allowance for capacity decrease if reverse osmosis is used for removal of up to 40% of the water in the juice.

For cane factories using oil as fuel the operating costs for removal of 1 ton water in an evaporator with an evaporation of 3 tons water/ton steam are compared with the operating costs for reverse osmosis (Table V).

Investment costs for reverse osmosis are approximately £200/ton water removed /24 hr.

Investment costs for an evaporator of the same capacity are lower, but the investment costs for evaporator + boiler are higher than this figure.

Reverse osmosis could therefore be of great benefit to factories which need both boiler and evaporator capacity, if electric supply is available.

Table V

	Evaporation costs/1000 tons water removed	*Reverse osmosis costs/1000 tons water removed*
Oil 22 tons at £10	£220	
Electricity, kW at £0·006	£ 6	£26·4
Membrane costs		£72
Evaporator cleaning	£ 3	
	£229	£98·4

Summary

By means of a number of experiments with an ultrafiltration and reverse osmosis laboratory module on cane juice at The Tanganyika Planting Company, possibilities of using membrane processes for the concentration and purification of cane juices have been evaluated.

Purification of mixed juice by ultrafiltration is possible. On average the module capacity was 450 litres juice per m² per 24 hours including time for sweetening-off. The filtered juice can be further purified by liming and filtration, giving a clear juice without any colloids.

Purification of cold limed juice is possible at the same capacity. The filtrate can go direct to evaporation, and white sugar can be produced without further purification.

Purification by ultrafiltration or concentration by reverse osmosis is not possible with clarified juice from simple defecation because of deposits, perhaps of wax, which are formed on the membranes.

Mixed juice, diffusion juice, and permeate from ultrafiltration can be concentrated at satisfactory rates.

Effect of drought on sugar cane

By HASAN ASKARI NAQVI* and RASHED-UL-QAYYUM†

(University of the Philippines, College of Agriculture, Los Banos, Laguna, Philippines)

Introduction

WATER is an essential requirement for plant growth. Where adequate nutrient supplies and satisfactory plant protection measures are adopted, sugar cane yield might be the highest at the optimum moisture levels. More than 70% of the total fresh weight of a cane plant consists of water and it is generally believed that one ton of water is required to make one pound of sugar in irrigated sugar cane plantations[1]. However, the amount of water actually utilized in the building processes of the plant is very small. The absorption of water in such large amounts helps maintain the internal water balance and turgidity of the plant cells[2], which are closely related to the rates of various physiological processes that control the quantity and quality of the plant growth. Excess water is lost through transpiration.

The process of transpiration acts as a temperature regulator in the plant and aids in the absorption of nutrients within the plant. The transpiration rate is controlled by leaf area, internal leaf structure, thickness of the cutin, extent of stomatal openings, and by such environmental factors as solar radiation, humidity, temperature and wind. The rate of water absorption depends upon the rate of water loss, the extent and efficiency of root systems, and the availability of soil moisture. Water deficit in the cane plants can be caused either by excessive loss of water, by slow absorption of water, or by a combination of the two[1]. The water deficit hastens maturation of the cells and tissues, increases the thickness of cell walls and decreases the succulence[3].

The effect of drought on the growth of sugar cane

Moisture as a climatic factor plays a dominant rôle in the growth of sugar cane. Some workers have shown that a close relationship exists between temperature, water consumption and growth[4]. They concluded that a definite amount of water is required for each grain of tissue and sugar produced. Obviously the rate of water intake and loss requires a rather precise balance in the crop. When the rate of transpiration exceeds the rate of absorption of water, the cane plants are apt to suffer from drought. TABAYOYONG *et al.*[5] reported that the effect of drought was greatest when it occurred a few months before harvest after ample rainfall during the growth period had occurred. With sufficient moisture near the surface, the roots did not penetrate deeply and the cell walls of the tissue were thin, elastic and permeable, facilitating dehydration. Prolonged drought prevented the development of a higher sucrose content. Drought resulted in low yields of cane with a high Brix but low purity.

In Queensland, Australia, a severe drought was experienced in 1965[6]. The average mortality of stalks ranged from 18 to 70%, depending on the variety of sugar cane. Moreover, the length of the cane was considerably reduced in some varieties. Drought injury was believed to result from both metabolic and mechanical effects that accompany tissue dehydration and overheating[7]. A reduced sugar yield on cane may result from a high fibre content due to restricted length of internodes and greater transpiration, stunted growth and thicker trashy materials enveloping the cane stalks[8,9]. Similarly LOCSIN[10] also reported 24% shortening of internodes and millable stalks of 29 cane varieties affected by dry weather. In the mill district of Victorias Milling Co. Inc., Philippines, during 1957–58, the average loss in cane length was reported to be 7·9–36·5% as a result of drought[5].

In the Philippines the fields are mostly dependent on natural rainfall (average rainfall above 80 inches annually), and the cane crop is badly affected whenever there is a long dry spell as has been found to occur every five years. Periods of drought were observed[9] in most of the cane growing areas in the country during the year 1949, 1954, 1958, 1967 and 1968.

RAO[11] has distinguished between two kinds of drought: atmospheric and soil drought. The former occurs when the atmospheric temperature is very high, and its effects can be avoided only by a plant possessing a well-developed root system, ample water-conducting tissues, and reduced leaf surface area. The second kind, where the soil is dehydrated, is more dangerous for the plant since the wilting is permanent and none of the anatomical-physiological pecularities of the plant can save it.

In Pakistan the cane fields are mostly dependent on artificial irrigation from canals, rivers and tube-wells. The average annual rainfall is hardly 10–30 inches. There is a vast network of irrigation canals, especially in Punjab and Sind provinces, and there

* Processing Chemist, Adamjee Sugar Mills Ltd., Daryakhan, Mianwali, Pakistan.

† District Soil Conservationist, Mastung, Kalat Dist., Pakistan.

[1] HUMBERT: "The Growing of Sugar Cane" (Elsevier, Amsterdam) 1968, 779.

[2] KRAMER: "Plant and Soil Water Relationship" (McGraw-Hill, New York) 1949.

[3] RICHARDS and WADLEIGH: "Soil Physical Conditions and Plant Growth" (Academic Press, New York) 1952, 73–251.

[4] BURR *et al.*: *Ann. Rev. Physiol.*, 1957, **8**, 275–308.

[5] *Victorias Milling Co. Expt. Sta. Rpt.*, 1959, (30).

[6] ANDERSON: *Cane Growers' Quarterly Bull.*, 1969, **32**, 121–123.

[7] RUSSELL: "Water and its Relationship to Soil and Crops" (Academic Press, New York). 1959.

[8] DEERR: "Cane Sugar", 2nd edition (Norman Rodger, London) 1921.

[9] MADRAZO: *Proc. 16th Conv. Philippines Sugar Tech.*, 1968.

[10] *Sugar News* (Philippines), 1950, **26**, 571–574.

[11] *Proc. 7th Congr. I.S.S.C.T.*, 1950, 82–87.

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Table I

Crop year	*Crusher juice Brix*	*Crusher juice purity*	*Fibre % cane*	*Imbibition % cane*	*Mixed juice % cane*	*Molasses %cane*
1967–68	17·52	81·44	14·53	19·10	89·25	3·74
1968–69	18·50	78·16	14·91	17·33	85·53	3·55
1969–70	18·31	77·44	15·66	20·97	87·91	3·69
1970–71 (drought year)	18·73	75·86	16·13	21·91	87·24	4·15
1971–72	18·65	79·19	15·77	23·20	89·21	3·62

is therefore practically no dry season effect on the sugar cane crop when the fields receive adequate irrigation water from the canals. However, certain areas need supplementary irrigation from tube-wells. In the mill district of Adamjee Sugar Mills Ltd. at Daryakhan, the cane crop was badly affected during the crop year 1970–71 with low yield per acre and low sugar recovery. Deficiencies in electric power supply over a long time, responsible for a lower pumping efficiency at the tube-wells, and a comparatively longer dry season when a total of 10–12 inches rainfall was registered, resulted in a water deficit in the area.

Behaviour of drought–affected cane during processing

WARREN[12] reported the processing of drought-affected cane for two crop years, 1947 and 1948, in a sugar factory in the West Indies. He found a reduction in the absolute juice extracted per ton cane. The pol in bagasse was increased from 1·68 to 3·84% giving a pol extraction of 90·57 against 96·50 although the same amount of water was applied at the mills as normally. The purity of final molasses increased by 2–3 units.

The cane brought to the mill during a drought in the Philippines contained more trashy material than cane grown under normal conditions[13]. This trashy material absorbed some juice in the mills, thereby reducing the extraction figure. A recent report[14] indicated that 1% increase in trash reduced the sucrose extraction by 0·41% and overall recovery by a minimum of 1·851%.

In a study[15] in India on the processing of drought-affected cane, it was found that affected cane started the season with a higher Brix and higher juice purity than normal. Deterioration of drought-affected cane was faster than with normal canes; this was considered significant because instances of cane being milled 36 or 48 hours after harvesting were common and affected the overall recovery in the factory operations. At the same time, drought-affected cane accounts for more difficult mud filtration during the processing[13,15] which consequently leads to greater sugar losses in the mud. WIGGINS[16] reported on studies of difficulties experienced at the clarification station with cane grown under drought conditions. In studying the composition of cane juices under variable degrees of moisture stress, a very large increase in the amino-acid content of the juice was observed from the drought-affected cane; the juice was practically impossible to clarify by the ordinary methods. However, there was a sharp reduction in the amino-acid content of the juice when the affected cane was irrigated.

It was noted at the Adamjee Sugar Mills Ltd. during the crop year 1970–71 that the cane brought to the mills contained more sand, clay and mud which passed on with the juice, resulting in early blockage of the heater tubes. The juice heater, which was usually cleaned after every 8–10 days during normal working, had to be cleaned after every 2–3 days. Another problem observed was the earlier fouling of the evaporator tubes.

In the table are given the Brix and purity of crusher juice for five crop years. It may be seen that the Brix of crusher juice during the crop year 1970–71 (drought year) was higher and at the same time its purity was lower than that of crusher juice in other seasons.

The fibre in cane during the drought year was higher than for the crops in the other years, while it may also be noted that the mixed juice % cane was comparatively lower in the 1970–71 (drought year) although the imbibition was higher. The molasses % cane also increased considerably during the drought year. This was the most alarming and obvious problem in the course of processing the drought-affected cane. The abnormal quantity of molasses not only caused difficulty in pan-floor operations, which seriously affected the milling capacity, but also caused storage problems.

In addition it was observed that sugar losses in bagasse, filter cake and molasses increased by 10–12% during the drought year as compared with the results of the other crushing seasons.

Acknowledgements

Grateful acknowledgement is extended to Dr. RAMON SAMANIEGO, Professor of Sugar Technology, Dept. of Agricultural Chemistry, and Dr. ELPIDIO ROSARIO, Asst. Professor of Agronomy, Department of Agronomy, UP College of Agriculture, College, Laguna, Philippines, for the help and guidance provided in writing this article.

[12] *I.S.J.*, 1950, **52**, 12–13.
[13] MADRAZO: *Proc. 17th Conv. Philippines Sugar Tech.*, 1969, 311–314.
[14] BIMELZA: *Proc. 19th Conv. Philippines Sugar Tech.*, 1971.
[15] PARASHAR: *I.S.J.*, 1960, **62**, 320.
[16] *Proc. B. W.I. Sugar Tech.*, 1954, 10–11.

The Enviro-Clear clarifier at Peterborough factory, 1971-72 campaign

By D. E. ASH

Paper presented to the 21st Technical Conference, British Sugar Corporation Ltd., 1972

Introduction

DURING the 1970–71 campaign, a laboratory scale model of the Eis (or Enviro-Clear) clarifier[1] was demonstrated successfully at Peterborough by F. G. EIS and J. MULDOWNEY, of Enviro-Clear Inc., New York.

Following this demonstration it was decided to purchase a 15 ft diameter vessel, which was installed on an experimental basis at Peterborough factory during the 1971 off-season.

Its performance during the 1971–72 campaign was perfectly satisfactory in all respects, subject to certain limitations, mainly due to lack of sufficient space and headroom in the only suitable site, which are mentioned later in this report.

The Enviro-Clear clarifier is basically a sludge blanket clarifier developed from similar types in use on effluent and water-softening plants and adapted for use in the sugar manufacturing process. The principle of operation is that a liquor is filtered upwards through its own suspended sludge bed with the aid of a polyelectrolyte settling agent to form a compact bed.

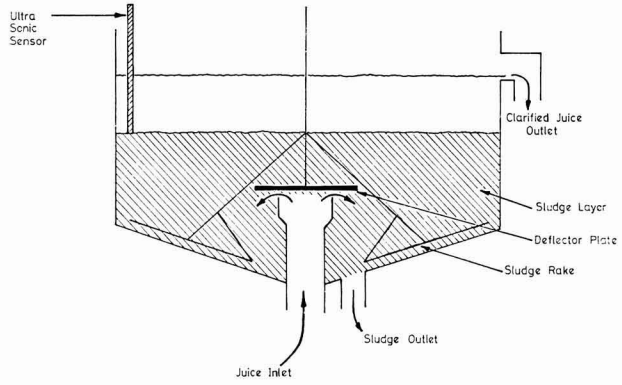

Fig. 1. Enviro-Clear clarifier

Description

The clarifier is preceded by a de-aeration trough (approximate dimensions 17 ft long, 3 ft wide and 6 ft deep) for removal of excess CO_2 gas from the juice; liquid level in the trough is controlled by an adjustable weir plate. The clarifier itself is cylindrical in shape, 15 ft in diameter by approximately 5 ft high, having a capacity of nearly 900 ft³. The floor of the vessel is in the form of a shallow cone, the mud being swept to the outlet by a set of slowly-rotating rakes. Clarified juice overflows at two points at 180° to each other, sludge removal being from the base of the clarifier, the sludge bed level being maintained by means of an ultrasonic sensor probe operating within a frequency range of 40–50 kHz, and linked to a Saunders control valve in the sludge underflow line. Fig. 1 illustrates the main points of the design.

Operation

The clarifier was used at a juice throughput of around 600 gpm, some 50% of total juice flow at Peterborough. At this flow rate the clarifier performed well and gave little trouble, but we were unable to reach the designed capacity of around 800 gpm, mainly because of the poor design of the de-aerator, which resulted in the presence of too many floating particles in the clarifier.

This had two adverse effects: (a) the overflow juice was not as clear as it might have been, and (b) large numbers of floating particles caused the ultrasonic level detector to operate and open the sludge underflow valve repeatedly, the sludge bed then being lost. We hope to improve the de-aeration arrangements.

Flow rates of juice to the clarifier were measured by means of an orifice plate which proved to be most unsatisfactory as the orifice place connexions continually blocked with mud despite the use of air and water purges. As a result it is felt that flow rates should be measured by means of a magnetic flowmeter, although further use of repositioned purges will be attempted in the 1972/73 campaign.

The unclarified 1st carbonatation juice entered by gravity from the de-aerator through the bottom of the clarifier and was spread evenly throughout the vessel by means of a horizontal deflector plate. Polyacrylamide flocculant solution, upon which successful operation of the clarifier is completely dependent, was injected into the juice feed line, immediately before the clarifier; over the campaign, average flocculant addition was 2·38 ppm on juice compared with 1·00 ppm on juice for the Dorr-Oliver system. It was recommended that flocculant injection took place at three points after the orifice plate, the last of these being at least three feet away from the clarifier, but unfortunately, owing to the restricted space at Peterborough, flocculant had to be injected

[1] See MCGINNIS *et al.*: *I.S.J.*, 1971, **73**, 265–268, 295-297.

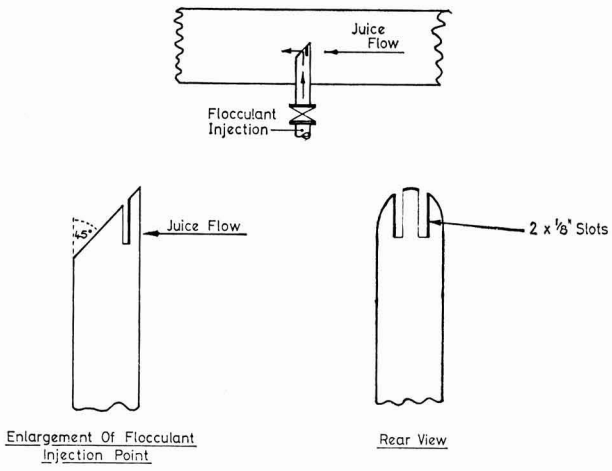

Fig. 2. Flocculant injection line

at two points before the orifice and at only one point after. Injection of the flocculant was made in the direction of the juice flow by means of a feed pipe welded inside the juice line, and specially slotted as recommended (see Fig. 2).

