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International Sugar Journal



APRIL 1975

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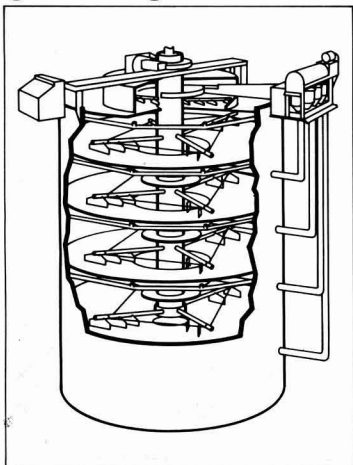
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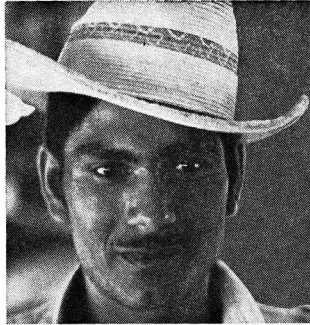
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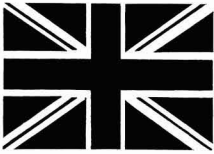
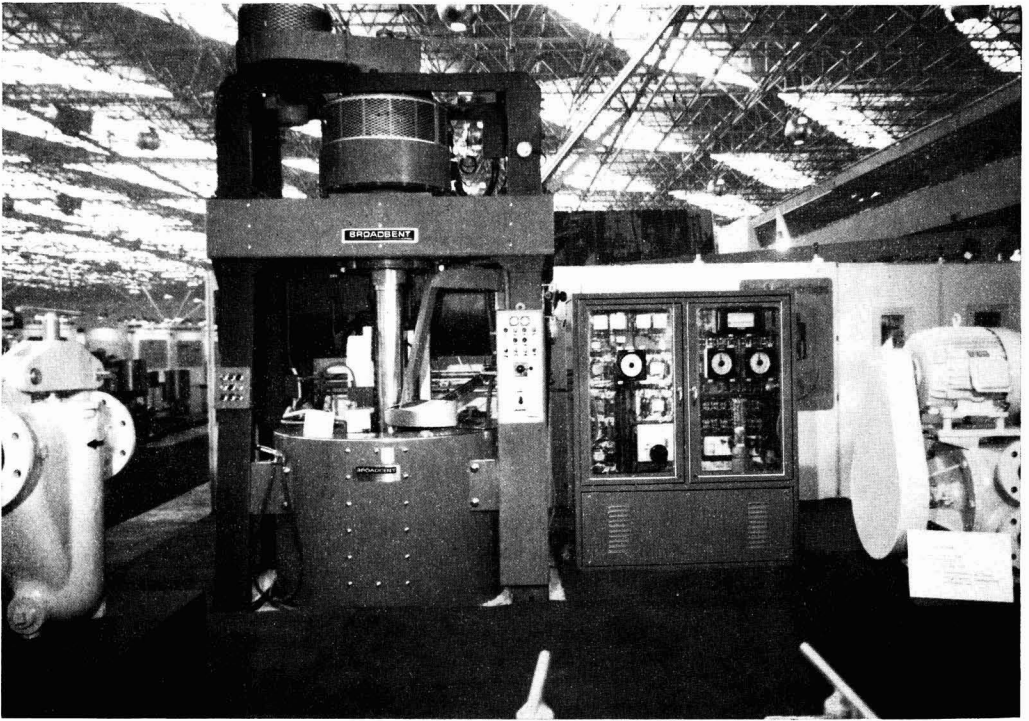


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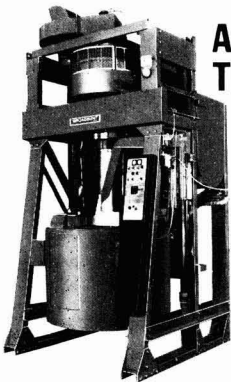


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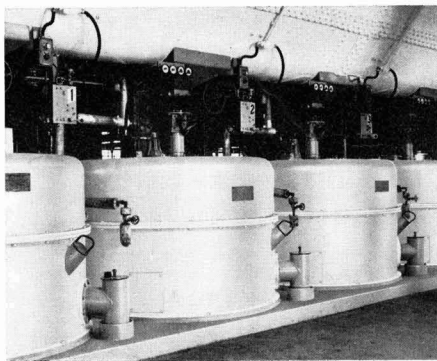


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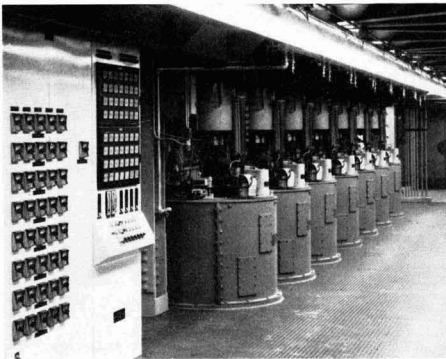


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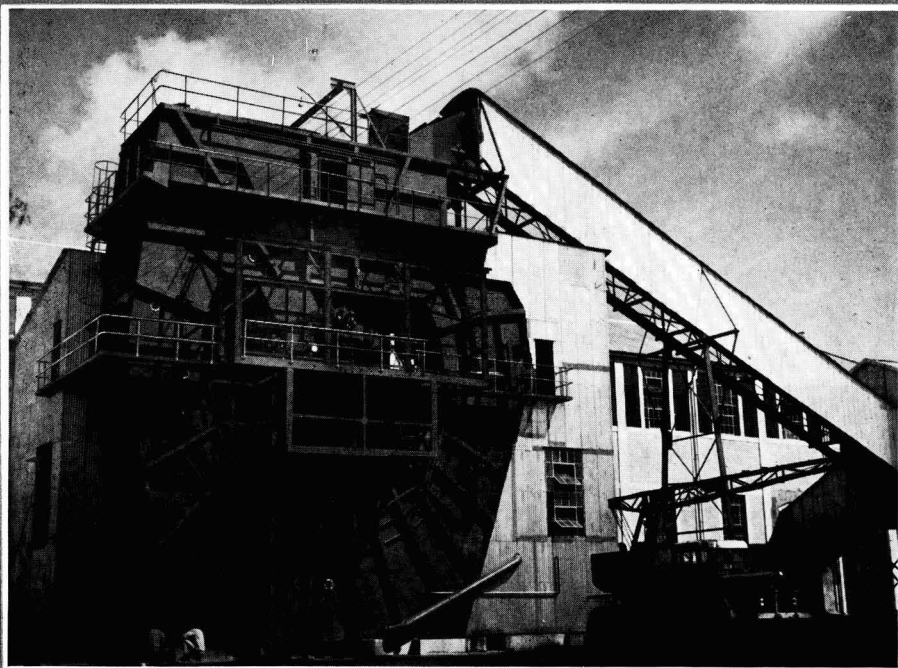