The clarifier suppliers stated that they had conducted a number of trial runs in the United States with different positions for flocculant addition and had found that the best results were obtained with the recommended arrangement. While this may well be correct, it is not possible with the existing installation to correct the situation at Peterborough because of the difficulty of accommodating the long straight pipe required for the orifice plate; improvement would be possible should a decision be taken to convert all 1st carbonatation juice clarification to the Enviro-Clear system in the future, with re-location of the entire station.

The sonic sensor controlled the mud bed level at a height of three feet in the clarifier and was linked to the underflow valve to control rate of sludge flow.

Fig. 3 shows the plant arrangement diagrammatically.

Performance

Clarified juice showed a considerable improvement in colour compared with that from the Dorr clarifiers, average juice colour from the Enviro-Clear system being 758 compared with 1037 from the Dorr system, the drop in colour ranging from 8% to 48% on individual samples.

Invert content of clarified juice was 0·06/110S higher from the Enviro-Clear clarifier than from the Dorr system owing to the fact that the low retention time led to less invert destruction. Table I compares the clarified juice and underflow sludge from the Enviro-Clear and the Dorr clarifiers.

Sludge from the Dorr clarifier was generally of the order of 30–35°Brix while that from the Enviro-Clear unit was 45–50°Brix. The overflow juice from the Enviro-Clear clarifier was notably very clear and sparkling.

Flocculant addition

The flocculant used was "Separan AP 273", which was originally made up in a 0·3% w/w mix, using diffusion make-up water as a diluent.

Table I. Input, sludge and clarified juice insoluble solids in grams per litre

	Enviro-Clear	*Dorr*
Input Juice	38	34
Clarified Juice	0·049	0·114
Sludge	250	170

Unfortunately it was found that it was possible for us to exceed the permitted legal limit of 5 ppm of flocculant on juice owing to the high capacity of the flocculant pumps; therefore for the majority of the campaign our flocculant mix was a 0·075% solution so that even at maximum pump stroke it was not possible to exceed the 5 ppm limit.

The flocculant was mixed in two rectangular tanks, each equipped with piping through which low-pressure air was supplied to agitate the water-flocculant mix.

This small-diameter pipework was in the form of a letter H, suspended horizontally just clear of the

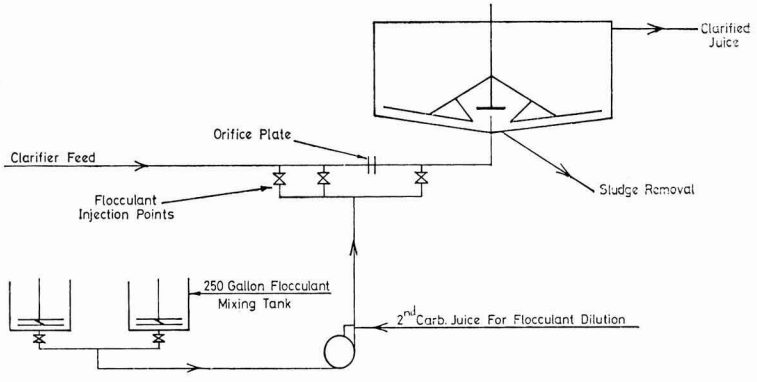

Fig. 3. Enviro-Clear clarifier and flocculant addition system

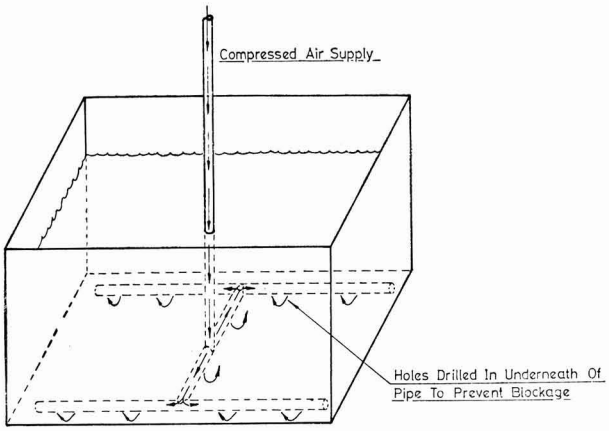

Fig. 4. Arrangement of compressed air line for flocculant mixing

base of the tank, with $\frac{1}{8}$ in diameter air supply holes drilled in the underside of the pipe to obviate blockages.

This arrangement, shown in Fig. 4, was most effective and produced a first-class mix, being superior to the mechanical mixing previously used.

The use of two tanks, one feeding and one waiting, allowed time for the flocculant to "age" and thus become more effective in operation. In practice it was found that the tanks were too small, resulting in a high labour usage for preparing flocculant; this was to be rectified during the 1972 off-season.

The flocculant solution was injected by a variable-speed pump, with thin juice fed into the pump delivery to assist as a dispersant when the solution was finally mixed with carbonatation juice.

Tests performed by the Research Laboratory staff indicated that addition of 1 ppm of flocculant to the Enviro-Clear unit produced an increase in the settling rate of 400%, while a further addition of three times this amount only increased the rate slightly. In practice, however, it was found that addition rates of less than 1·75—2·00 ppm could not be relied upon to give adequate settling at all times.

Average "Separan" usages for the campaign were 2·38 ppm on juice for the Enviro-Clear clarifier and 1·00 ppm for the Dorr-Oliver system; this represented a total cost for flocculant of £2192, of which £1544 was used on the Enviro-Clear system and £648 on the Dorr-Oliver system. If all our juice were passed through Dorr clarifiers the total cost for the campaign would be approximately £1300; assuming two Enviro-Clear clarifiers the total cost would be about £3000. With improvements to the de-aerator it may be possible to use less flocculant on the Enviro-Clear clarifier, thus reducing the costs.

A ten-day trial was conducted using another flocculant, namely "Magnafloc LT25" and results showed that this was equally effective as "Separan"; in fact, the operators preferred it because it appeared to give a more compact bed in the clarifier and it mixed more readily when preparing stock solution.

Effect of the Enviro-Clear system on 2nd carbonatation juices

Retention times of juice in the Dorr and Enviro-Clear clarifiers at Peterborough are approximately 90 minutes and 10 minutes respectively.

On 2nd December 1971, approximately corresponding samples of overflow juices and muds were taken from both clarifiers. Overflow juices were divided into two samples, one being analysed direct and the other, without soda ash addition, being treated with CO_2 to the 2nd carbonatation end-point, and filtered before analysis. The mud samples were filtered and then treated as for the overflow juices.

As might be expected, the results obtained demonstrated that as a result of the shorter retention time, less invert sugar and less glutamine were degraded in the Enviro-Clear clarifier than in the Dorr. In consequence the juice leaving the Enviro-Clear contains less lactic acid and less pyrrolidone carboxylic acid, and on further processing gives rise to a 2nd carbonatation juice with lower lime salts than juices produced from the Dorr.

As a footnote we may add that we have recently received information from the Manitoba Sugar Co. Ltd., of Canada, where a pilot-plant Eis clarifier was studied; the results obtained were in general very similar to our own experience.

* * *

Finland sugar imports 1972[1].—In 1971 over half Finnish sugar requirements were supplied by the USSR (136,848 metric tons, tel quel, of a total of 209,856 tons). The balance was supplied mainly by Australia (33,468 tons), Brazil (24,203 tons), Dominican Republic (11,952 tons) and Poland (3376 tons). In 1972, however, imports from the USSR were reduced almost completely, to 173 tons, and other sources of sugar found. Thus the 1972 total of 213,541 tons came from Australia (36,840 tons), Belgium (11,502), Brazil (37,360), Cuba (26,946), Dominican Republic (13,236), Fiji (11,953), Poland (5226) and South Africa (70,248), while other countries provided the remaining 57 tons.

* * *

Bangladesh sugar industry[2].—All fifteen sugar factories in Bangladesh are now under the control of the Bangladesh Sugar Mills Corporation, Shilpa Bhaban, Motijheel, Dacca. The cane area for the 1972/73 crop was reduced to 38,447 hectares by comparison with 66,776 hectares in 1971/72 and 62,486 ha in 1970/71. The total capacity of the mills was the same at 16,900 metric tons of cane per day but sugar production which had reached 118,154 metric tons, raw value, in 1970/71 but had fallen to 26,466 tons in 1971/72 was again reduced to 21,439 tons in 1972/73. The result shows an improvement, however, in yield of sugar per hectare which was 0·558 tons in 1972/73 as against 0·396 tons in 1971/72. Both figures are, of course, lower than the pre-war yield of 1·891 tons/ha in 1970/71.

[1] C. Czarnikow Ltd., *Sugar Review*, 1973, (1118), 48.
[2] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (9), 9.

Sugar cane agriculture

A study of polyphenols in sugar cane in relation to red rot disease present in the stem of sugar cane varieties. A. K. VERMA, S. P. JAISWAL, K. L. BAJAJ and I. S. BHATIA. *Sugar y Azúcar*, 1971, **66,** (12), 11–13.—In parts of subtropical India red rot disease (*Glomerella tucumanensis*) is a serious disease of sugar cane and is responsible for the deterioration of a large number of commercial varieties. It is pointed out that the present method of rating varieties for resistance to red rot disease is very time-consuming and has many limitations. A series of investigations was therefore started to develop a quick method of rating based on biochemical resistance. A progress report is here given. Polyphenols have long been considered to play an important part in disease resistance in plants. It was concluded that a higher inherent polyphenolic content was observed in the disease-resistant cane varieties[1].

* * *

MF 102 is compact harvester. ANON. *Producers' Rev.*, 1971, **61,** (12), 5–6.—A new Massey-Ferguson harvester, the "Compact MF 102", is described and illustrated with photographs. It is considered to be ideally suited to the grower who harvests up to 15,000 tons of cane a year, and is the first small self-propelled machine to be developed.

* * *

When lightning strikes sugar cane. ANON. *Producers' Rev.*, 1971, **61,** (12), 17.—Lightning is considered to be rarely responsible for starting fires in sugar cane. Usually it is accompanied by rain. The recognition of lightning damage is quite easy. In tall cane the spindles are generally killed and the leaf sheaths and leaves are shredded. The internodes shrivel, and side shoots and aerial roots sometimes appear. A little further away from the centre of the strike the leaf blades have a purplish colour. Sometimes, at the centre of the strike, the stalks will burst open with some shredding of the rind. A search will usually disclose a hole in the ground, indicating the centre of the strike. Lightning affects only very small areas, sometimes just a few stools. The larger patches rarely exceed 15 to 20 feet in diameter.

* * *

Queensland's sweet canes. ANON. *Producers' Rev.*, 1971, **61,** (12), 17–19.—Queensland is noted for the sweetness or high sugar content of its sugar cane. This is attributed to the prevailing climatic conditions. It is stated "Our very sweet cane varieties, bred in Queensland, have been imported by other countries and found not to produce the same sugar content when grown there. Conversely the variety N:Co 310, imported from South Africa, is a sweeter cane here than in the land which bred it".

* * *

Soldier fly study shows promise. ANON. *Producers' Rev.*, 1971, **61,** (12), 31–32.—Some recent research work on the biology of the soldier fly is referred to. It has been ascertained that only the females disperse widely and that birds, notably swallows and martins, and fish may consume large quantities of the flies. Four species of fish were found to be feeding on flies resting on the river between dispersal flights, fresh water herring consuming large amounts. Studies are to be made on the release of sterile male flies.

* * *

Advantages of a legume crop for the fallow. ANON. *Producers' Rev.*, 1971, **61,** (12), 41.—Cow peas and velvet beans are the main kinds of legume used in cane areas. The advantages claimed for them are that they protect the soil from rain and wind erosion, reduce loss of humus, increase fertility, suppress weeds and help the farmer to save money.

* * *

Weedicides keep drains clean. ANON. *Producers' Rev.*, 1971, **61,** (12), 47.—The disadvantages of heavy weed growth in drains are discussed and the following queries answered: how should the weedicide be applied; when should the drain be sprayed; where should the weedicide be applied; and what weedicide should be used.

* * *

A comparative analysis of the economics of employing animal or mechanical traction in the cultivation of sugar cane. D. M. MORÍN. *Publ. Misc. Estac. Exp. Agric. Tucumán*, 1971, (40), *Series B*, 40 pp.—An account is given of a detailed study of the relative cost of employing animals (mules) or a tractor for the smaller growers in carrying out the numerous tasks necessary in the cultivation of sugar cane. The cost of animals and their daily maintenance are carefully contrasted with the cost of a tractor and its fuel and maintenance costs. Information is tabulated under various headings. It was concluded that the all-important factor is the size of the holding, a tractor not being economical on a farm below a certain size.

[1] *See also* RAO *et al.*: *I.S.J.*, 1971, **73,** 239.

Sugar cane manuring in Maharashtra—a review. II. Phosphorus. J. R. KAKDE. *Sugar News* (India), 1971, **3**, (5), 14-16, 26-29.—Responses to phosphorus are variable and much influenced by type of soil. Uptake is reduced in soils that are waterlogged, rich in calcium and magnesium and heavily fertilized with nitrogen. The well-drained, lighter soils showed better utilization of phosphorus. With regard to potassium, this element is regarded as not usually deficient in Maharashtra soils. The physiological rôle of potassium is not well understood and it is thought it is important largely as a catalyst.

* * *

Seed protection programme in sugar cane—an urgent necessity. R. S. KANWAR. *Sugar News* (India), 1971, **3**, (5), 18-19.—It is regarded as very necessary that seed cane nurseries be established instead of drawing planting material from ordinary commercial cane, for this is often diseased. It is argued that the hot air treatment of seed cane for the control of ratoon stunting disease and grassy shoot by the sugar factories has not been very efficient and that it should be done by the State (sugar cane research stations). Other cane diseases that can be better controlled with seed cane grown separately are red rot, wilt and smut.

* * *

Comparative assessment of frost tolerance in some important sugar cane varieties with reference to the effect on buds. O. SINGH, H. S. GILL and G. N. BABU. *Indian Sugar*, 1971, **21**, 483-485.—Three-bud setts of five varieties were treated in various ways and then subjected to cold treatment, i.e. —4°C for 12 hr and for 24 hr. The buds of the mid-season varieties Co 1330 and Co 975 proved to be more tolerant than those of the late varieties Co 1148, P 11996 and CoJ 46. The leaf sheaths, where not removed, were of protective value against low temperature. Waxing the cut ends of setts also appeared to protect buds against freezing.

* * *

Response of sugar cane to steeping of setts and spraying of molasses on the foliage. U. S. SINGH, M. M. S. SAXENA and –. SHRINATH. *Indian Sugar*, 1971, **21**, 487-489. — Experiments are reported to test the findings of some earlier workers on the effects of molasses on setts and foliage of sugar cane. The experiments were carried out under field conditions in a randomized block design with the sugar cane variety CoS 510. Results showed that the steeping of setts and spraying of the foliage with molasses solutions of 35% and 20% failed to cause any improvement in yield or juice quality.

* * *

The uptake of nutrients by the cane crop. II. Effect of chemical composition of leaves and cane of different varieties. K. KAR and P. D. BAJPAI. *Indian Sugar*, 1971, **21**, 491-498.—Sugar cane is acknowledged to be a gross feeder. The large amount of material removed from a field in the form of harvested cane involves a significant loss in productive nutrients for subsequent crops, hence the need for constant manuring or fertilizing in most soils. The experiements here reported confirmed the belief that high yielding varieties have a greater absorption capacity for nutrients than low yielding varieties. Their fertilizer needs are also higher.

* * *

Pests of sugar cane. ANON. *Brasil Açuc.*, 1971, **78**, 548-549.—Experimental work on biological control of some sugar cane insect pests in Brazil is discussed.

* * *

Pests and diseases of sugar cane in Mexico. S. F. CACERES. *Bol. Azuc. Mex.*, 1971, (262), 5-8.—These are enumerated or briefly described. Borers are among the worst pests in Mexico and reference is made to the potential parasites *Paratheresia claripalpis* (Mexican fly), *Lixophaga diatraeae* (Cuban fly) and *Metagonistylum minense* (Amazon fly). Among diseases, mosaic, ratoon stunting and eye spot claim most attention.

* * *

Influence of the new Cuban sugar cane varieties on the bagasse, pulp and paper industries (of Mexico). E. BATLLE and J. A. ESPINOSA. *Bol. Azuc. Mex.*, 1971, (262), 13-20.—Tables are given showing the chemical composition of bagasse of different varieties of sugar cane, notably PR 980, C 23651, C 8751, MY 53108, B 42231 and POJ 2878, as well as characteristics of the pulp. There were noticeable differences between different varieties.

* * *

Prototype of heavy-duty Toft cane harvester for Hawaii. ANON. *Australian Sugar J.*, 1971, **63**, 421. A brief description and illustration of this giant machine for use in Hawaii are given. In Australia it performed well with two-year-old standover cane of N:Co 310. It is designed to deal with tangled two-year-old cane, normally encountered in Hawaii.

* * *

The influence of the type of tractor employed on the costs of agricultural operations with sugar cane. D. M. MORÍN. *Publ. Misc. Estac. Exp. Agríc. Tucumán*, 1971, (41), *Series B*, 7 pp.—With small-scale operators or farmers it was concluded that the size or horsepower of the tractor is all-important in determining whether its use will be economical.

* * *

Our more important cane insects in the South African sugar industry. A. J. M. CARNEGIE. *S. African Sugar J.*, 1971, **55**, 611-615; 1972, **56**, 13-19.—Many insects eat sugar cane but only a few become serious pests. The fact that South Africa has fewer serious cane pests than most cane-growing countries may be due to its relatively cold winters. At present the more serious pests are all indigenous. The pests discussed include the sap sucker (*Numicia viridis*), two aphids (*Longiunguis sacchari* and *Rhopalosiphum maidis*), the mealy bug (*Saccharicoccus sacchari*), leaf hopper (*Perkinsiella saccharicida*), moths, borers, beetles and the so-called wattle pests (*Hypopholis sommeri*,

H. licas and *Schizonycha affinis*) which may attack both wattles and cane. The most common cane borer in South Africa is *Sesamia calamistis*, and signs of its presence are to be found in most cane fields. However, it does not cause damage to the extent of that done by *Eldana saccharina* at its worst.

* * *

Relationship between time and mode of application of fertilizer to sugar cane. S. G. SRIVASTAVA and S. N. PANDIT. *Ind. J. Agric. Sci.*, 1970, **40,** 634–636.—The experiments described were started in 1965 at the Indian Institute of Sugar Cane Research, Lucknow, to determine the effectiveness and economy of spray application of urea in split doses in comparison with the conventional soil application at planting in one dose or in split doses. It was found that an adequate dose of nitrogenous fertilizer applied in the soil during the formative phase of the sugar cane crop gave higher yields than when it was applied in split doses during the period of maximum removal of nitrogen by the plant. However, if fertilizer application be delayed beyond the formative phase of the crop, foliar spray in split doses is better than split application to the soil. Possibly the third and last period of maximum uptake of nitrogen by sugar cane in August allows very little time for the soil-applied fertilizer to be utilized fully, whereas the fertilizer applied as a foliar spray is absorbed quickly by the plant.

* * *

Effect of the number and position of buds on a sett on the clump formation and yield of sugar cane. R. R. PANJE, P. S. GILL and B. SINGH. *Ind. J. Agric. Sci.*, 1971, **41,** 431–440.—The effect of the number and position of buds on the sett on its germination and clump formation was studied and the utilization of these results in the improvement of sugar cane yield per hectare is discussed. In 3-, 4-, and 5-budded setts the second bud gave the highest germination followed by the first, and the rest of the buds followed in a descending order from top to bottom. Clump weights showed the same trend. Increasing the number of non-terminal buds by cutting 4- and 5-budded setts did not increase the overall germination capacity, but it increased the mean clump output. Under northern Indian conditions two functioning buds built up between them as much clump output per sett as three buds. In 5-budded setts the higher mean clump output was reflected in sugar cane yield at harvest and was about 10% more than in 3-budded setts.

* * *

Investigations of the flowering of *Saccharum*. I. Ontogeny of the inflorescence. P. H. MOORE. *Canad. J. Bot.*, 1971, **49,** 677–682; through *Hort. Abs.*, 1971, **41,** 1193.—Early development of the inflorescences of two sugar cane hybrid clones is described, including those phases having potential for either further reproductive development or reversion to vegetative growth. The stage of irreversible reproductive growth is ontogenetically much later for *Saccharum* than for other plants.

The effect of iodoacetate and analogous compounds upon sucrose secretion by sugar cane and other leaf tissues. J. EDELMAN and A. I. SCHOOLAR. *J. Exp. Bot.*, 1971, **22,** 118–124.—Out of nine species other than sugar cane only those plants having the C_4 carboxylation pathway of photosynthesis showed iodoacetate-dependent sucrose secretion from leaf discs. Experiments with analogues of iodoacetate indicated that in sugar cane tissue this secretion could be correlated with the capacity of the compounds to react with SH groups.

* * *

Growers revolutionize planting techniques. I. T. FRESHWATER. *Cane Growers' Quarterly Bull.*, 1972, **35,** 76–78.—Changed labour conditions in Queensland have brought about radical changes in planting methods. Formerly, to maintain continuity the average planting gang consisted of six to eight men engaged in cutting, loading and carting the planting material, and stripping the trash before feeding it through a cutter-planter. The new technique requires a minor modification to a modern chopper-harvester so that sett length billets of 12 to 15 inches can be cut. These are hand planted using new versions of an old style "drop" planter. The need for sharp cutting knives is emphasized.

* * *

Farm drainage—types of open earth channels. G. A. CHRISTIE. *Cane Growers' Quarterly Bull.*, 1972, **35,** 79–82.—Dense weed or grass growth can halve the capacity or effectiveness of a drain. The capacities of drains and main waterways of specific sizes are indicated and the advantages of grassed-down shallow waterways, allowing farm machinery to cross them, are outlined. The need to avoid practices likely to encourage erosion is pointed out.

* * *

Yellow spot 1971 — what damage did it cause? B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1972, **35,** 86–88.—Further information is given on the severe yellow spot outbreak in North Queensland in 1971[1]. Because of a change in the strain of the fungus causing the disease, cane varieties previously found to be resistant are no longer safe from attack; a survey of seedlings from the Bureau of Sugar Experiment Stations showed, in farm trials, that only 20% were resistant to yellow spot in 1971 compared with 80% two years previously.

* * *

Two new weed pests for the Innisfail area (of Queensland). J. F. USHER. *Cane Growers' Quarterly Bull.*, 1972, **35,** 98–99.—The weeds are Mexican clover (*Richardia brasiliensis*) and calopo (*Calopogonium mucunoides*). Both are vigorous growers and capable of being troublesome in cane. They set seed freely. Preliminary tests have shown that both weeds are vulnerable to certain herbicides, 2,4-D in the case of Mexican clover and a mixture of 2,4-D and 2,4,5-T in the case of calopo.

[1] See *I.S.J.*, 1972, **74,** 272.

Land levelling. M. A. HETHERINGTON. *Cane Growers' Quarterly Bull.*, 1972, **35**, 100–101.—In flat cane fields, water-holding depressions cause uneven growth and should be filled in. As the fill material has a tendency to settle, the operation usually has to be repeated annually for several years before all water-holding depressions have been eliminated. Where soils are dry or heavy fills have been made, a fairly heavy roller will consolidate the new soil and hasten settling. The best time to begin levelling operations is after the first crop cycle has been completed and the crop ploughed out.

* * *

Pig damage can be costly. C. M. MCALEESE. *Cane Growers' Quarterly Bull.*, 1972, **35**, 104–106.—Damage to cane by wild pigs in Queensland has become more serious in recent years, particularly in cane adjoining swamps where the pigs may congregate. The pigs have originated from domestic animals which escaped long ago. They not only eat the stalks of cane but trample down much cane which can become unfit for harvesting through subsequent side shooting. Many boards pay a bounty on pig scalps. Trained dogs are used in hunting. Where pig damage is bad and the terrain not too rough extra fencing may be worthwhile.

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Approved varieties—1972. N. J. KING. *Cane Growers' Quarterly Bull.*, 1972, **35**, 107–108.—A list is given of the sugar cane varieties approved for the 31 Queensland mill areas for 1972.

* * *

Approved fodder canes. N. J. KING. *Cane Growers' Quarterly Bull.*, 1972, **35**, 108.—The fodder canes approved for the various Queensland mill areas are listed as China, China Stalk, Co 290, Co 301, C.S.R.1 (known as E.G.), Q 60 and Uba.

* * *

St. James tries the Supple system. ANON. *Sugar Bull.*, 1971, **50**, (Dec. 1), 6–7.—Reference is made to the favourable impression made by trials with the Supple system on a Louisiana sugar cane estate, this system being a method of replacing yard derricks with front-end loader tractors. The machine used was a Caterpillar 966 C with a Cameco front-end loader designed especially for picking up cane. The machine is said to be capable of handling 8 tons of cane at a time and can stack 13 feet and higher. Cane can be fed to the mill at a rate of 4400 tons per day, which could probably be increased to 5000 if need be. The machine's mobility makes it extremely versatile and flexible in feeding the mill and stacking the cane.

* * *

Answers to questions most often asked about the Supple system. ANON. *Sugar Bull.*, 1971, **50**, (Dec. 1), 8, 11.—This system of handling cane was introduced by E. SUPPLE in 1969. Details of it are given. Yard derricks are replaced by front-end loader tractors. The opinion is expressed that the system will eventually be used in most Louisiana mills. Derricks and bridge cranes do not compare favourably with the Supple system from a cost standpoint, which is the main determining factor.

* * *

Breeding behaviour of certain agronomic characters in progenies of some sugar cane crosses at the Sugar Cane Research Station, Anakapalle. M. LAKSHMIKANTHAM, K. K. P. RAO and J. P. RAO. *Indian Sugar*, 1971, **21**, 541–545.—This study was made to determine how far certain important agronomic characters, such as number of stalks per stool, diameter and height of stalks, erectness and Brix, are passed on to the so-called "settling" (second generation of clonally propagated plants). The findings are tabulated and discussed.

* * *

Water requirements of sugar cane. I. Effect of pre- and post-monsoon irrigations on yield and quality in relation to different nitrogen levels. K. N. S. KAURAVA and R. K. RAJPUT. *Indian Sugar*, 1971, **21**, 547–552. Inadequate use of fertilizer and inefficient irrigation are regarded as two of the most important factors in restricting sugar production in India. An account is given of trials carried out to ascertain the optimum intervals in irrigation during the pre- and post-monsoon period and the most suitable doses of nitrogen. Irrigation applied at frequent intervals gave the highest yields; 200 kg/ha of nitrogen gave the best fertilizer result.

* * *

Nitrogen requirement of sugar cane in Rajasthan. N. S. PARIHAR. *Indian Sugar*, 1971, **21**, 555–558.—In Rajasthan the prevailing yields of sugar cane are low and possibly the lowest in India. Climatic conditions may account in part for this, but lack of nitrogen is an important limiting factor. The climatic and edaphic characters of the five cane-growing regions are described. The results of nitrogen trials are summarized. Optimum doses varied considerably from region to region.

* * *

Evaluation of new chemicals for the control of sugar cane Pyrilla (*Pyrilla perpusilla* Walk). J. S. SANDHU and Y. P. MADAN. *Indian Sugar*, 1971, **21**, 561–563. In view of the possible hazards of "Endrin" to the operator in a grown-up crop of sugar cane, some new insecticides of low mammalian toxicity were compared with "Endrin", "Malathion" and BHC. Of these, 0·025% "Endosulphan" and 0·03% "Fenitrothion" compared well with "Endrin" with regard to Pyrilla (grassy shoot) control and have been recommended for use. The other insecticides tried were "Birlane", "Azodrin", "Phosphamidon" and "Trithion".

* * *

Freeze resistance in varieties of mature sugar cane. J. E. IRVINE. *Sugar Bull.*, 1971, **50**, (Dec. 15), 9–14. Observations on light freezes have indicated that freezes which kill the leaves, the terminal bud and a

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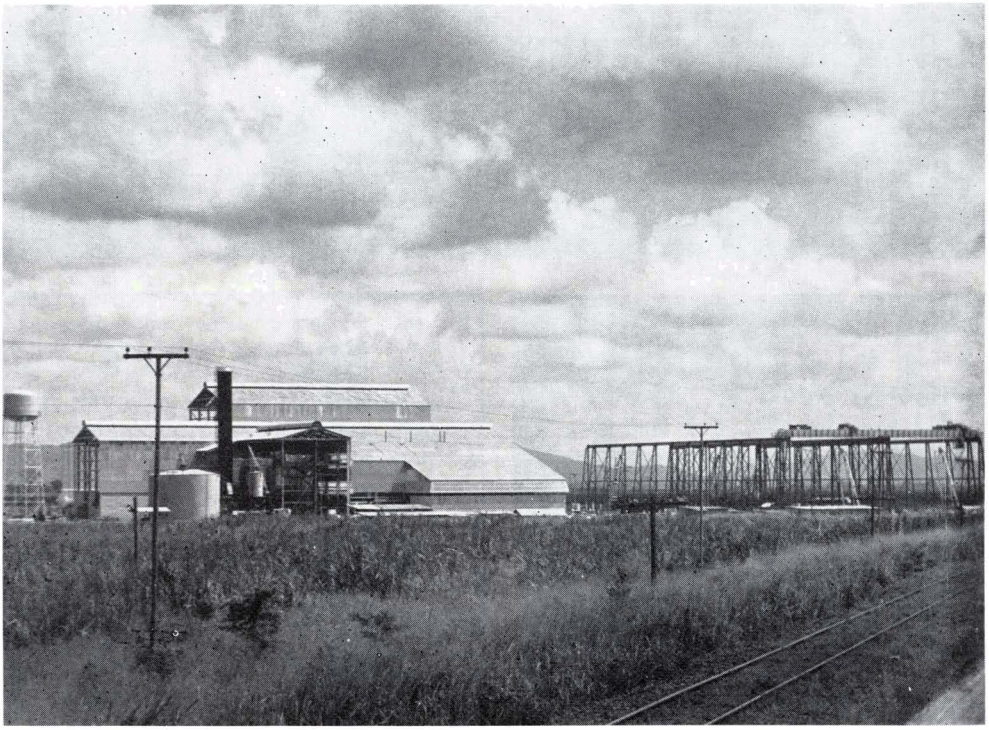

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few immature internodes only serve to stop the formation of sucrose, but cause no serious deterioration in mill cane quality. The harvest season of 1970 provided an opportunity to reaffirm these findings and to measure the effect of a more damaging freeze on some of the newer varieties. The effects are described of a light freeze followed by a heavy freeze (24°F) soon afterwards.

* * *

New directions of pest control in the Taiwan sugar industry. Y. P. YU. *Taiwan Sugar*, 1971, **13**, 219.—It is pointed out that in spite of the strenuous efforts made in combating diseases and pests, outbreaks continue to occur, such as downy mildew, white leaf and smut as well as locusts, woolly aphis and army worm. Recent research has revealed that a certain substance in the saliva of the grass cicada, an especially troublesome soil insect, stunts the growth of sugar cane. The sucking of a little juice by the insect is harmless in itself but the saliva makes it a deadly enemy of ratoon crops. A greater emphasis is now being placed on the biological control of sugar cane insects. Programmes which utilize the parasitic wasp to control cane borers and fungus to control grass cicada have already been started at several places on a field scale. Initial reports have been encouraging.

* * *

Sugar cane diseases in Taiwan. H. T. CHU. *Taiwan Sugar*, 1971, **13**, 220–229.—Some 120 sugar cane diseases are known throughout the world and of these Taiwan is known to have 54. These are listed. Remarks are made on some of them, notably the more important, and measures for control discussed. Diseases for which varietal resistance is being tested include mosaic, white leaf, downy mildew, red rot, pineapple disease, leaf blight, smut, leaf scorch and yellow spot. As ratoon stunting disease and pineapple disease can be controlled by the fungicidal or hot water treatment of the seed cane, testing for resistance to these diseases has not been undertaken.

* * *

Biological control of sugar cane moth borers in Taiwan. T. H. SU and C. J. LIANG. *Taiwan Sugar*, 1971, **13**, 230–232.—The success obtained with *Trichogramma australicum* as an egg parasite of cane borers in Taiwan is discussed. Eggs of the grain moth are used in the mass production of *Trichogramma*. From 1968 to 1971 the parasite was liberated on four plantations (totalling 500 ha). The number of parasitized borer eggs in these fields increased 3–5 times. The quantity of dead heart and bored cane joints in the colonized fields decreased by 32–85% and 40–48% respectively. Because of these promising results, the Taiwan Sugar Corporation has begun to extend this method of controlling the moth borer to all seriously infested sugar cane farms.