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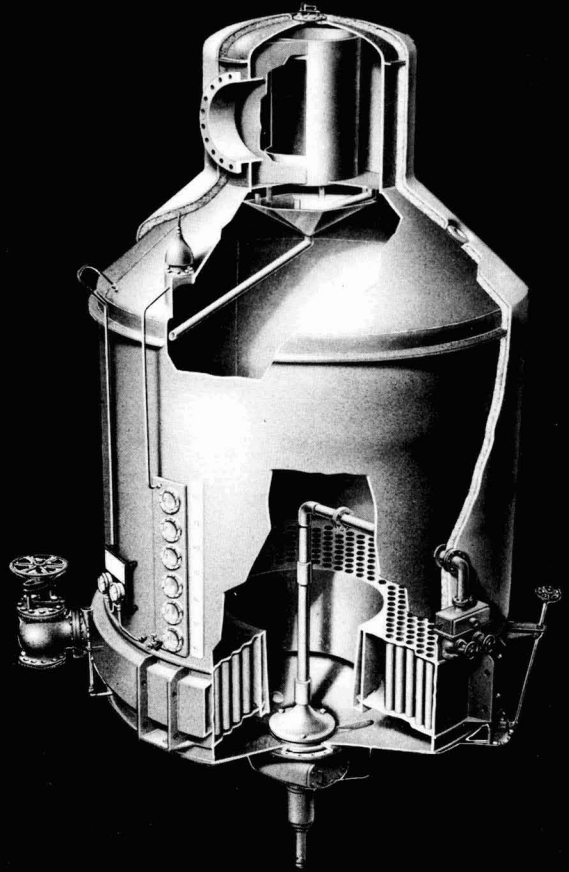
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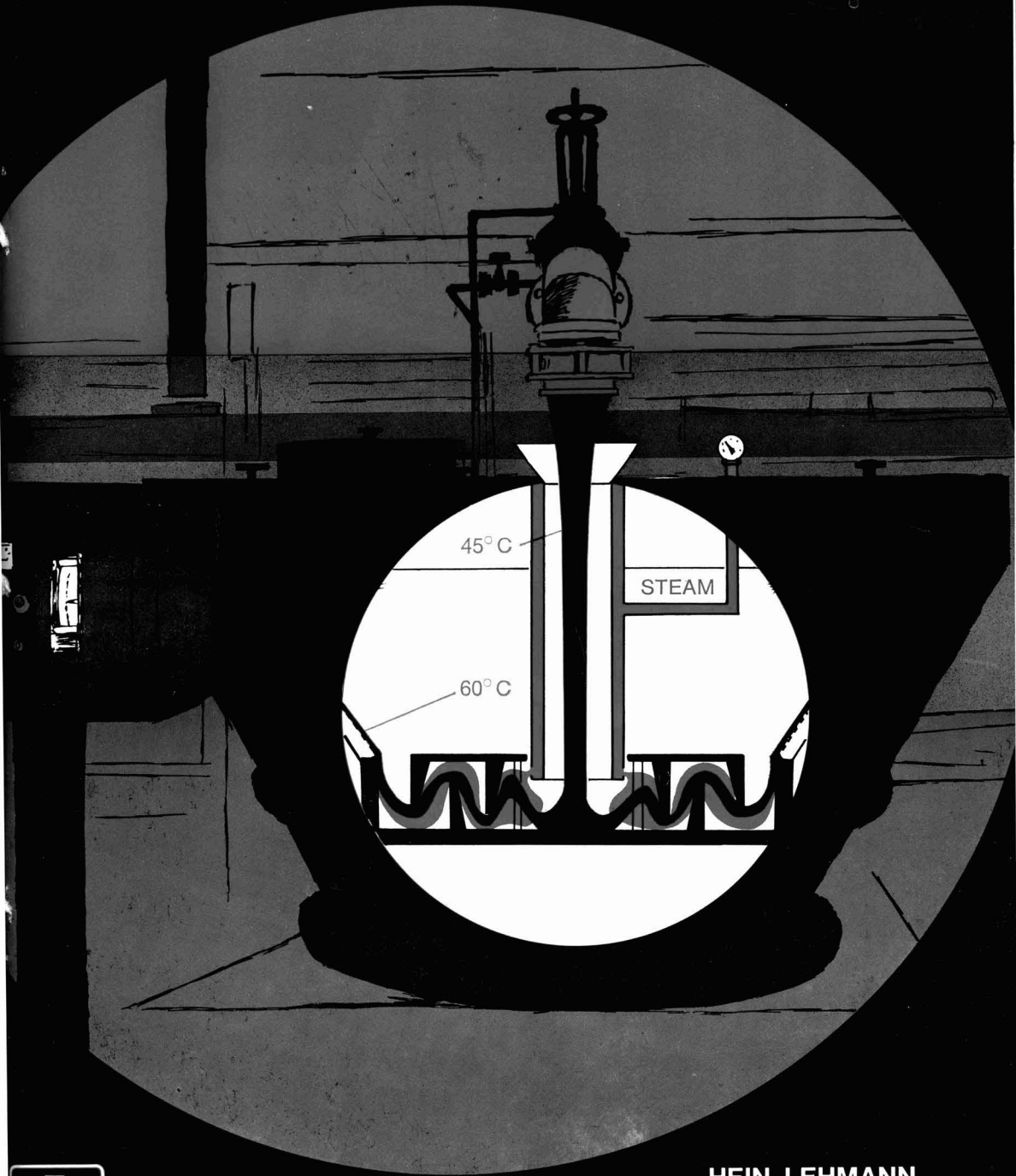
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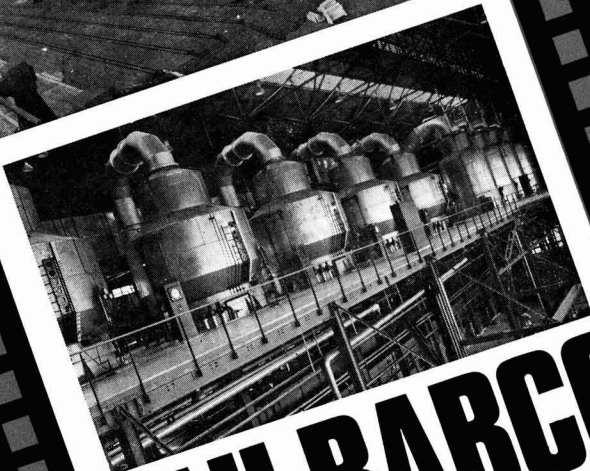
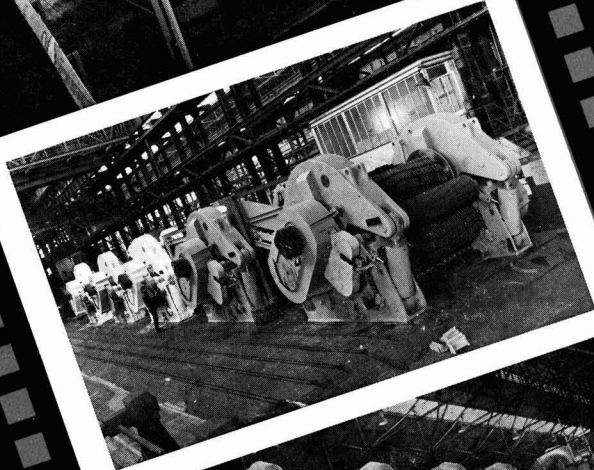
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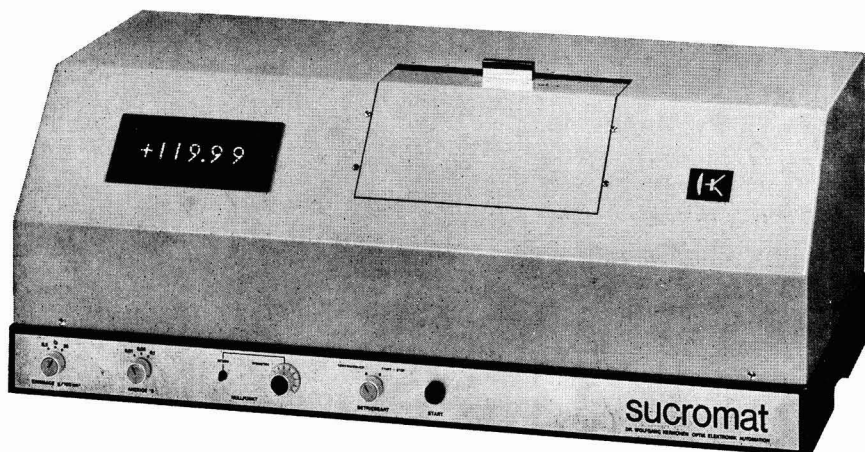