* * *

Fungi parasitic on the nymph of *Mogannia hebes* Walker. Z. N. WANG and L. S. LEU. *Taiwan Sugar*, 1971, **13**, 233–236.—Details are given of the parasitization of *Mogannia hebes*, a root pest of sugar cane, by the fungus *Isaria sinclairii*. Observation and experiment have shown that infected nymphs commonly die deep in the soil and are not exposed to the air to hasten dissemination of the parasitic fungus. Thus an artificial application of the fungus, as soon as the cicada nymphs appear, should help to control the insect before it does damage. Experiments in applying the fungus in the field are under way.

* * *

***Tetrastichus inferens*, a parasite of the pupae of *Sesamia inferens* Walker.** T. H. SU. *Taiwan Sugar*, 1971, **13**, 237.—This newly recorded parasite was collected in Taiwan sugar cane fields and identified in 1970. An account of the insect and its life history is given, accompanied by an interesting photograph showing the tiny insect ovipositing on the relatively large body of its host.

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A wheat germ medium for the sugar cane grey borer. W. Y. CHENG. *Taiwan Sugar*, 1971, **13**, 238–242.—An account is given of experiments with media for raising cane borer larvae, notably the grey borer (*Eucosma schistaceana*), and substituting germinated wheat and vitamin B with wheat germ and vitamin fortification in an existing medium, with good results. The work was undertaken in order to develop, if possible, an artificial medium for the grey borer in the hope that it might lead to a suitable medium for the brown borer and the stem borer because these insects cannot be reared in the laboratory at the present time.

* * *

A study on sugar cane white leaf disease and its relationship with wild cane, *Saccharum spontaneum*. S. C. LIN and C. H. LI. *Taiwan Sugar*, 1971, **13**, 247–252. White leaf disease has been shown to be identical in cultivated cane and in wild cane (*Saccharum spontaneum*), which occurs freely in Taiwan. The insect *Epitettix hiroglyphicus* may act as the vector or carrier of the disease from wild to cultivated cane. Details are given of transmission and laboratory work carried out on the disease.

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Spacing and seed rate experiments with sugar cane in United Arab Republic. A. H. NOUR, M. I. A. SAMIE, E. E. GHAFAGA and M. A. GOHAR. *Sugar y Azúcar*, 1972, **67**, (1), 17–19.—Literature on the subject is reviewed. The advent of mechanical harvesting and use of modern herbicides has called for wider spacing in many countries but this has not applied so far in Egypt. An account is given of spacing experiments with the two commercial cane varieties N:Co 310 and Co 413. These showed that a spacing of 1 metre between the rows and one row of seed material amounting to 3 tons of seed would give maximum sugar production.

* * *

Sweet sorghum—potential sugar crop in South Texas. W. R. COWLEY and B. A. SMITH. *Sugar J.*, 1971, **34**, (9), 20–22.—See *I.S.J.*, 1972, **74**, 371.

Sugar beet agriculture

Knowledge on and problems relative to beet rhizomania. C. A. GHILLINI and V. D'AMBRA. *Ind. Sacc. Ital.*, 1971, **64,** 183–188.—In a discussion on this disease, caused by *Polymyxa betae*, recommendations are given on preventing its spread. Experiments so far have indicated that the only means of control is soil fumigation, which, however, is considered costly.

* * *

Matching seed belts to drilling speed. J. CROW. *British Sugar Beet Rev.*, 1971, **40,** 85–86.—The writer points out that "Master Land Wheel Drive" drills made by Stanhay (Ashford) Ltd. can be used at speeds between 2 and 4 mph, but speeds in excess of 3 mph are not recommended for drilling sugar beet. It is essential to use the correct seed belt to match forward speed, and drilling speed should therefore always be specified when ordering belts.

* * *

"Betanal E"—lessons from 1971 spraying season. J. G. SWALWELL. *British Sugar Beet Rev.*, 1971, **40,** 87–89. It is pointed out that the discovery of "Phenmedipham" in West Germany as a selective post-emergence herbicide for sugar beet was a major breakthrough. Blockage problems caused by crystallization in band sprayers have been experienced in the UK, and these and the way they have been overcome with the new formulation, "Betanal E", are described.

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Acid patches in growing crop treated with factory waste lime. J. TOPPER. *British Sugar Beet Rev.*, 1971, **40,** 91.—Experience in profitably utilizing this very fine form of liming material to give immediate beneficial effects on the acid, unthrifty patches of a 46-acre sugar beet farm in the Spalding area of the UK is described. A dressing of 10 tons/acre was applied. The methods of handling and spreading the material are discussed.

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Improved beet topping. ANON. *British Sugar Beet Rev.*, 1971, **40,** 93.—Research is being carried out at the National Institute of Agricultural Engineering to examine the problem of accurately topping sugar beet and to provide design data for improved machines. The effects of a number of variables in the beet stand, the topping mechanism, geometry and dynamic response characteristics of the topping mechanism are being studied.

* * *

"Merpelan", a selective herbicide for sugar beet growing. R. R. SCHMIDT and L. EUE. *Zucker*, 1972, **25,** 58–60.—This herbicide is well tolerated by beet and is effective with most of the weeds in sugar beet fields. It may be applied before, at or after sowing. The most efficient application was found to be 4 kg/ha over the whole field before emergence. In very dry regions it should be incorporated with the soil before sowing. Compared with manual weeding it gave higher yields.

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Germination vigour and sugar beet seed emergence. J. CHRISTMANN. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (13), 7–16.—In field and laboratory tests on monogerm seed, the effects of various factors on germination and emergence were observed. The variables included quantity of water applied and type of pelleting. In all cases greater germination was obtained by pelleting, while emergence under laboratory conditions was greater than in the field.

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Spring work with sugar beet. J. PICHENEZ and D. GUIRAUD. *Hautes Etudes Betterav. Agric.*, 1972, **4,** (13), 19–26.—Preparation of the soil, seed sowing or drilling, use of herbicides, and planting to stand are discussed and some of the modern machinery or equipment now used described or illustrated. A notable feature is the use of double rear wheels on a tractor in order to minimize soil compaction.

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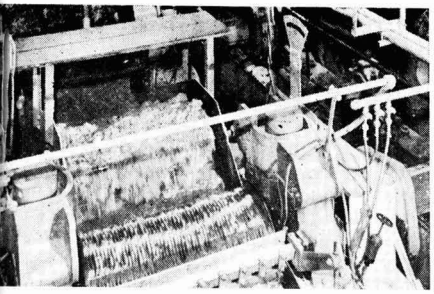
Effect of sodium and magnesium fertilizers and irrigation on growth, composition and yield of sugar beet. A. P. DRAYCOTT and R. F. FARLEY. *J. Sci. Food Agric.*, 1971, **22,** 559–563.—The sodium used in the experiments described was in the form of agricultural salt and the magnesium in the form of kieserite. Sodium and irrigation increase the leaf area index and total dry matter of the crop. The average increase in sugar yield was 0·5 t/ha from sodium and 0·68 t/ha from irrigation. From late July onwards irrigated plants had slightly fewer leaves than unirrigated ones. Plants given sodium had more of their total dry matter in the roots than did those not given sodium. The effects of sodium and irrigation were additive. Magnesium fertilizer increased the concentration of magnesium in the plants and their total content, but had no effect on growth, uptake of the other cations or final yield of the crop. It is concluded that sodium increased sugar yield by increasing the leaf area index early in the season and by increasing the proportion of the total dry matter partitioned to the roots. Irrigation also appeared to act partly by increasing leaf area index but it also greatly increased the uptake of nutrients.



Cane sugar manufacture

Cane deterioration and its effects in the Racecourse area—1971 season. C. S. HENDERSON. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 267–273.—Examination of possible causes of cane deterioration showed that delays between harvesting and crushing had considerable effect. Sugar losses in damaged billets could not be assessed, although deterioration was rapid and severe. The damage, up to 100% of the cane load, is associated with the use of thrower-elevator harvesters. The influences of billet length reduction and cane overburning require further investigation. Deterioration caused gum formation on vacuum pan heating surfaces, crystal elongation, crystallization rate reduction, false grain formation and massecuite solidification in crystallizers. Measurement of 1st expressed juice pH has proved reliable as a guide to stale cane.

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The effect of billet size on the rate of cane deterioration. P. C. IVIN. *Proc. 39th Conf. Queensland Sugar Cane Tech.*, 1972, 279–280.—It was found that 24 hours after harvesting, the fall in purity in healthy cane billets shorter than 10 inches was slightly greater than that in mutilated cane billets and considerably greater than in healthy billets longer than 10 inches. The dextran content of the short billets was higher than in the long billets after 18 hr, both contents increasing after 36 hr. On the other hand, the dextran in mutilated cane, considerably greater than in the short billets after 18 hr, fell after 36 hr but was still some 35% greater than in the short billets.

* * *

Modifications to an ATV subsider. R. E. BICKLE, D. J. HALE, W. H. ROSS and E. WHAYMAN. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 289–292.—Difficulties in the handling of juice at rates exceeding the equivalent of 100 t.c.h. in the modified ATV clarifier at Cattle Creek[1] have led to the use of two auxiliary clarifiers to take excess juice. With the aim of using only the ATV clarifier, modifications as described by HALE & WHAYMAN[2] were made to it, which permitted a load equivalent to an average of 140 t.c.h. (with peaks of 150 t.c.d.) without any detectable changes in juice or sugar quality when the average residence times was reduced from 2·8 to 1·9 hr. The clarifier operated better than before, and the mud appeared to be thicker.

* * *

Juice flow control. D. J. HALE and E. WHAYMAN. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 293–302.—As a means of regulating juice flow, a system placed after the milling train was investigated which incorporated a surge tank, level transmitter, flow controller and control valve. Three level controllers were tested as flow controllers and their performances assessed. The most suitable type of controller is a matter for the individual user and depends on the degree of sophistication required, but charts from one factory, over a 4-hr period flow, show variations below $\pm$ 2% at a crushing rate of 250 t.c.h. Apart from the controller, for which advantages and disadvantages are given, requisites for smooth flow control were found to be: adequate surge tank volume, a wide P.B. (proportional band = % change in input signal, i.e. tank level required to give a predetermined pressure output) setting or some form of gap action control, correct sizing of the control valve and knowledge of valve characteristics under operating conditions.

* * *

The effect of flocculants on filter performance. A. G. NOBLE. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 303–314.—Factory-scale trials on clarifier mud filtration after addition of 1 ppm (on cane) "Separan AP 273" at Plane Creek and "Sedipur TF 2" at Millaquin with or without lime (to give filtrate pH of about 8·5, i.e. about 0·01% on cane) showed that flocculant plus lime gave a lower pol:mud solids ratio than did flocculant or lime alone, while flocculant alone gave better results than did lime, which still reduced mud pol. Comparison between the flocculants was not possible because of differences in operating conditions at the two factories. The economic benefits of flocculant application are examined, indicating greater financial savings with flocculant plus lime than with flocculant or lime alone. Pol losses resulting from the treatment are also estimated.

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Investigations of clarifier operation. K. J. NIX. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 315–325.—Tests on a model clarifier based on an increased settling area utilization and reduced residence time are described and the results compared with factory clarifier performances. Investigations on ATV clarifiers at two factories are also reported. It was found possible to obtain acceptable mud solids contents (greater than 6%) with small mud depths which were nevertheless adequate to give compaction. However, reduction in the residence time (e.g. from 150 to 31 min) caused a slight rise in pH (e.g. 7·4

[1] *I.S.J.*, 1965, **67**, 341.
[2] *ibid.*, 1971, **73**, 52.

compared with 7·0) and a drop in juice filtrability, although juice clarity was still quite good and polyelectrolyte consumption was lower than with factory clarification.

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Low cost automatic control. G. V. PERSHOUSE. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 343–345.—A simple control system for the mud level in the boots of rotary vacuum filters is described. Having a diaphragm motor, as used in the car industry for heavy-duty air brakes, as actuator, a simple air bleed orifice controller and a ball cock float as sensing element/nozzle flapper unit, six units of this type have operated satisfactorily for 3 years at Tongaat, and the costs are considerably lower than those of a conventional automatic control system.

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The control of vacuum pan crystallizers. R. J. BATTERHAM, J. A. FREW and N. W. REES. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 363–368. Automatic pan boiling control is discussed and details given of an experimental laboratory-scale pan which uses an on-line digital computer to evaluate supersaturation and the weights of water, impurities, sugar and crystals at any time during the strike and to control the evaporation and feed rates as well as the set point of a vacuum controller independently of the evaporation rate. The pan is based on a Sugar Research Institute design and has an agitator. Operation near the nucleation boundary has been achieved without false grain formation. Factory-scale trials with a similar control system in a natural-circulation pan were planned for 1972.

* * *

Prospects for continuous crystallizers. D. H. FOSTER. *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 379–382.—Factors favouring the use of continuous crystallizers are discussed and residence time tests reported in which sodium chloride was added with massecuite and measured by atomic absorption spectroscopy on discharge. Results showed that Stork-Werkspoor crystallizers showed good plug flow characteristics, with massecuite retention approximating to the theoretical time, while Burnett crystallizers proved unsatisfactory in this respect and require modifications.

* * *

Theory of the clarifier and the Dorr "444" clarifier. B. RAO and G. V. S. RAO. *Indian Sugar*, 1972, **21**, 731–742.—Comparative tests with a Dorr-Oliver "RapiDorr" and "444" clarifier at the authors' factory are discussed and results tabulated in some detail. Advantages and disadvantages of the "444" are listed; these indicate that the clarifier is better than the "RapiDorr" under ideal conditions, but deviation from these causes difficulties.

* * *

Selection of electrical equipment in sugar factories. J. W. KHANNA. *Indian Sugar*, 1972, **21**, 803–807. Selection of electrical equipment is not usually made with sufficient care, in the author's opinion, and the expected demands and capabilities of various types of a given piece of equipment are not considered. Problems connected with cane crane drives, cane carrier and cutter drives, switchgear and motors in the vicinity of bagasse furnaces (where bagasse and bagasse dust can enter the equipment), switchgear in the moist atmosphere of a boiling house, *A*-massecuite crystallizer drives and centrifugal motors are discussed. The pros and cons of single-core cable are also considered.

* * *

Phosphate addition to juice. B. R. MATH. *Sugar News* (India), 1972, **3**, (11), 10–11.—The technological benefits of adding phosphate together with lime during sulphitation are discussed.

* * *

Evaporator's good aid—magnesia. A. J. MARGABHANDHU. *Sugar News* (India), 1972, **3**, (11), 11–12. Addition of magnesium oxide together with lime in clarification increased the interval between evaporator stoppages for cleaning. The amount used was 20–25% on lime.

* * *

Enzymatic removal of starch. ANON. *N.S.I. News* (India), 1972, **7**, (4), 6–7.—Tests showed that addition of 20 ppm α-amylase to 20°Bx sugar solution containing 75–400 ppm starch reduced the starch content by a minimum of 73%. Further tests are being conducted on higher Brix solutions.

* * *

Reduction of waste in the sugar industry. S. CHANDRA. *Indian Sugar*, 1972, **22**, 13–15.—The various forms of waste considered include that of time spent on plant checks and maintenance, deterioration in maintenance materials and spares losses, and losses in deteriorated cane and in various factory processes.

* * *

Possibilities of using pneumatically operated instruments in the Indian sugar industry. P. V. L. NARASIMHAM. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.1–E.5.—The possible applications of pneumatic control instruments are discussed and illustrated by two examples: proportioning of milk-of-lime and mixed juice, and regulation of the temperature of juice leaving a heater.

* * *

Roller lift and juice extraction in a first mill. P. N. R. RAO and H. N. GUPTA. *Proc. 4th Joint Conv. Indian Sugar Tech. Assocs.*, 1971, E.7–E.9.—In milling experiments, top roller lift in a 3-roller mill was greater with grooving of 12·5 mm pitch than with coarse grooving of 25 mm pitch at the same settings, irrespective of cane preparation. Maximum juice extraction was lower with the coarse grooving when the cane was finely prepared.

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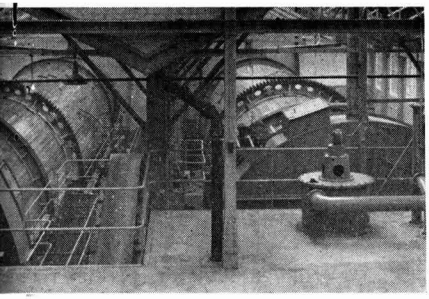

Beet sugar manufacture

Adsorption of colouring matter and sucrose on $CaCO_3$. S. E. KHARIN and V. V. MASLOVA. *Sakhar. Prom.*, 1972, **46,** (4), 6–8.—Laboratory tests showed that sucrose in solution had only slight effect on the adsorption at 20° and 80°C of melanoidins and invert sugar alkaline degradation products on $CaCO_3$ formed from $CaCl_2$ and K_2CO_3 added dropwise to the sucrose. Caramels were only slightly adsorbed by the carbonate. At 20°C sucrose caused a slight drop in the amount of carbonate precipitated compared with the effects in water, whereas at 80°C sucrose had no effect on precipitation.

* * *

Industrial tests on an evaporator under forced circulation conditions. M. A. GEISHTOVT *et al. Sakhar. Prom.*, 1972, **46,** (4), 9–13.—See *I.S.J.*, 1972, **74,** 344.

* * *

Automatic control of thyristor electric drives for beet slicers and diffusers. N. F. SHURBOVANYI, B. A. EREMENKO and V. A. ZAETS. *Sakhar. Prom.*, 1972, **46,** (4), 16–20.—Control systems for beet slicer throughput (involving slicer, cossette conveyor and belt weigher) and tower diffuser loading are described. The basic control element in both systems is a thyristor converter regulating power input to the D.C. motor. Factory-scale tests have demonstrated that the systems operate successfully, permitting smoother operation and reducing pulp losses.

* * *

Level indicator for viscous and muddy media. V. G. BELIK, Z. S. VOLOSHIN and V. I. NESTERENKO. *Sakhar. Prom.*, 1972, **46,** (4), 23–25.—A device is described for incorporation in automatic control schemes. Intended for use with viscous materials such as massecuite and mud suspension, it operates on the basis of the torque exerted by the material on a rotary paddle and hence on the drive shaft of an electric motor, so that as the level falls the paddle can move more freely and *vice versa*.

* * *

Geometrical parameters for beet piles with mechanized piling. N. M. KICHIGIN and N. A. EMEL'YANOV. *Sakhar. Prom.*, 1972, **46,** (4), 28–29.—Formulae are presented for calculation of various dimensions of beet piles of conventional prismatic shape with squared ends and with rounded ends.

* * *

Optimum heating surface of an evaporator. V. A. KOLESNIKOV. *Sakhar. Prom.*, 1972, **46,** (4), 38–41. The question of optimum evaporator heating surface to give optimum performance at minimum fuel consumption is discussed against the background of experience in the USSR and other countries.

Advances in the chemistry and technology of sugar. S. ZAGRODZKI. *Gaz. Cukr.*, 1972, **80,** 81–90.—A survey, with 47 references to the literature, is presented of advances in sugar chemistry and technology in Poland, including knowledge on the sucrose crystal, sucrose solution properties, chemical aspects of factory processes, recent developments in processes and equipment, and future prospects (including larger sugar factories with more rational beet distribution, liquid sugar production and sucrose by-products manufacture).

* * *

Measure of the technical effects of a sugar factory within the sphere of its waste water economy. K. SKALSKI. *Gaz. Cukr.*, 1972, **80,** 93–96.—The questions of water consumption in Polish sugar factories and of the quantity of effluent and its BOD_5 are discussed. As a means of predicting effluent load, the author has established a linear relationship between the amount of water used (% on beet) and the effluent BOD_5 (1000 kg O_2/1000 tons of beet). Applications of the graph presented are explained.

* * *

New development in the DDS beet diffuser. H. BRÜNICHE-OLSEN. *Zeitsch. Zuckerind.*, 1972, **97,** 266–268.—The modification to the conventional DDS beet diffuser design which is described comprises two small auxiliary scrolls located above the main scrolls which enable the nominal throughput to be increased by 50% and permit more regular cossette charging.

* * *

On the new R.T. continuous saccharate process. R. VANDEWIJER, J. JACQUES and R. PIECK. *Sucr. Belge*, 1972, **91,** 187–197.—In the scheme used at Tirlemont for treatment of up to 100 tons of molasses daily, the molasses is diluted to about 12% sugar with water previously cooled to 8–10°C in a tank provided with a stirrer and is then fed to a trough, also provided with an agitator, in which it is retained for 15 min at 11–12°C. Molasses is recirculated from about halfway along the trough to a point about one-sixth from the start (approx. 10:1 volume ratio) to ensure good dispersion of the lime which is fed direct to the recycle line from a weigher via a screw conveyor. Molasses is also recirculated (3:1 volume ratio) from the bottom of the end section to a point near the fresh molasses feed point (it is cooled to about 8°C before re-introduction) to permit a large proportion of the precipitated saccharate particles to be re-utilized. Subsequent 5 minutes' retention in a settler is sufficient since the lime particles settle rapidly, after which the

outflow is sent to a continuous belt filter for mother-liquor separation. The saccharate cake is washed and the slurry sent to the factory while the waste water may be used for a hot saccharate process. Results from the 1971/72 campaign show an average saccharate cake purity of 93·5 (92·5–95·0). Advantages of the scheme are discussed.

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Danish Sugar Corporation celebrates centenary. ANON. *Sugar y Azúcar*, 1972, **67**, (4), 15–19.—See *I.S.J.*, 1972, **74**, 99–102.

* * *

Beet flume water clarification. J. P. THOMAS and W. A. SACKETT. *Sugar J.*, 1972, **34**, (11), 23–25.—In small-scale model tests on flume water treatment in an Enviro-Clear clarifier[1] 90–97% of the suspended solids in the feed was removed in the underflow which usually contained more than 25% solids, while the overflow solids content was normally below 200 ppm. Retention time averaged less than 11 min. Raising the feed pH by adding lime further reduced the overflow suspended solids.

* * *

Chemical problems concerned in various phases of sugar factory operation. A. CARRUTHERS. *Ind. Sacc. Ital.*, 1972, **65**, 31–35.—Problems discussed include the pressing of beet pulp to reduce its moisture content, extraction of pectins into raw juice by high pH in diffusion, the formation of imido-disulphonate and the reactions undergone by formaldehyde added as a microbiocidal agent.

* * *

Introduction of three-massecuite scheme at Dolinskii sugar factory. A. K. KALINICHENKO *et al. Sakhar. Prom.*, 1972, (5), 10–11.—Improvements brought about by replacing a 2-massecuite system with a 3-massecuite one, in which part of the 2nd massecuite is used as footing for 3rd massecuite, are described.

* * *

Rate of corrosion of St. 3 steel in raw juice. V. V. SUPRUNCHUK *et al. Sakhar. Prom.*, 1972, (5), 11–14. The rate and intensity of St. 3 steel corrosion in raw juice fell with contact time in contrast to the effects of immersion in mains water, which caused the final mass loss through corrosion to be much higher than in raw juice although the initial corrosion in water was much smaller. Corrosion rate was fairly constant in water. The behaviour in juice is attributed to retention of a protective film of corrosion products on the steel; removal of this film caused a rise in the corrosion rate, which fell with increase in sucrose concentration, was much higher in the presence than the absence of oxygen, rose with temperature and increased sharply with fall in pH, particularly from 7·5 to 4·0.

* * *

Effect of calcium hydroxide on formation and removal of colouring matter in liming. I. F. BUGAENKO and M. MUKHAMED. *Sakhar. Prom.*, 1972, (5), 14–17. Colour formation in invert solutions was greater at lower alkalinities (after liming to 0·1–0·2% CaO) after heating to 85°C than at higher alkalinities. From experiments this is attributed to the inhibiting effect of undissolved lime particles at the higher alkalinities. Absorption spectra indicated that these particles affect colouring matter adsorption and composition. Cold liming is therefore recommended instead of hot liming, especially when deteriorated beet, which contain more reducing matter, are being processed.

* * *

Efficient scheme for transferring carbonatation station products when using disc filters. YU. V. ANIKEEV and V. A. ZAMBROVSKII. *Sakhar. Prom.*, 1972, (5), 17–19. A scheme recommended for transferring and filtering juices after 1st and 2nd carbonatation, evaporation and sulphitation is described, in which particular attention is focused on procedures for sweetening-off, precoating and restarting operation of disc filters.

* * *

Pressures on the fibre of bags of sugar under the action of gravitational pressure in stacks. N. M. KICHIGIN and I. I. NOVOGURSKII. *Sakhar. Prom.*, 1972, (5), 19–20.—Expressions are derived relating static pressure, sugar bulk density and limiting conditions with respect to stack height and fibre rupture resistance in bags containing sugar. The effect of horizontal movement, caused by the downward pressure on the bag, is also considered; it is stressed that with high static pressure and prolonged storage, compaction of the sugar will occur and reduce horizontal movement, thus increasing fibre life.

* * *

Study of the operation of equipment for lime suspension treatment. E. T. AKSENOV and V. F. KHARITONENKO. *Sakhar. Prom.*, 1972, (5), 21–22.—Experiments are reported in which the most suitable scheme for milk-of-lime treatment was found to include a slaker screen for removal of particles greater than 10 mm, a vibratory screen (preferable to a sand removal trough) for removal of particles measuring 1–10 mm, and a hydrocyclone, which is suitable for removing all particles larger than 0·3 mm.

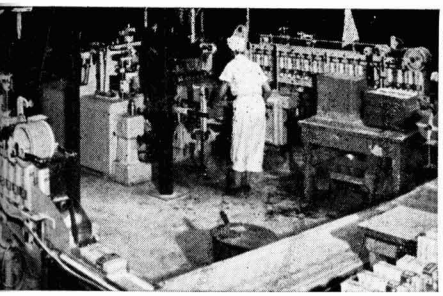
* * *

Automatic control of factory throughput and juice flow. B. A. FREMENKO, K. F. GERBUT and V. P. RUDNEV. *Sakhar. Prom.*, 1972, (5), 23–26.—Details are given of a patented automatic control system for controlling materials flow from diffuser to vacuum pans, involving use of an analogue diffuser, local control loops, buffer tanks, etc. At Yagotinskii experimental factory test results in 1970/71 indicated lower diffusion losses, more precise alkalinity and pH control in juice purification and higher hourly sugar output than with simple local control schemes, while remelt liquor Brix was the same for both systems.

* * *

Checking and adjusting drive pinions on sloping scroll diffusers by means of a theodolite. S. V. DUDNIKOV and V. A. LUPASHKO. *Sakhar. Prom.*, 1972, (5), 34–35. A method of aligning drive shafts and pinions on DDS-type diffusers is described.

[1] *I.S.J.*, 1971, **73**, 265–268, 295–297.



Sugar refining

Louisiana's Southdown enterprise: a coordinated sugar operation. ANON. *Sugar y Azúcar*, 1971, **66,** (10), 60–62.—Information is given on the cane growing, raw sugar producing and refining operations of Southdown Sugars Inc. and Southdown Land Co., both subsidiaries of Southdown Inc. Particular emphasis is laid on the land grading programme and its benefits and on treatment and disposal of the condenser water and cane wash water at Southdown refinery[1].

* * *

Preliminary results on the use of "Talofloc" in sugar refining. M. C. BENNETT. *Sugar y Azúcar*, 1971, **66,** (10), 90–94.—Preliminary results obtained at three refineries using the "Talofloc" decolorizing process[2] are discussed. Apart from the advantage of better liquor clarification and other improvements compared with conventional processing involving phosphatation clarification, the process is estimated to permit savings of 1–2 cents/100 lb of refined sugar and allow considerable increases in the capacities of the defecation and decolorization stations. Situations where the "Talofloc" process will give the greatest economic benefits are indicated. Tests with sugars and syrups containing "Talofloc" showed that concentrations between 10 and 100 times the maximum expected leakage have no effect on processes and products (including confectionery, soft drinks, baking products and beer).

* * *

Investigations on crystal sugar crushing. II. E. A. NIEDIEK. *Zeitsch. Zuckerind.*, 1972, **97,** 20–31.—The crushing properties of two types of mill, i.e. with one solid surface using impact for size reduction (e.g. pin and hammer mills) and with two solid surfaces between which the material is ground (e.g. roller, ball and attrition mills), are described. Tests with particular mills are discussed in detail with the aid of graphs, and conclusions regarding the mechanics of sugar milling are reported. The degrees of fineness obtainable with slurry mills are indicated.

* * *

The function of chemisorbed oxygen in carbon adsorbents. V. R. DEITZ and J. L. BITNER. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 2–15. The non-carbon constituents in carbon adsorbents, particularly oxygen, play a significant rôle in adsorption, and the total oxygen contents of two adsorbents were increased progressively by reaction with ozone at 26°C, which however caused a fall in nitrogen adsorption. Explanations of this are examined and a sequence of three reactions is suggested to explain the weight changes caused by the ozone treatment and the behaviour of the N adsorption isotherm at 77·4°K at which temperature decomposition of the treated adsorbent ceased.

* * *

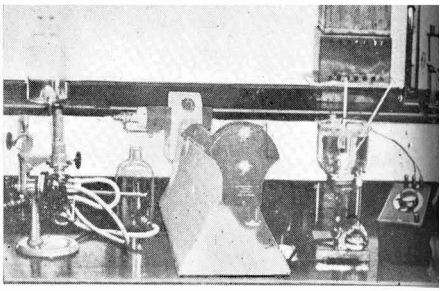
Refinery testing of an improved granular carbon. S. B. SMITH, H. F. LAUGHLIN, C. G. FORMECK and C. O. WALTERS. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 28–48.—Comparative tests with "Suchar 681", a granular active carbon with an alkaline additive for pH control, and Pittsburgh "Cane CAL" carbon showed that refinery liquors passed more freely through "Suchar 681", which had greater throughput and removed more colour than did "Cane CAL". Carbon loss through attrition was 36% smaller for "Suchar 681", while inversion was substantially lower than with unbuffered carbon (increasing the additive proportion to 2–2½% and adjusting regeneration conditions should, it is suggested, improve pH control considerably). Savings over a 300-day period for a refinery producing 1 million lb of sugar daily are calculated as $8,420 when "Suchar 681" is used instead of "Cane CAL" (this calculation is based on 8 cycles of adsorption and regeneration).

* * *

Filtrability tests using millipore filters. J. P. SULLIVAN. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 49–60.—Instead of expressing filtrability in terms of the volume of liquor collected in a specified time interval, the author proposes expression of filtrability as $T/V = kT + b$, where T is time (sec), V is volume (ml), b is a constant governed by experimental conditions such as Brix, viscosity, temperature, pressure and membrane porosity, and k (ml^{-1}) is a constant dependent on liquor quality. The filtrability constant, K, is given as 10^4k, and the fewer the insolubles in the liquor the nearer to 0 will be its value, which will be independent of filtration conditions affecting flow rate, since in the proposed method filtrability is estimated from the continuous increase in resistance to flow rather than from the volume flowing in a given time. Use of the method is illustrated by laboratory studies, with "Millipore" filters, of the filtrabilities of three raw sugars at a refinery using lime-phosphate clarification followed by press filtration.

[1] *See* CHEN *et al.*: *I.S.J.*, 1972, **74,** 341.
[2] *I.S.J.*, 1972, **74,** 313.

Laboratory methods & Chemical reports



A routine method for measuring molasses viscosity. R. WILKES and R. P. JENNINGS. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 107–113.—The method used by Huletts Sugar Ltd. to determine refinery molasses viscosity at 50°C is described, measurements being made at two concentrations, preferably slightly below and slightly above 80% solids and the value read by extrapolating a curve of log viscosity *vs.* concentration in the range 78–84%. For the sake of comparison between factories, pretreatment of the molasses by centrifuging to remove suspended matter is recommended. Variations in the slope of the curve during a season are indicated.

* * *

The determination of sucrose in final molasses. W. F. BEAMS and A. W. MACGILLIVRAY. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 114–120.—Five methods were compared, viz. the DUTTON method based on Clerget polarization before and after inversion with invertase; the Sugar Research Institute method, in which the reducing sugars are determined by the LANE & EYNON method before and after acid inversion and potassium oxalate used as sequestering agent for calcium; the Canadian National Committee method, in which invertase is used for inversion and EDTA acts as sequestering agent for calcium in the LANE & EYNON method; the JACKSON & GILLIS method based on polarization before and after acid inversion; and the SMRI method based on acid inversion and use of the LANE & EYNON method to determine reducing sugars. Results were also compared with values given by the isotope dilution method, and the Sugar Research Institute method found to give comparable results while being relatively quick and straightforward, so that its possible use for routine analysis is to be studied. Theoretical corrections for oligosaccharides applied in the methods are examined.

* * *

The presence and significance of crystalline aconitate salts in massecuites and molasses. A. W. MACGILLIVRAY. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 121–126.—The author discusses the presence of relatively large concentrations of crystalline calcium magnesium aconitate in South African molasses and massecuites. It has an adverse effect by increasing viscosity, which is demonstrated by graphs.