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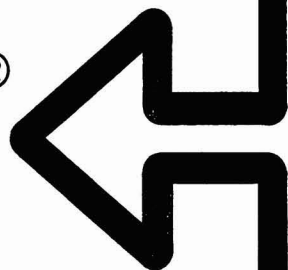
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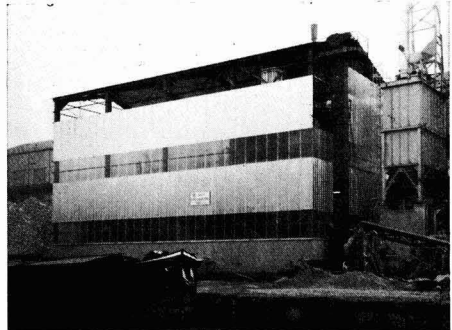
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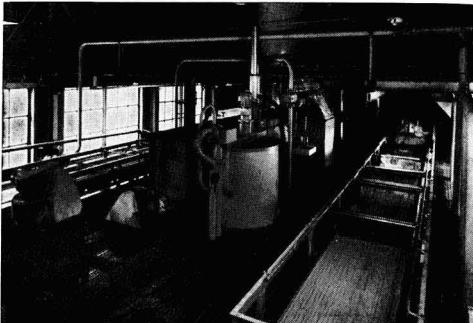
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For other sources consult Farrel headquarters in Ansonia, Conn., U.S.A.