* * *

A carbonatation performance test. D. S. WILKES. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 130–135.—Details are given of a laboratory method used to evaluate the carbonatation properties of raw sugars received at the refinery. Good correlation has been found between the laboratory results and factory performances. The method takes only about 1 hr 20 min and so is suitable for routine analysis. Values have shown seasonal fluctuations in carbonatation performance, partly as a result of raw sugar storage.

* * *

False pol detection by gas-liquid chromatography. J. E. IRVINE. *Sugar Bull.*, 1972, **50,** (Jan. 15), 10–12. Because of apparent discrepancies between sugar determined in crusher juice and expected sugar recoveries, attributed to inaccuracies in polarimetric measurement, gas-liquid chromatography was applied to determining the dextrose:levulose ratio in a number of samples from different cane varieties. Results indicated differences in the ratio between varieties; early-maturing, high-purity varieties had a lower ratio than later-maturing varieties. That this could lead to a false pol reading was verified by tests on two solutions made up with the same amount of sucrose but with different dextrose:levulose ratios. Polarimeter readings indicated a sucrose content 1% higher in the sample having the higher ratio. Studies are continuing to see if any other optically-active substance is responsible for the error, as well as investigations into the effects of burning, freezing, delayed grinding and time of harvest on the ratio.

* * *

Comparison of the technological properties of molasses with its non-sugars composition. N. P. SILINA and E. L. LYAKHTSIK. *Sakhar. Prom.*, 1972, **46,** (3), 13–15. Analyses of molasses from three Soviet sugar factories showed that potassium, sodium and nitrogen remained fairly constant through the campaign while molasses sugar tended to increase, as did the high molecular non-sugars, lime salts and ash. Hence, molasses purity or sugar should not be estimated on the basis of measurements of only one non-sugar or group of non-sugars. High molecular constituents and decomposed reducing sugars are considered the primary cause of fluctuations in molasses sugar, while increase in viscosity is blamed on the increase in lime salts as well as the high molecular non-sugars.

* * *

Deterioration of raw cane sugar. I. Safety factors. J. P. STUPIELLO and S. JOLY. *Brasil Açuc.*, 1972, **79,** 152–160.—Three groups of samples of raw cane sugar were analysed in order to determine safety factor (SF) and the dilution indicator (DI). Samples were collected just before and during storage over one

year. After a short period of storage the SF and DI had reached ideal values for safe storage although their initial values were high and would have led to their rejection for storage. Thus, sampling at the moment or within a few days of bagging does not seem to be desirable. Different sugars from a factory may behave differently during storage.

* * *

Average purity of total losses. V. R. RAO. *Indian Sugar*, 1971, **21**, 601–604.—The author shows that the average purity of total losses (total purity loss) is the same as molasses virtual purity in the NOËL DEERR formula[1]. It is also shown by three examples that molasses virtual purity is not always higher than true molasses purity.

* * *

Concept of clarity in Philippines sugar centrals *versus* clarification efficiency. A. AZIZ. *Sugar News* (Philippines), 1972, **48**, 9–11.—Assessment of juice clarification efficiency from turbidity measurements with a Kopke apparatus, as practised in the Philippines, is not recommended but should be replaced, it is suggested, by determination of juice non-sugars before and filter cake solids after clarification. Use of the juice apparent purity as a guide to clarification efficiency is also criticized.

* * *

Production control in the cane sugar industry in Peru. G. HUSZ. *Zeitsch. Zuckerind.*, 1972, **97**, 198–203. Details are given of the scheme developed by the author for use at Casa Grande in determining cane sucrose content.

* * *

Determination of sodium, potassium and calcium by means of flame photometry. S. H. FLEITES, M. MURO and J. MONTERDE. *Bol. Azuc. Mex.*, 1971, (263), 20–25. A detailed account is given of the use of the Model II flame photometer of VEB Carl Zeiss Jena for the rapid determination of the three elements in molasses.

* * *

Method of evaluating refined sugar purity. N. K. KVACHEVA and G. A. CHIKIN. *Sakhar. Prom.*, 1972, **46**, (4), 30–31.—The method described is based on the linear relationship between colouring matter concentration and sugar solution optical density (established by the authors) and involves preparing a solution of the test sugar to a given concentration and measuring the optical density spectrophotometrically at 280 nm; this is then divided by the optical density of pure sucrose solution of the same concentration to give the non-sugars content. Some results are tabulated to demonstrate the effects of various adsorbents on refined sugar.

* * *

Determination of crystallization parameters. G. PIDOUX. *Zucker*, 1972, **25**, 327–333.—It has been found that use of the POWERS method of grist analysis[2] does not always give a straight line for sieve residue percentages from 10 to 90, the distributions approximating under these circumstances to a normal Gaussian curve. The properties of the Gauss law and the construction of probability curves are explained. By means of numerical examples the various types of distribution normally encountered are described and the method used to obtain a correct evaluation of Gaussian distributions is demonstrated. It is considered inadvisable to use only two sieves for M.A. and C.V. calculation, since it is not known which type of law is applicable to the distribution of the material retained by the sieves. Instead, the author advocates using four sieves and two probability graphs: on arithmetic paper (using the POWERS method and HENRY curve) and, if this is not valid, on logarithmic paper (GIBRAT curve).

* * *

The determination of fluoride in sugar cane by using an ion-selective electrode. C. W. LOUW and J. F. RICHARDS. *Analyst*, 1972, **97**, 334–339.—A method is described for determining fluoride in cane by means of a fluoride ion-selective electrode. The method involves separation of the fluoride from the bulk of interfering elements (silicon, aluminium and iron) in the sample solution by drying, ashing and mixing with a sodium carbonate-zinc oxide fusion mixture. After fusion, the mixture is extracted with water a given number of times and sodium citrate buffer solution added to form complexes with the residual trace elements. Good accuracy and precision are obtainable over a fluoride concentration range of 5–1000 ppm, and six samples can be analysed per working day.

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The margin of error in the boiling house balance is the determinant in calculation of industrial yield. J. M. TAMARGO T. and J. RODRÍGUEZ L. *ATAC*, 1971, (4), 48–59.—If a boiling house balance is drawn up for an extended period errors are reduced, but daily calculations are liable to result in errors in the calculation of yield based on cane milled and sugar produced. Random variances are the ones concerned rather than systematic variances, and these can arise from many causes including variation of temperature of products analysed, time interval between measurement of corresponding products, use of assumed values (on the basis of the latest measurements) for certain characteristics which require much time and so are done infrequently, and subjective error on the part of the analyst, etc. The estimation of sugar in process depends on the weight of a product and its sugar content; both of these are subject to error, e.g. in the volumes of syrup and molasses tanks, crystallizers, pans, etc., as well as in pol measurement. A calculation is made of the error in the total balance which can arise from given errors in the individual measurements.

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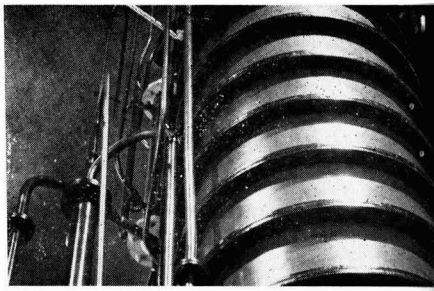
[1] *I.S.J.*, 1971, **73**, 92.
[2] *ibid.*, 1948, **50**, 149–150.

By-products



Activated carbon from sugar cane bagasse. M. RUIZ and C. ROLZ. *Ind. Eng. Chem., Prod. Research & Dev.*, 1971, **10,** 429–432.—Carbon was obtained from bagasse, cachaza and coconut husk, respectively, by low-temperature carbonization (500–550°C for 60–75 min followed by water washing and oven drying at 100°C for 12 hr) with simultaneous activation with zinc chloride (for all three carbons) as well as sulphuric and phosphoric acids, respectively, for bagasse carbon only. The physical properties of the carbons are tabulated and graphs given demonstrating the kinetic behaviour and equilibrium data for the carbons with respect to colour adsorption. The bagasse + $ZnCl_2$ carbon came closest to two commercial carbons in kinetic behaviour, but all the by-product carbons had a lower colour removal capacity than the commercial grades.

* * *

Sugar beet pulp. R. J. BURT. *British Sugar Beet Rev.*, 1971, **40,** 94–95.—Reasons are given for the popularity of dried molassed beet pulp as an energy source in dairy cattle rations. More than half of the 500,000 tons of molassed pulp produced annually by the British Sugar Corporation Ltd. is bought by dairy farmers in the UK.

* * *

Influence of recirculation in the single-stage production of bio-mass. I. D. O. FERNÁNDEZ. *CubaAzúcar*, 1970, (July/Sept.), 28–38, 59–64.—Highly concentrated feed material for fermentation may be diluted with water or, in a recirculation system, with effluent from the yeast separation stage, with the intention of increasing yield by reduction of the loss of reagents and nutrients. Such a situation is analysed mathematically and theoretical expressions derived from which it is possible to calculate the various process parameters and results for different retention times within the fermenter. It is concluded that recirculation will always increase productivity and yield of the fermentation process and this increase will be greater as the retention time and productivity of the process without recirculation are lowered.

* * *

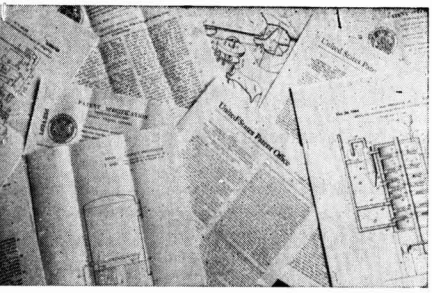
Study on the feasibility of a factory for boards of sugar cane bagasse using soya flour-based glue. J. A. LÓPEZ H. and H. A. PAZ. *Publ. Espec. Fac. Agron. y Zootecn.* (Univ. Nac. Tucumán, Argentina), 1971, 52 pp.—The remarkable increase in world particle board manufacture between 1956 and 1966 is tabulated and compared with the increase in sugar, pulp and paper production in the same period. Production in Argentina fron 1962 to 1969 is tabulated and a list given of the companies making such boards, using wood as raw material. Use of bagasse for particle boards is reviewed from the first plant in Réunion established in 1965. A report is then made on the feasibility of a particle board factory in Argentina; this takes into consideration the market, the process, including details of the techniques employed and characteristics of the product, engineering, the size and location of the project, and integration with the sugar industry, cultivation of soya, the laminated wood industry and the construction industry. A description of the process is provided, with flow diagrams and a materials balance, while calculated quantities and costs are tabulated.

* * *

Combined effect of heat and alkali in sterilizing sugar cane bagasse. Y. W. HAN, H. A. SCHUYTEN and C. D. CALLIHAN. *J. Food Sci.*, 1971, **36,** 335–338; through *J. Sci. Food Agric. Abs.*, 1971, **22,** 2663. A spore-forming bacterium was isolated from sugar cane bagasse (to be used for conversion to microbial or single-cell protein), incubated for 7 days at 30°C and a homogenate prepared from it. The homogenate was centrifuged, re-suspended in sterile water and heated for 20 min at 75°C. Alternate exposure to blending and centrifuging was continued until a clean, uniform spore preparation was obtained. The spore preparation was subjected to combinations of heat and alkali concentration to determine the rate of destruction. A series of survival, thermal death time and alkaline destruction curves revealed a different mode of death by heat exposure than alkali treatment. Equations, prepared from experimental data, reveal that the death rate of the spores is affected in an exponential manner by temperature and in a direct relationship by alkali concentration.

* * *

Changes in rumen fermentation parameters with age in Holstein calves weaned early onto molasses-based diets. T. R. PRESTON, M. MOREJÓN and M. QUIÑONES. *Rev. Cubana Cienc. Agríc.*, 1971, **5,** 271–278.—Rumen fermentation in the calves was significantly affected by the carbohydrate source in diets. A molasses-based diet caused the volatile fatty acids concentration to fall and the pH to rise compared with other diets. However, with the molasses diet the pH fell with age in contrast to a rise with age when grain was used. Molasses also gave higher buffering capacities and rumen ammonia contents than did grain, molasses + urea giving the highest values.



Patents

UNITED KINGDOM

Separating fructose from glucose. R. TATUKI, of Aomori, Japan, and T. KUBO, of Tokyo, Japan. **1,260,826.** 6th February 1970; 19th January 1972. A neutral or acidic solution of glucose and fructose, e.g. as produced by inversion of dissolved sucrose crystals, having a Brix of less than 77°, is treated with $CaCl_2$ (which may be formed *in situ*) in excess of 15% on total sugars, and the solution concentrated under reduced pressure to at least 77°Bx followed by slow cooling with stirring whereby a fructose-$CaCl_2$ double salt is formed. This is separated and the fructose recovered from it by electrodialysis through an ion exchange membrane, the initial invert sugar solution being used as the diffusate. The remaining glucose may be separated by electrodialysis through an ion exchange membrane using the initial solution as diffusate, and is isomerized to give a glucose-fructose solution which is used as the initial feed

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Photo-electrically controlled beet thinner. EVERSMAN MANUFACTURING CO., of Denver, Colo., USA. **1,265,438.** 10th April 1970; 1st March 1972.

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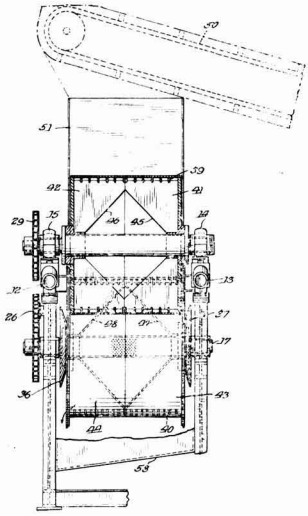
Dewatering bagasse. C F & I ENGINEERS INC., of Denver, Colo., USA. **1,265,448.** 19th June 1970; 1st March 1972.

Bagasse from a diffuser is so wet (about 85% moisture) that it is difficult to separate sufficient water in a single milling or pressing stage to yield a product dry enough (50% moisture) to burn in a furnace. To save the expense of a second mill or press, a preliminary separation of excess water (to about 70%) is achieved by a low-cost unit between the diffuser and the mill or press. It comprises two rollers, the upper roller having a shaft supported by bearings 14, 15 carried by arms 13, 12 which pivot about an axis parallel with the shaft. The lower drum rotates about a shaft 17 having fixed bearings and has a perforated surface whereas the upper drum surface is not perforated.

The lower drum width is slightly greater than that of the upper drum and it is provided with flanges at the ends so that the upper drum rotates between the flanges, preventing the sideways escape of bagasse passing between the drums. The latter are reinforced



by annular ribs 39, 40 and radial plates 41 mounted on cones 45, 46, 47, 48 within the drums. Bagasse delivered from the diffuser by conveyor 50 falls into chute 51 and so between the two drums. After passing through, it falls onto a conveyor which takes it for further dewatering; during its passage between the drums, however, part of its moisture content is squeezed out and enters the ducts 43, 44 through the perforations in the lower drum surface, collecting in chamber 53 from which it is pumped. Conical shields 36, 37 prevent this water from entering and damaging the bearings of the lower shaft 17.

* * *

Beet diffuser. RAFFINERIE TIRLEMONTOISE S.A., of Brussels, Belgium. **1,265,561.** 20th February 1969; 1st March 1972.

The diffuser comprises a drum which rotates, inner partitions and screens acting as conveyors to take beet slices from the head end to the tail end, while water effectively moves in counter current to them, extracting the sugar content and becoming a juice which is discharged at the head end. The partitions 2 include perforated baskets 12 while slots with edges 3a, 3b, 3a′, 3b′ in the partitions are

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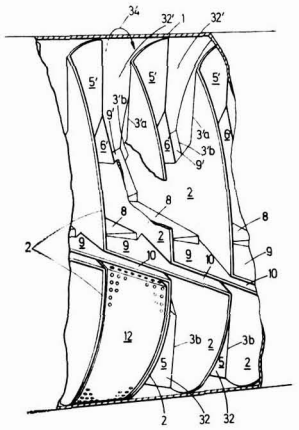

joined by plates 5, 5′ to give the effect of a double screw conveyor. Other slots in the partitions are connected by plates 9 which form channels from one chamber 32 to another chamber two along. As the drum rotates in the direction of arrow 34, the beet slices and juice are transported during one half-rotation by means of plates 5, 5′ one cell along the diffuser. During the remaining half-rotation, as the mixture in the basket 12 is raised, the juice content is separated, enters channel 10 and passes in the other direction to mix with drained slices two cells back. Thus in one complete rotation the slices move one cell in one direction and the juice one (nett) cell in the opposite direction. (See also *I.S.J.*, 1971, **73**, 125.)