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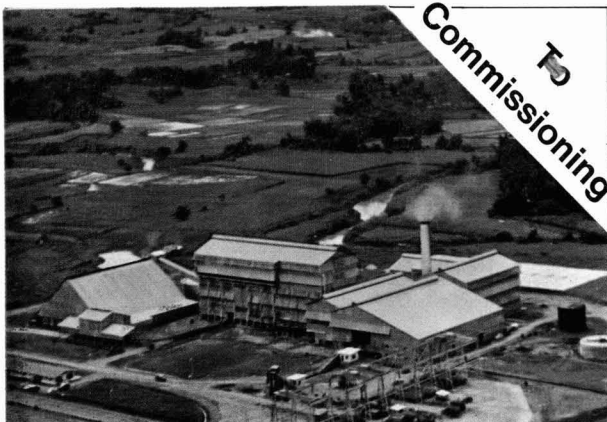
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Panel of Referees

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Consultant and former Director of Research, British Sugar Corporation Ltd.

W. R. CRAWFORD,

Research and Development Engineer, Walkers Ltd.

K. DOUWES DEKKER,

Consultant and former Director, Sugar Milling Research Institute, South Africa.

H. EVANS, O.B.E.,

Director, Bookers Agricultural and Technical Services Ltd.

M. MATIC,

Director, Sugar Milling Research Institute, South Africa.

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T. RODGERS,

Production Director, British Sugar Corporation Ltd.

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Published by

The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: High Wycombe 29408
Cable: Sugaphilos, High Wycombe

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Annual Subscription: £5.00 or \$15.00 post free

Single Copies: 60p or \$1.80 post free

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UK ISSN 0020-8841

International Sugar Journal

April 1975

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ต้องสมมุติ กรมวิทยาศาสตร์

- 4 ส.อ. 2518

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

La décomposition explosive de masse-cuites chauffées. D. H. FOSTER. p. 99-103

Suite à la défaillance d'un tuyau de transport pour masse-cuite *A* qui s'était bouché pendant le nettoyage à la vapeur, on a entrepris une étude du comportement—lors du chauffage—des masse-cuites *A* et *C*, ainsi que d'un magma de sucre raffiné. Des essais, effectués à différentes températures constantes, à l'aide d'une bombe de 600 cm³, ont montré qu'une réaction exothermique a lieu dans la région de 122-170°C et qu'elle est plus intense dans les masse-cuites impures. Le délai entre le début de chauffage et le début de la réaction brutale était également plus court dans les masse-cuites à basse pureté. Ce délai était réduit par une augmentation de la température de stockage et du volume de masse-cuite. De fortes pressions furent développées et des gaz étaient formés qui se composaient surtout de CO₂ mais contenaient également des hydrocarbures. On discute de la nature des réactions.

* * *

Etudes sur la filtrabilité des sirops carbonatés de sucres bruts. F. K. MAK et F. H. C. KELLY. p. 103-107

On a effectué une série d'expériences pour examiner les propriétés coagulantes du "Separan AP 273" lorsque ce produit est ajouté à la liqueur carbonatée en présence de substances polaires qui peuvent inhiber la cristallisation du CaCO₃, telles que tyrosine, alanine, acide chlorogénique et amidon, qui se trouvent tous dans le jus de canne. On discute les résultats à l'aide de photos de microscopie électronique.

* * *

Revue des produits chimiques régulateurs de croissance dans la culture de la canne à sucre. A. J. VLITOS. p. 107-109

On présente une revue avec 37 références bibliographiques, sur les recherches au sujet de la fonction des régulateurs chimiques de la croissance de la canne. Ces produits sont d'origine naturelle ou synthétique.

* * *

La possibilité d'une industrie sucrière dans l'Australie occidentale. ANON. p. 109

On réfère brièvement la conférence à laquelle des personnalités officielles de l'Australie occidentale et du Queensland ont discuté de l'établissement future d'une industrie de sucre de canne dans l'Australie occidentale.

Die explosionsartige Zersetzung von erhitzten Füllmassen. D. H. FOSTER. S. 99-103

Nachdem ein verstopftes Ableitungsrohr für *A*-Füllmasse beim Behandeln mit Dampf zerstört worden war, wurde eine Untersuchung über das Verhalten von *A*- und *C*-Füllmassen sowie von Raffinade-Magma beim Erhitzen durchgeführt. Versuche in einer 600-m³-Bombe bei verschiedenen konstanten Temperaturen zeigten, dass ganz allgemein eine exotherme Reaktion stattfand, die in unreinen Füllmassen und bei Temperaturen zwischen 122 und 170°C heftiger erfolgte. Der Zeitraum zwischen dem Beginn des Erhitzens und dem Einsetzen der plötzlichen Reaktion war ebenfalls bei Füllmassen niedriger Reinheit am kürzesten und wurde noch weiter verringert, wenn die Lagertemperatur und das Füllmassevolumen vergrößert wurden. Es traten hohe Drücke auf, und es wurden Gase frei, die hauptsächlich aus Kohlendioxid bestanden, aber auch Kohlenwasserstoffe enthielten. Die Art der Reaktionen wird diskutiert.

* * *

Untersuchungen über die Filtrierbarkeit von kohlenstoffhaltigen Rohzuckersirupen. F. K. MAK et F. H. C. KELLY. S. 103-107

Die Verfasser haben eine Reihe von Versuchen durchgeführt, um die Koagulationseigenschaften von "Separan AP 273" bei der Zugabe zu kohlenstoffhaltigen Flüssigkeiten und in Gegenwart von polaren Substanzen festzustellen, von den man vermutet, dass sie das Kristallisieren von Calciumcarbonat verhindern, z.B. Tyrosin, Alanin, Chlorogensäure und Stärke. Diese Stoffe sind alle von Natur aus im Zuckerrohrsaft enthalten. Die Ergebnisse werden an Hand von elektronenmikroskopischen Aufnahmen diskutiert.

* * *

Ein Ueberblick über chemische Wachstumsregulatoren beim Zuckerrohranbau. A. J. VLITOS. S. 107-109

Es wird ein Ueberblick über die Funktion von natürlichen und synthetischen Wachstumsregulatoren beim Zuckerrohranbau gegeben. Der Arbeit sind 37 Literaturstellen beigelegt.

* * *

Die Möglichkeiten einer westaustralischen Zuckerindustrie. ANON. S. 109

Es wird kurz über eine Konferenz berichtet, auf der offizielle Vertreter aus Westaustralien und Queensland die künftige Entwicklung einer Rohrzuckerindustrie in Westaustralien diskutierten.

La descomposición explosiva de masas cocidas acoloradas. D. H. FOSTER. Pág. 99-103

Después del fracaso, mientras se trataba con vapor, de un tubo para transferencia de masa cocida *A*, que se puso obstruido, el autor ha investigado el comportamiento de masas cocidas *A* y *C* y de un magma de azúcar refinado cuando se calentaban. Ensayos en una bomba de 600 cm³ a diversas temperaturas constantes han demostrado que, generalmente, había una reacción exotérmica que estuvo más severo con las masas impuras y a temperaturas en la gama 122° a 170°C. El intervalo entre el comienzo de calefacción y el comienzo de la reacción súbita también estuvo más corto con las masas de más baja pureza, y se redujo además con aumento de la temperatura de almacenaje y del volumen de masa cocida. Altas presiones se engendraron y se desarrollaron gases que incluyeron principalmente CO₂ pero hidrocarburos también. La natura de las reacciones se discuten.