* * *

UNITED STATES

Producing L-glutamic acid. H. FUKUDA, T. KANZAKI, H. OKAZAKI, M. DOI and M. SUZUKI, *assrs.* TAKEDA CHEMICAL INDUSTRIES LTD., of Osaka, Japan. **3,623,951.** 8th February 1966; 30th November 1971.—A strain of the micro-organism *Brevibacterium thiogenitalis* is cultured in a medium containing an assimilable carbon source (molasses) and a digestible nitrogen source, and an inorganic compound necessary for the growth of the micro-organism [as well as (2000–20,000 γ/ml of) a persulphate (Na, K or NH_4 persulphate) and (0·1–100 γ/ml of) a pyrimidine, thiazole or disulphide compound]. Cultivation proceeds until a substantial quantity of L-glutamic acid has been produced, after which it is recovered.

* * *

Cane diffuser. W. KAETHER, W. DIETZEL and H. D. BACKOFEN, *assrs.* BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **3,629,001.** 30th December 1968; 21st December 1971.—See U.K. Patent 1,248,259[1].

* * *

Cane diffuser. W. KAETHER and H. D. BACKOFEN, *assrs.* BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **3,629,002.** 11th December 1968; 21st December 1971.—See UK Patent 1,252,749[2].

* * *

Non-caking sugar. K. SUZUKI, of Tokyo, Japan, *assr.* TOYO SEITO K.K. **3,629,003.** 17th December 1969; 21st December 1971.—Caking of granulated sugar is prevented and its free-flowing nature retained by intimate mixing, between production and packaging, with 0·08–0·8% w/w of anhydrous calcium lactate.

* * *

Beet cart (for transport of harvested beets from field to factory). H. D. HARRIS, of Lubbock, Texas, USA, *assr.* HARRIS & THRUSH MANUFACTURING CO. **3,629,890.** 6th May 1969; 28th December 1971.

* * *

Continuous invert sugar production. R. N. PRINCE and A. O. MAYLOTT, *assrs.* CALIFORNIA AND HAWAIIAN SUGAR CO. **3,632,446.** 5th March 1969; 4th January 1972.—White sugar is added continuously to a premelter and a mixture of water and steam added. The wet sugar is taken by a scroll conveyor to the top of a main melter column where more water is added, with stirring, and the sugar completely dissolved to give a liquor of 76·2 R.D.S. The latter is adjusted to 75·2 R.D.S. and pumped to a holding tank. From this it passes to a primary inversion tank and thence to a secondary inversion tank, the rate of supply being regulated by level controllers in the tanks. The tanks are provided with stirrers and steam jackets and hydrochloric acid is pumped into the first tank in order to maintain a desired pH of 1·7–2·3 (preferably 2·1). Steam heating by the jacket is regulated to maintain a temperature of 72°C under which conditions 30–35% of the sugar is inverted during the retention time of 15–40 minutes. After transfer to the second tank the inversion continues and the liquor leaving the second tank is monitored by a polarimeter which governs the rate of withdrawal to maintain 50% inversion; with greater inversion the rate of withdrawal is increased and residence time reduced while with less inversion the retention time is increased by reducing the withdrawal rate. The 50% invert syrup is transferred to a third tank where Na_2CO_3 solution is added with agitation, the acid neutralized and inversion halted. The neutral syrup is passed through a heat exchanger to cool it and sent either to process or to storage.

* * *

Producing citric acid by fermentation. J. H. FRIED, of Waterford, Conn., USA, *assr.* CHAS. PFIZER & CO. INC. **3,632,476.** 1st May 1969; 4th January 1972. Citric acid is produced by aerobic cultivation of a strain of a *Candida* sp. (*C. guilliermondii*, *C. lipolytica* or *C. albicans*) in an aqueous nutrient medium (containing e.g. cane molasses) in the presence of 0·5–1·5 g/litre of PbO, $PbOCl_2$ or a Pb salt [$PbCl_2$, $PbBr_2$, $Pb(NO_3)_2$, $Pb(CNS)_2$, PbS_2O_3, Pb formate, Pb acetate, Pb propionate or Pb butyrate].

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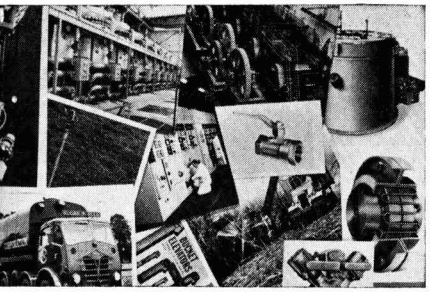
[1] *I.S.J.*, 1972, **74**, 284.
[2] *ibid.*, 380.

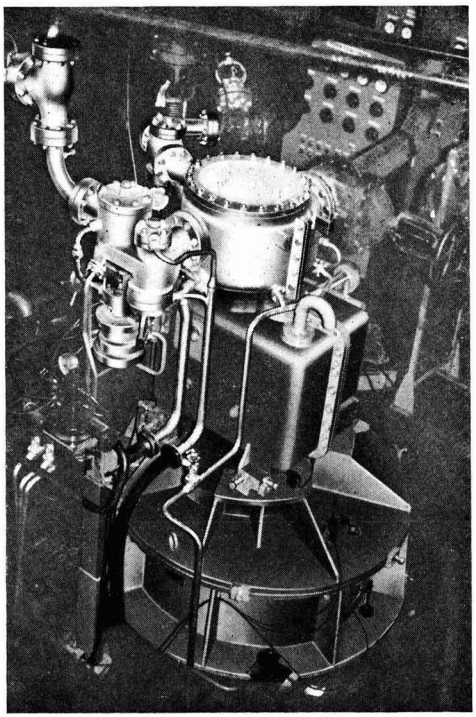


Trade notices

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

Steam turbine for centrifugal drive. Hiro Zoki Co. Ltd., 2-3-10 Nihonbashi, Chuo-ku, Tokyo, Japan.

Requirements for the drive of a batch centrifugal include reliability for high cycle frequency, operation at low speed for charging, high speed for molasses separation, and safe and rapid braking. These requirements are usually met by a suitable electric motor, but Hiro Zoki Co. Ltd. have introduced the VOG-4 type steam turbine to perform the same task. By using the steam energy directly, losses are avoided in the conversion into electrical energy and thence into mechanical energy, while speed can be controlled easily by means of a governor.



A reversing turbine of simple construction is incorporated for braking purposes and triplicate safety devices ensure safety against overspeeding. The turbine provides between 1·7 and 2 times the torque required for the rated output and yet is compact, replacing the electric motor conventionally fitted to the centrifugal. A forced-feed lubrication system is employed both for the turbine and reduction gearing. As an example of performance, using an inlet (saturated) steam pressure of 18 kg.cm^{-2} (256 psi) and an exhaust pressure of 1 kg.cm^{-2} (14 psi), the turbine develops an output of 150 kW and consumes steam at the rate of 4100 kg.hr^{-1} during acceleration and 3000 kg.hr^{-1} during braking. Further information is available in Leaflet No. 3803 published by the manufacturers.

* * *

Load weight checking. Weylode Engineering Ltd., Grange Lane, Alvechurch, Birmingham B48 7DJ, England.

The "Weylode" is basically a 6-inch (150-mm) diameter pressure gauge of high accuracy which measures the oil pressure in the rams of a tipper truck when it is slightly tipped. Since this pressure is directly related to the weight of the load carried (provided it is evenly distributed), the gauge will give an indication of the load weight within 2% of weighbridge figures for gross vehicle weight. Although such accuracy is not acceptable for purposes of buying and selling, the "Weylode" does provide a useful check where there are no weighing facilities and can be used for internal checking of material drawn from a stockpile or crop yields from fields. Installation is comparatively easy and takes only about 1 hr. Among loads for which the "Weylode" is applicable are sugar beet and sugar.

* * *

Fives Lille-Cail order from Iran.—Fives Lille-Cail, well known as suppliers of complete sugar factories, have recently received an order for the supply of a molasses sugar extraction plant to Esfahan beet sugar factory in Iran. The unit, designed to treat 150 tons of molasses daily, will be the second of its type (using the RT cold continuous system) to be installed by Fives Lille-Cail; the first, which has operated entirely satisfactorily since its installation in 1972, is located at Origny-Sainte-Benoite sugar factory in France. Esfahan factory, completed in 1960 by Fives Lille-Cail, has undergone three extensions, so that its capacity has been raised from an original 1000 tons/day to 4000 tons/day. The order also covers the supply of various pieces of equipment, notably a 200-m^3 lime kiln and four FC 1000 continuous centrifugals for low-grade work.

Canada sugar imports[1]

	1972	1971	1970
	—— (*long tons, tel quel*) ——		
Raw sugar			
Australia	373,520	271,048	265,235
Brazil	0	0	4,607
British Honduras	7,338	23,984	24,407
Cuba	29,564	69,648	67,137
Dominican Republic	10,507	10,541	0
Fiji	47,599	77,072	61,500
India	18,984	72,478	57,976
Mauritius	138,513	103,078	161,237
South Africa	229,111	209,467	200,546
Swaziland	38,014	41,068	36,887
Uganda	0	0	11,551
USSR	0	0	20,098
West Indies & Guyana	0	6,099	22,830
	893.150	884,483	934,011
Refined sugar			
Holland	186	250	147
Norway	0	98	134
UK	40	37	462
USA	491	66	38
Other countries	14	3	0
	731	454	781

Australian sugar companies merger[2].—Fairymead Sugar Co. Ltd. and Gibson & Howes Ltd. have merged to form a new company, Bundaberg Sugar Co. Ltd., which is to operate the cane plantations and sugar factories of the constituent firms.

* * *

West Indies sugar technologists meeting.—The fifteenth of a series of meetings of West Indies sugar technologists since 1943 took place in Barbados during the 7th–12th May 1973. The meetings take place under the auspices of the West Indies Sugar Association (Inc.) and are held in rotation in the countries whose sugar industries are members of the Association. There are sugar technologists' associations in each of these member countries but at present no formal association for technologists for the whole area. Some 80–100 delegates were expected from outside Barbados, including representatives from Guyana, Jamaica, St. Kitts, Trinidad, Guadeloupe, Martinique, Puerto Rico, Surinam, the Dominican Republic and the United States. Discussions and presentation of papers were in three divisions: field, factory and general, while field tours and visits to sugar factories, to demonstrations and research centres and the sugar cane breeding station in Barbados, played an important part in the week's programme. Details of the programme may be obtained from Mr. R. NORRIS, Secretary, West Indies Sugar Association (Inc.), P.O. Box 170, Bridgetown, Barbados.

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Portugal sugar imports, 1972[3].—Imports of sugar into Portugal in 1972 amounted to 251,791 metric tons, as against 188,251 tons in 1971. As before, the principal supplier was Portuguese East Africa with 196,471 tons in 1972 and 155,140 tons in 1971.

* * *

UK sugar distribution payments.—As announced previously[4], the distribution payments made by the UK Sugar Board were reduced from £10 to £5 per ton from the 1st May. The payments represent the consumer subsidy on sugar which is being phased out over the period ending 30th June 1973.

* * *

Trinidad sugar exports 1972[5].—Exports of sugar from Trinidad in 1972 amounted to 187,624 tons as against 172,167 tons in 1971. The UK was the major customer, taking 151,941 tons compared with 136,072 tons in 1971, while the US received 25,194 tons in 1972 as against 26,171 tons the previous year. The remainder was sold in the West Indies, while domestic sales were 39,449 tons in 1972 as compared with 36,439 tons in 1971.

Japan sugar imports[6]

	1972	1971	1970
	—— (*metric tons, tel quel*) ——		
Australia	653,599	472,169	510,192
Brazil	111,348	25,773	143,578
Colombia	59,143	51,050	45,994
Cuba	855,174	1,050,825	1,093,431
Dominican Republic	200,032	163,933	63,155
Fiji	21,179	15,165	5,325
Korea	1,130	0	0
Ryukyu	114,949	226,249	217,771
Salvador	21,769	6,330	6,337
South Africa	566,850	275,005	373,050
Taiwan	135,062	164,148	108,723
Thailand	34,849	46,723	32,378
Other countries	1,623	0	26
	2,776,707	2,497,370	2,599,960

Kenya Sugar Authority[7].—In terms of a legal notice published in the Kenya government gazette, the Kenya Sugar Authority has been set up to promote the development in Kenya of sugar cane and white sugar production, following the declaration of sugar to be a special crop. In addition to being concerned with the efficient functioning and development of the industry, the body will also advise on all aspects of sugar cane research, register all cane producers within factory zones, maintain statistical records relating to the industry and advise on the utilization of sugar by-products. Kenya's sugar production amounted to some 150,000 metric tons in 1971 whilst a further 78,000 tons were imported to meet local consumption; imports in 1972 are estimated at 130,000 tons.

* * *

New sugar factory for Brazil[8].—The Instituto Nacional de Colonização e Reforma Agrária (INCRA) is to set up a sugar factory by the Transamazonian Highway near Altamira, Pará, with an annual capacity of 36,000 metric tons of sugar.

* * *

Yugoslavia sugar production, 1972/73[9].—A total of 3,170,000 metric tons of beets, grown on 75,000 hectares, yielded 395,377 tons of sugar, raw value, in the 1972/73 campaign, representing a beet yield of 42·27 tons/ha and an extraction of 12·47% sugar on beet, which combine to give a sugar yield of 5·27 tons, raw value, per hectare. In the previous campaign, 2,712,588 tons of beet were produced from 78,366 hectares (a yield of only 34·61 tons/ha) but with a higher extraction of 14·32% yielded 388,539 metric tons of sugar, raw value, the combined yield being 4·96 tons of sugar per hectare.

* * *

Argentina sugar exports 1972[10].—Exports of sugar from Argentina increased greatly in 1972, reaching 167,134 metric tons, tel quel, as against 121,138 tons in 1971. Destinations in 1972 included Ireland with 4607 tons (none in 1971), Morocco with 23,220 tons (8000 tons in 1971), Portugal with 9619 tons (none), Sri Lanka with 26,168 tons (none), the USSR with 16,015 tons (none), the USA with 77,830 tons (63,638), and South Vietnam with 9675 tons (none). 1971 destinations had also included East Germany (19,500 tons) and Uruguay (30,000 tons).

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[1] C. Czarnikow Ltd., *Sugar Review*, 1973, (1119), 53.
[2] *Australian Sugar J.*, 1972, **64**, 424.
[3] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (10), vii.
[4] *I.S.J.*, 1973, **75**, 98.
[5] *Barclays International Review*, February 1972, 46.
[6] C. Czarnikow Ltd., *Sugar Review*, 1973, (1120), 57.
[7] *Standard Bank Review*, March 1973, 6.
[8] *Bolsa Review*, 1973, **7**, 118.
[9] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (7), vii.
[10] C. Czarnikow Ltd., *Sugar Review*, 1973, (1117), 44.

European sugar beet area[1]

	1973 (*estimate*)	1972	1971
West Europe		*hectares*	
Belgium/Luxembourg	105,000	103,000	92,000
Denmark	67,000	56,000	50,000
France	465,000	415,000	390,600
Germany, West	345,000	332,843	318,362
Holland	113,000	112,981	102,228
Ireland	30,880	34,008	29,200
Italy	248,000	239,000	247,154
UK	189,400	179,000	179,282
Total EEC	1,563,280	1,471,832	1,408,826
Austria	51,300	48,411	38,930
Finland	20,500	19,100	17,118
Greece	26,500	21,100	23,410
Spain	200,000	195,000	210,000
Sweden	42,200	42,200	40,000
Switzerland	9,990	9,843	8,924
Turkey	160,000	148,289	158,497
Yugoslavia	85,000	74,384	78,366
Total West Europe	2,158,320	2,030,159	1,984,071
East Europe			
Albania	6,000	6,000	6,000
Bulgaria	65,000	62,000	60,000
Czechoslovakia	180,000	180,000	180,000
Germany, East	226,000	220,000	210,850
Hungary	95,000	79,047	73,555
Poland	450,000	438,000	420,678
Rumania	200,000	195,000	176,901
USSR	3,500,000	3,435,000	3,321,000
Total East Europe	4,722,000	4,615,047	4,448,984
Total Europe	6,880,320	6,645,206	6,433,055

Swiss sugar imports, 1972[2].—Imports of sugar into Switzerland in 1972 totalled 225,486 metric tons, tel quel, compared with 237,996 tons in 1971. As in the previous year, the largest supplier was France with 138,225 tons (128,411 in 1971), while 37,602 tons were supplied by the UK (49,379 tons in 1971), 23,027 tons by West Germany (5183), 13,155 tons by Czechoslovakia (29,284) and 11,618 tons by Holland (21,879 in 1971).