* * *

Estudios de la filtrabilidad de siropes carbonatados de azúcar crudo. F. K. MAK y F. H. C. KELLY. Pág. 103-107

Un serie de experimentos se han hecho para investigar la propiedad coagulativa de "Separan AP 273" cuando se ha añadido a licor carbonatado y en la presencia de sustancias polares sospechadas de ser causas de inhibición de cristalización de CaCO₃, es decir, tirosina, alanina, ácido clorogénico y almidón, que ocurren todo en jugo de caña. Las results se discuten con el ayudo de microfógrafos electrónicos.

* * *

Un examen en el cultivo de caña de azúcar de materias químicas que controlan desarrollo de plantas. A. J. VLITOS. Pág. 107-109

Un examen se presenta, con 37 referencias a la literatura, de investigaciones de la función de materias químicas, naturales y sintéticas, para controlar desarrollo de caña.

* * *

Posibilidad de una industria azucarera en Australia Occidental. ANON. Pág. 109

Se refiere brevemente a una conferencia en que oficiales de Australia Occidental y Queensland han discutado el establecimiento de una industria de azúcar de caña en Australia Occidental.

THE INTERNATIONAL SUGAR JOURNAL

Vol. LXXVII

APRIL 1975

No. 916

Notes & Comments

World sugar balance

F. O. Licht K.G. have recently issued¹ their estimate of the world sugar balance for the crop year September 1974/August 1975, and this is given below together with corresponding figures for the two previous crop years.

	1974/75	1973/74	1973/72
	<i>(metric tons, raw value)</i>		
Initial stocks	15,865,000	15,693,000	16,991,000
Production	79,468,000	80,972,000	77,138,000
Imports	24,413,000	24,482,000	24,417,000
	119,746,000	121,147,000	118,546,000
Exports	24,346,000	24,819,000	24,870,000
Consumption	79,521,000	80,463,000	77,983,000
Final stocks	15,879,000	15,865,000	15,693,000

It is interesting to see that the final stock figure is put almost exactly the same as in the previous year; in other words, Licht consider that consumption will be reduced in proportion to the diminished production of 1974/75, presumably in response to the higher prices which have resulted. The stock figure represents almost exactly 20% of annual consumption, compared with the 25% which was thought normal in former days when sugar was more readily available, cheaper to buy and cheaper to store.

* * *

World raw sugar price

Mauritius suffered the ill-effects of a cyclone which struck the island early in February, damaging cane in the fields (initial estimates were of 30-50% destruction) and also causing some loss of sugar in store. The market reacted to the news so that the London Daily Price rose to £370 per ton by the 11th February, easing to £360 when news was received indicating less damage than originally feared. In the last week of the month, a rapid fall began, however, and from £345 on the 21st, the price had dropped to £275 by the 28th February. This may have been stimulated by the news of only a small quantity of import authorization by the EEC at its 20th February tender, estimates of about 150,000 hectares increase in EEC beet sowings and the reduced consumption of Licht's latest world sugar balance assessment for 1974/75.

But, according to C. Czarnikow Ltd.², "Overlying all these factors, however, has been the impression that the world market supply and demand situation has undergone a radical change and that, whereas it was anticipated only a few months ago that buyers would find supplies very hard to obtain, it now appears

that, for the time being at least, every new buyer entering the market is presented with a substantial range of available sugar.

"There have been indications of a sizeable fall in sugar usage in some developed countries but it can hardly be anticipated that the current low levels will continue. To some extent buyers throughout the supply pipeline have been running down stocks in anticipation of making replenishment at lower price levels. Eventually more normal consumption patterns must emerge, however, and it may well be that any improvement in market values will bring in substantial buying interest. Nevertheless, it is clear that, in some cases, there has been a change in the pattern of sugar consumption largely occasioned by the present and recent levels of prices. In some fields alternative, less sweet commodities can be utilized by manufacturers. These may change the nature of the final product but still leave it acceptable to buyers and it seems possible that, unless sugar prices are reduced even further, earlier forecasts of future consumption will prove to be far too high."

* * *

UNCTAD commodity proposals

Discussions took place in Geneva in February on proposals by UNCTAD for the stabilization of prices and supplies of major commodities. These call for an overall package deal covering 18 commodities, of which sugar is one. The proposals involve supply and purchase commitments and establishment of international buffer stocks, and are both complex and wide-ranging in their aims. C. Czarnikow Ltd. have reservations in respect of the sugar proposals³:

"In particular we feel there are very real dangers in the establishment of buffer stocks in respect of a commodity such as sugar. The vast sums of money needed and the annual servicing costs involved would cause problems enough, but in addition the impossibility of establishing reserve stocks of sugar for some time to come, possibly even for many years, makes this hardly a practicality. No actual tonnage has been proposed for sugar buffer stocks, but figures of 2,775,000 tons and 5,550,000 tons have been suggested. These quantities represent respectively one eighth and one quarter of the total annual volume of world trade. Large though these tonnages are, it has to be borne in mind that the international trade in sugar represents

¹ *International Sugar Rpt.*, 1975, 107, (6), 1.

² *Sugar Review*, 1975, (1220), 37.

³ *ibid.*, 1975, (1218), 27.

only about one quarter of world consumption and any changes in production and consumption patterns must be reflected in the world residuary markets.

“Some of the long-term arrangements within which sugar was traded for many years have recently been brought to an end. On the other hand there has in recent years been a rapid expansion in the establishment of long-term bilateral arrangements which have afforded guaranteed outlets for producers and guaranteed supplies for consumers at prices which are fair to both sides, while the arrangements recently negotiated between the EEC and the ACP countries have represented a major development in the provision of access for the produce of developing countries. These arrangements all bring considerable benefits to the parties concerned and it is important that, in endeavouring to bring greater stability to commodity prices, action is not taken as a result of these UNCTAD discussions which in any way weaken established trade links. Changing political and economic developments bring alterations to established trade patterns and it is therefore a prerequisite of any multiple commodity arrangement that provision should exist for considerable flexibility on a commodity-by-commodity basis.”

* * *

Commonwealth sugar supplies for the EEC

Sugar supplies to the UK and the other members of the EEC should reach at least 1,275,000 tons during the first year of the 5-year trade and aid agreement according to an announcement of the Commission¹. This figure is slightly below the former Commonwealth Sugar Agreement quotas for the countries concerned and is made up as follows:

Barbados	50,000	long tons
Belize	40,000	” ”
Fiji	166,000	” ”
Guyana	166,000	” ”
Jamaica	120,000	” ”
Malawi	20,000	” ”
Mauritius	492,100	” ”
St. Kitts	15,000	” ”
Swaziland	118,100	” ”
Trinidad	70,000	” ”

In addition, India, which was not a party to the EEC cooperation agreement with the 46 ACP countries, is expected to provide the community with an extra 25,000–30,000 tons.

* * *

UK sugar imports and exports

Official statistics of UK imports and exports of sugar in 1974 have been issued and are published elsewhere in this issue. Import statistics show clearly the fall in supplies from Barbados, Guyana, Jamaica and Trinidad and the increase necessary as a consequence in imports from the other members of the EEC. Previously, imports from these countries were well below 100,000 tons but in 1974 they grew to more than 360,000 tons. The other major suppliers were Argentina and Cuba, each delivering more than 60,000 tons and Brazil, from which country imports more than doubled to 153,958 tons. The total imports, at 2,203,481 tons, were the highest for ten years.

Exports were about the same as in 1972 but 40,000 tons down from the high level of 1973. Major customers from former years continued to receive sugar although some trade was at a lower level. Interesting new outlets were Hungary, which took 25,000 tons

as a first-time customer, and Turkey, to which 10,000 tons were exported as against only 15 in 1963 and none in the previous two years. Israel received 32,000 tons in 1974 as against 20,000 in 1973 which was itself double the 1972 level.

* * *

Cuban sugar crop²

During an informal conversation with foreign correspondents, the Cuban Prime Minister, FIDEL CASTRO, said that the 1975 cane harvest will be seriously affected by a prolonged drought which had lasted two years and would reduce sugar production by 800,000 tons. Last year's output was generally estimated at 5.9 million tons but, as has been the policy since 1970, there has been no forecast of this year's production. Dr. CASTRO said that present yields were high but he gave no figures.

Asked what the Soviet Union presently paid for its Cuban sugar, he replied that it was slightly under prices on the world market. But, he stressed, these prices have the advantage of being stable. This was the first official confirmation that Cuba and the USSR had renegotiated their sugar agreement of December 1972 under which Moscow undertook to almost double the price of eleven cents a pound it had paid until then. The Moscow Agreement was signed when prices on the international market averaged six cents/lb and was described as “generous” by local news media.

At the end of January 139 mills were in operation of the 145 scheduled to take part in this year's harvest. Ten other mills will be out of action during the whole harvest while undergoing repairs and modernization.

* * *

US sugar supplies

Interest is focusing on the effect of future US sugar purchases on the world price and *vice-versa*. Refiners have not been in any hurry to obtain supplies for 1975, having accumulated ample stocks towards the end of last year. Nevertheless, with the ending of the Sugar Act, the US is now the largest purchaser from the world market if she is to cover her requirements formerly obtained from quota holders. The high prices have caused a sharp drop in refiners' distribution in the US from the beginning of December 1974, as they have in Canada and Japan, and, in spite of important subsequent falls in the world and domestic prices, consumer resistance is evidently continuing.

When the refiners start to make purchases to cover their needs for the rest of the year this will obviously tend to give firmness to the market, and it remains to be seen how this affects demand. It has been noted that patterns of trading may be altered markedly as a result of previous world market sales made by traditional suppliers to the US who now have no sugar available. Such new patterns would need to be taken into consideration if new sugar legislation were to be introduced in the US—Representative W. POAGE, Chairman of the House Agriculture Committee, stated in early January that he intended to continue to campaign for a new Sugar Act. At the same time the break with the previous Act will make it simpler to accommodate the possible re-introduction of Cuban sugar supplies to the US market if they should eventuate as has been proposed by a number of Congressmen.

¹ *The Times*, 19th February 1975.

² *Public Ledger*, 1st February 1975.

The explosive decomposition of heated massecuites

By D. H. FOSTER

(Sugar Research Institute, Mackay, Queensland)

Paper presented to the 15th Congr. ISSCT, 1974

INTRODUCTION

THE spontaneous heating of molasses, especially when it is stored hot, is well known and it is common practice to bubble air through the molasses to remove heat and to reduce frothing. It is generally considered that the heating and frothing are due to the Maillard reaction which is a condensation of amino-acids with reducing sugars¹. The reaction is accompanied by various molecular rearrangements, polymerization and decarboxylation (formation of CO₂) of some of the products.

The recent failure at an Australian mill of a blocked *A*-massecuite cut-over pipe which was being steamed with 1,000 kPa gauge steam (181°C) was at first thought to be a simple mechanical pipe failure since two other cut-over pipes had burst in recent years and their failures had been attributed to faulty piping. In this instance, however, there had been considerable damage and it was thought desirable to carry out experiments to test the behaviour of heated sugar products.

Subsequent investigation of the literature showed that rapid decomposition of molasses had been recorded at least once in the past. HAZEWINKEL & LOHR² reported a loss of dry substance and frothing commencing after half an hour and continuing for one or two hours at 134°C. These investigations were made after it was found that in boiling to produce solidified molasses for the Indian market there were losses of dry substance. It has been related to the writer, in a private communication, that on one occasion in Java a vacuum pan had been accidentally closed and there had been pressure build-up and failure of the vessel.

EXPERIMENTAL PROCEDURE

A 600 cm³ steel bomb was constructed (see Fig. 1) with a diaphragm-type pressure sensing element attached to the bomb by means of a short connecting tube. Water (50 cm³) was placed in the bomb and the massecuite or molasses was weighed into a glass container which was set upright in the bomb. Tests were made with varying mass of material and void space in the bomb. Pure sugar magma, *A*- and *C*-massecuite and final molasses were tested.