* * *

Greek beet area increase[3].—The sugar beet area contracted in Greece in 1973 for the next campaign is 27,800 hectares, which compares with an area of 21,600 for the last campaign. Payment for the sugar beet is also to be increased.

* * *

Hong Kong sugar imports and exports[4].—Imports of sugar into Hong Kong were reduced from 124,486 long tons, tel quel, in 1971 to 77,326 tons in 1972. Major suppliers were China (28,962 tons), Thailand (15,646 tons), Japan (8564 tons) and North Vietnam (8124 tons). Exports were also reduced from 37,398 tons to 18,605 tons in 1972, the most important customer again being Malaysia, which took 9267 tons.

* * *

Japan beet sugar production[5].—Beet sugar production in Japan in the 1972/73 campaign reached 376,600 metric tons, refined value (418,400 tons, raw value), compared with 336,900 tons, refined value (374,300 tons, raw value) in the previous campaign.

* * *

Norway sugar imports[6].—Imports of sugar into Norway rose from 168,020 metric tons, white value, to 171,299 tons in 1972. As before, the largest suppliers were Denmark and the UK with 61,084 tons and 58,689 tons, respectively (59,501 and 49,867 tons in 1971).

Thailand sugar exports 1972[7]

	1972	1971
	(*metric tons, tel quel*)	
France	13,440	—
Hong Kong	15,746	—
Japan	34,961	44,810
Jordan	19,998	—
Malaysia	72,693	5,000
Nepal	5,987	—
Pakistan	41,978	—
Saudi Arabia	20,214	—
Singapore	2,031	17,790
Sri Lanka	76,532	—
Sudan	28,002	—
USA	16,808	16,572
Vietnam, South	68,917	60,828
Yugoslavia	9,500	—
	426,807	145,000

Indian sugar project for Malaysia.—An agreement has been signed in Malaysia for establishment of a joint Indian-Malaysian sugar project[8]. Phaltan Sugar Works of India is to invest 10 million rupees and will provide experience in cane cultivation and sugar manufacture, while Walchandnagar Industries Ltd. will supply machinery worth Rs. 40 million. The Malaysian company is the Negri Sembilan (State) Development Corporation, and will clear 35,000 acres of jungle to be brought under cane to be crushed in the 2500 t.c.d. factory, which will produce white sugar. The equipment to be used will include a DDS cane diffuser made under licence by Larsen & Toubro Ltd. in India[9].

* * *

USSR beet crop, 1972/73[10].—The total sugar beet crop for the 1972/73 campaign amounted to 75·7 million tons, an increase of 3·6 million tons or 5% on the 1971/72 crop which amounted to 72·1 million tons. The 1970/71 crop had totalled 78,300,000 tons but in all cases an appreciable quantity of beets are not bought for sugar production; thus, in 1970/71 only 71,380,000 tons were processed to sugar and 64,340,000 tons in 1971/72. Since the beet area was increased from 3,300,000 hectares in 1970/71 and in 1971/72 to 3,500,000 hectares for 1972/73, the latest crop figures reflect a continuing decline in beet yield per hectare.

* * *

St. Kitts (London) Sugar Factory Ltd., 1972 report.—The output of the 1972 crop in St. Kitts was 25,391 tons of commercial sugar, equivalent to 26,531 tons 96° pol basis. The tonnage was again small although juice quality was considerably better than in 1971. The low crop was partly due to bad weather and partly to the deterioration and reduction in cane cultivation following the years of depressed prices. All the sugar was sold to the UK at the Negotiated Price under the Commonwealth Sugar Agreement. The 1973 crop is again expected to be low but steps have been taken, under the lead of the St. Kitts Government, to increase production from 1974 onwards.

* * *

Singapore sugar imports, 1972[11].—Imports of sugar by Singapore reached 137,188 metric tons, tel quel, in 1972, compared with 138,425 tons in 1971.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (12), 1.
[2] C. Czarnikow Ltd., *Sugar Review*, 1973, (1117), 42.
[3] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (8), 5.
[4] C. Czarnikow Ltd., *Sugar Review*, 1973, (1117), 43.
[5] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (9), 9.
[6] C. Czarnikow Ltd., *Sugar Review*, 1972, (1117), 44.
[7] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), x.
[8] *Sugar News* (India), 1972, **4**, (8), 25–26.
[9] *N.S.I. News*, 1972, **8**, (2), 3.
[10] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (4), 1.
[11] C. Czarnikow Ltd., *Sugar Review*, 1973, (1121), 61.

Brevities

Hungary 1972 beet crop[1].—According to the Hungarian Central Statistical Office, the sugar beet crop amounted to 2·9 million tons in 1972 or 42% more than in 1971.

* * *

Bulk sugar store for Mozambique[2].—Mechaniplan (Pty.) Ltd. of South Africa have been awarded a 250,000 Rand contract to design, supply and erect all the mechanical and electrical plant for a 40,000-ton sugar store, the third to be built at Lourenço Marques.

* * *

Poland beet crop 1972[3].—According to reports from Poland, 14·3 million metric tons were harvested in 1972, an increase of 13·9% on the crop of the year before.

* * *

Bagasse board plant for Peru[4].—Construction is to begin in June of a $4,300,000 plant at Laredo for the manufacture of hardboard from bagasse. The work is being carried out by G. Siempelkamp & Co. of Krefeld, Germany, and production will begin at the end of 1974, at a rate of 60 tons a day.

* * *

Brazil drought[5].—The Export Director of the Brazilian Sugar Institute has announced that drought in the north-eastern provinces of the country would lead to reduction in sugar production for export. Shipping dates for sugar from the 1972/73 crop will be kept but the 1973/74 crop may be affected; it has already been announced that it was to start a month early, on 1st May instead of 1st June.

* * *

New US beet sugar factories[6].—The 1971 Amendments to the US Sugar Act enabled the Secretary of Agriculture to allocate between 25,000 and 50,000 acres of beet to new or substantially enlarged sugar factories with a guarantee of continuation for three years. It has now been announced that two new allocations have been made under these arrangements and new factories are to be built in time to work during the 1974/75 campaign. They are to be located in the Red River Valley of North Dakota and Minnesota, where one area has been sponsored by a cooperative in Hillsboro and another in Wahpeton.

* * *

New sugar factory for the Sudan[7].—A third sugar factory with an annual production of 90,000 metric tons is to be built in the Sennar region. The two existing factories produce 90,000 tons of sugar in total per annum so that, with the new factory, domestic production could rise to 180,000 tons, as against the present annual consumption figure of some 250,000 tons which is expected to rise to 400,000 tons by 1980.

* * *

Sierra Leone sugar imports, 1972[8].—Imports of sugar into Sierra Leone in 1972 totalled 20,197 long tons, tel quel, as against 23,177 tons in 1971.

* * *

Mexico cane area expansion[9].—The cane area in Mexico for the 1972/73 season will amount to some 448,000 hectares, compared with 414,000 hectares in 1971/72 and 417,000 hectares in 1970/71. From the enlarged area is expected a sugar production some 200,000 tons higher than in 1971/72 when 2,526,000 tons were produced.

Dominican Republic sugar statistics[10]

	1972	1971
	short tons, tel quel	
Initial stocks	224,059*	240,096
Production	1,255,562	1,210,595
Exports		
Algeria	13,665	—
Canada	11,768	11,760
Finland	5,346	14,006
France	27,165	25,097
Germany, East	40,488	—
Iraq	—	13,768
Japan	206,757	186,709
Malaysia	28,959	28,976
Morocco	9,498	—
New Zealand	28,206	56,396
Singapore	—	31,716
Sri Lanka	13,889	—
Tunisia	14,112	—
USSR	25,520	—
UK	33,423	—
USA	741,230	711,723
Vietnam, South	20,943	—
	1,221,444	1,082,176
Consumption	155,894	145,851
Final stocks	102,283	222,664

* Adjusted.

Argentina sugar production, 1972[11].—According to the Centro Azucarero Argentino, sugar production in 1972 totalled 1,210,000 metric tons, tel quel, of which 1,070,000 tons were white sugar and 140,000 tons were raws. Expressed as raw value, the total was 1,320,000 metric tons, which compares with a corresponding figure of 1,015,162 metric tons in 1971, i.e. an increase of 314,000 tons or 31%.

* * *

East German sugar factory closure[12].—The Teutschenthal factory, part of the "Vorwärts" sugar combine, has ceased operations as a sugar factory and will continue only as a drying plant. With a slice of only 500 tons of beet per day, this raw sugar factory was the smallest in East Germany. There remain one refinery and 47 sugar factories in operation, the latter comprising 22 raw sugar factories and 25 white sugar factories. There are 14 former factories working as drying plants and one former refinery as a packing station.

* * *

Chile beet crop, 1972/73[13].—The sugar beet area in Chile for the 1972/73 campaign was reduced to 24,114 hectares, compared with 33,069 ha in the previous campaign. Although the beet yield rose slightly, from 31·72 tons/ha in 1971/72 to 32·43 tons/ha, the total beet quantity processed amounted to only 782,100 tons as against 1,048,933 tons in 1971/72.

[1] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (4), 5.
[2] *S. African Sugar J.*, 1973, **57**, 152.
[3] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (4), 5.
[4] *Bolsa Review*, 1973, **7**, 203.
[5] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (10), 6.
[6] C. Czarnikow Ltd., *Sugar Review*, 1973, (1122), 66.
[7] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (5), 8.
[8] C. Czarnikow Ltd., *Sugar Review*, 1973, (1121), 61.
[9] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (4), 7.
[10] C. Czarnikow Ltd., *Sugar Review*, 1973, (1123), 71.
[11] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (4), 8.
[12] *Zeitsch. Zuckerind.*, 1973, **98**, 219.
[13] F. O. Licht, *International Sugar Rpt.*, 1973, **105**, (10), 6.

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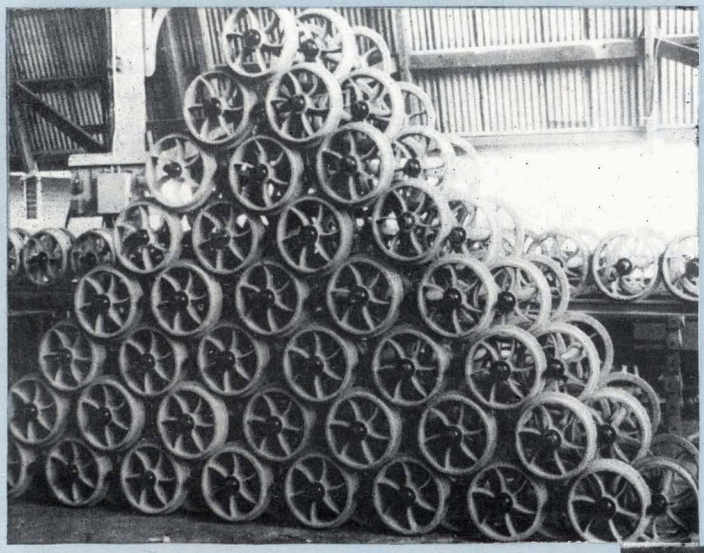

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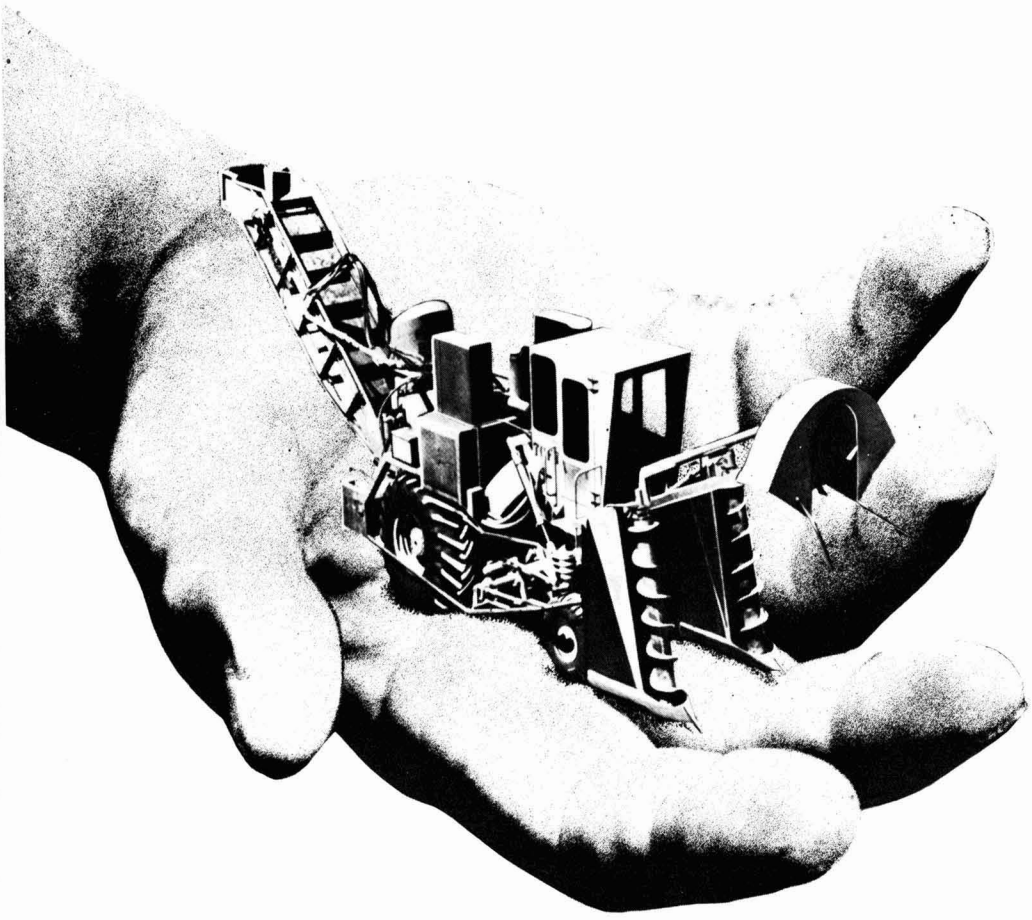

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The moisture balance type D illustrated is essentially the same as the type CB excepting that it can take samples from 100 to 1000 grm depending on the density of the product. In the case of bagasse the weight of sample possible is 100 grm contained in a dish 250 mm long × 200 mm wide × 22 mm deep.

The scale range is graduated 0/100% moisture and the maximum temperature of determination is 200°C controllable by a resistance knob.

The accuracy of the scale for 100 grm is ±0.5% or 0.05% on 1000 grm samples of material. The power required for operation is 1 kW. A timer 0/60 minutes is fitted as standard.

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Please state single phase voltage and frequency when ordering.

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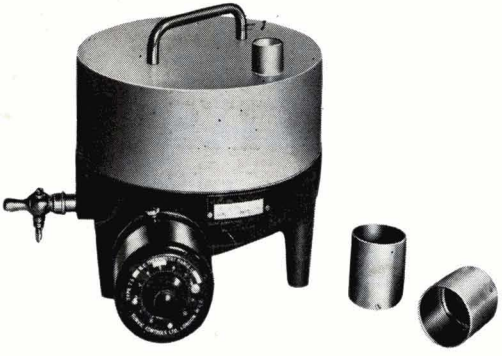
The equipment consists essentially of a fan which draws in air, passes it over heating elements and then through the bagasse. A time switch and thermostat are provided so that any temperature between 90° and 150°C can be maintained with a time of operation between 0 and 60 minutes.

Please state single phase voltage and frequency when ordering.



LABORATORY SUGAR DRYER

For the rapid estimation of moisture in sugars, a comparatively large volume of heated air should be passed over and through the sample. Care should be taken in these estimations, however, as it is essential to know the conditions of temperature and time of drying during which period no decomposition takes place. Once these conditions have been established for a particular type of sugar estimations become routine thereafter and results can be obtained in about 10 to 15 min.

This oven is fitted with a thermostat type TS.2, which gives temperature control of ±0.25°C over a range of ±60° from a central adjusted temperature.

Four sample containers are provided to fit into recesses in the body of the oven, and two additional containers are provided as spares.

This type of oven must be used in conjunction with a vacuum pump or the factory vacuum line, if available, for drawing the air over the heating element, through the sample and into the vacuum line or pump trap. A time device can also be supplied as an extra with a re-set push-button so that, simply by pushing the button for making contact, a whole series of rapid determinations can be made under the predetermined conditions of time, temperature and air volume, the whole process being automatic once the cycle is set in operation.

The Sugar Manufacturers' Supply Co. Ltd.

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Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.

PRINTED IN GREAT BRITAIN