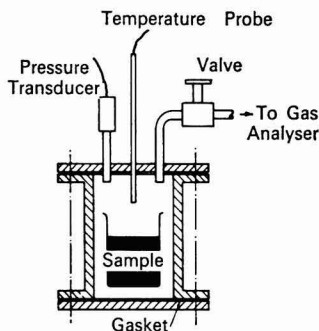


Fig. 1. Sketch of bomb

The pure sugar magma was made by mixing refined sugar with pure syrup to give 50% crystal content by weight. The *C*-massecuite and final molasses were from Racecourse mill and the *A*-massecuite was from Pioneer mill. The weight of dry substance taken for each test run, the void volume in the bomb and the nominal temperature and corresponding steam pressure are shown in the captions of Figs. 2 to 11. The nominal temperature was obtained by heating the bomb in a small oven and there was a time lag before it reached the desired temperature.

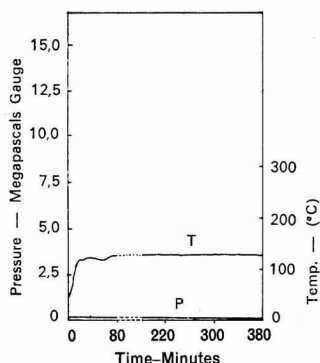


Fig. 2. Pressure development in white sugar magma
Conditions: oven temperature 122°C; normal steam pressure 105 kPa gauge; void volume 50%; weight of dry substance 271.8 g

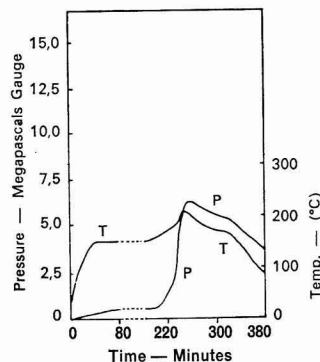


Fig. 3. Pressure development in white sugar magma
Conditions: oven temperature 148°C; normal steam pressure 349 kPa gauge; void volume 50%; weight of dry substance 271.8 g

RESULTS AND DISCUSSIONS

The actual bomb temperature and the pressures which were developed are shown graphically in

¹ HONIG: *Proc. 12th Congr. ISSCT*, 1965, 1741-1749.

² *Archief voor de Suikerind. Ned. Ind.*, 1912, 20, 1809-1817.

³ *Adv. Carbohydr. Chem.*, 1968, 23, 419-474.

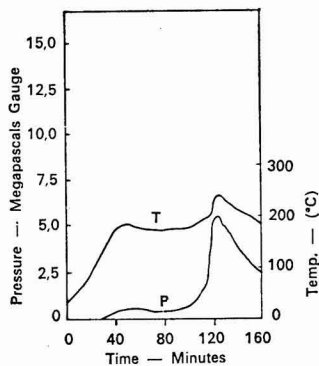


Fig. 4. Pressure development in white sugar magma
 Conditions: oven temperature 170°C; normal steam pressure 698 kPa gauge; void volume 50%; weight of dry substance 284.4 g

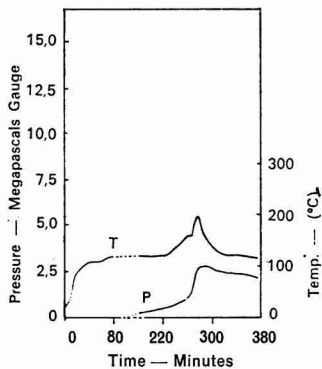


Fig. 5. Pressure development in A-masseците
 Conditions: oven temperature 122°C; normal steam pressure 105 kPa gauge; void volume 50%; weight of dry substance 283.5 g

Figs. 2 to 11. For the white sugar magma there was no evidence of an exothermic reaction or pressure rise up to 380 min at 122°C (Fig. 2) but pressures of about 5000 kPa gauge were observed to develop suddenly after 220 minutes at 148°C (Fig. 3) and after 110 minutes at 170°C (Fig. 4). These pressure rises were accompanied by a sudden rise in bomb temperature which is indicative of an exothermic reaction. The fact that high pressures were developed without the presence of nitrogenous constituents indicates that the decomposition in this instance is not due to Maillard and associated reactions. Organic acids would be formed from pure sugars under these conditions and these would lead to hydrolysis of the sucrose to hexoses and decomposition of these to hydroxymethylfurfural and levulinic acid. Under severe conditions levulinic acid would lose carbon dioxide and yield other degradation products. These reactions and many others are described by SHAFIZADEH³ in relation to the pyrolysis of cellulose. GARDINER⁴ has also shown that sucrose and hexoses on pyrolysis at 420°C yield anhydro sugars which can then break down further into a host of compounds including tars. The reactions are complex and besides carbon dioxide various acids, aldehydes and ketones may be formed⁵. In fact, under very hot conditions hydrogen and hydrocarbons may be formed from cellulose (MARTIN, on page 464 of SHAFIZADEH's review³). The formation of hydrogen-enriched compounds is to be expected from the loss of CO₂ from carbohydrate compounds. Evidence of inflammable gases and indication of hydrocarbons will be referred to later in this report.

Besides the reactions referred to above there are naturally-occurring acids such as aconitic and citric acids in sugar products which would also yield carbon dioxide on heating. When A-masseците is subjected to similar experimental conditions to those used on pure sugar much greater pressures and temperatures were achieved than with pure sucrose. This may partly be due to decarboxylation of substances not derived from the sugars but it is most likely that the more rapid reaction is due to the catalytic effect of the impurities. Most of the heat of reaction must come from the decomposition to carbon and water since large amounts of carbonaceous residue remain in the

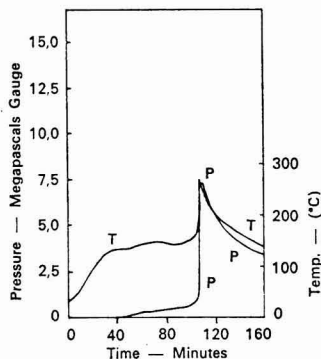


Fig. 6. Pressure development in A-masseците
 Conditions: oven temperature 148°C; normal steam pressure 340 kPa gauge; void volume 50%; weight of dry substance 283.5 g

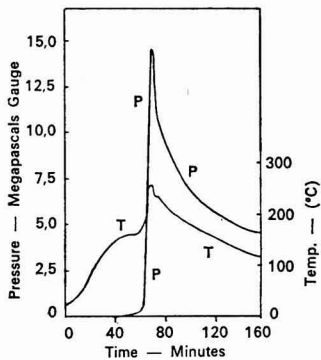


Fig. 7. Pressure development in A-masseците
 Conditions: oven temperature 170°C; normal steam pressure 698 kPa gauge; void volume 50%; weight of dry substance 283.5 g

⁴ *J. Chem. Soc.*, 1966, Section C, 1473-1476.

⁵ GLASSNER & PIERCE: *Anal. Chem.*, 1965, 37, 525-527.

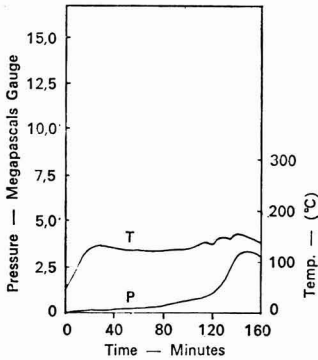


Fig. 8. Pressure development in C-masseccite
Conditions: oven temperature 122°C; normal steam pressure 105 kPa gauge; void volume 50%; weight of dry substance 256.4 g

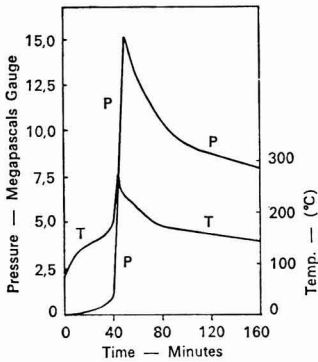


Fig. 9. Pressure development in C-masseccite
Conditions: oven temperature 148°C; normal steam pressure 349 kPa gauge; void volume 47%; weight of dry substance 278.5 g

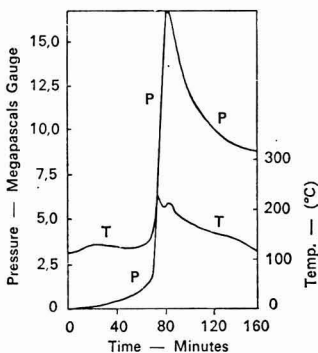


Fig. 10. Pressure development in C-masseccite
Conditions: oven temperature 122°C; normal steam pressure 105 kPa gauge; void volume 36.3%; weight of dry substance 359.1 g

bomb and the alternative reaction to give carbon dioxide and hydrogen has a very low heat of reaction.

Figs. 5, 6 and 7 show the temperature and pressure changes with A-masseccite in the bomb. At 122°C

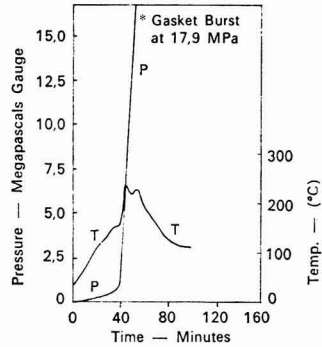


Fig. 11. Pressure development in C-masseccite
Conditions: oven temperature 148°C; normal steam pressure 349 kPa gauge; void volume 35%; weight of dry substance 382.5 g

(103 kPa gauge nominal steam pressure) the pressure increased rapidly at approximately 270 minutes to 2,750 kPa gauge. At 148°C it went to 6,895 kPa gauge after about 100 minutes and at 170°C to over 13,800 kPa gauge after 65 minutes.

Similar results for C-masseccite are shown in Figs. 8 and 9 for 122°C and 148°C. In all tests described so far the mass of masseccite was about 280 g and the bomb void volume about 50% (300 cm³). When the weight of C-masseccite was increased to 360-380 g the waiting period was shortened and the reaction was much more severe (see Figs. 10 and 11). At 122°C the pressure rose to over 17,000 KPa gauge at 70 minutes after heating commenced and at 148°C after 40 minutes the pressure rose to over 17,000 kPa gauge and the bomb leaked from the gasket area probably owing to stretching of the bolts holding down the lid.

A useful summary of the ultimate pressures reached in each experiment is given in Fig. 12.

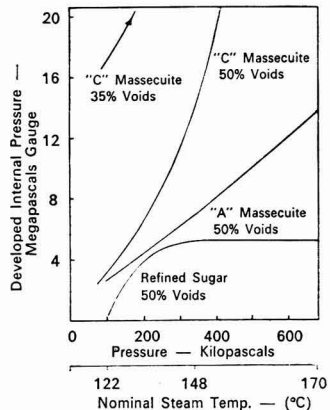
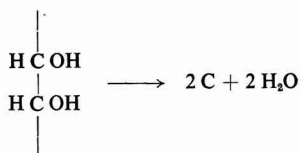


Fig. 12. Relationship between nominal and actual pressures

Investigations on the products of the reactions are not complete. The residue in the bomb appeared carbonaceous and the liquid contents have not been examined at all. The residual carbon would result from complete dehydration of the carbohydrate and this is an exothermic reaction:



The weight losses after cooling and releasing the gases from the bomb were determined when there had been no leaks. These ranged up to 19% of the original dry solids in the bomb as shown in Table I.

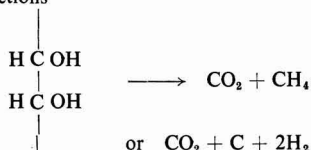
The gas analyses were made with an Orsat apparatus and indicated about 90% CO₂ and a small amount of CO. Details of the gas analyses associated with the experiments described in Figs. 5 and 7 are given in Table II.

Table II. Analysis of gases % total gas volume

	CO ₂	CO	O ₂	Wt. loss % of original dry substance
Fig. 5 expt.	91.4	1.1	nil	6.0
Fig. 7 expt.	86.9	5.6	nil	19.2

After the CO₂ is scrubbed out by bubbling through an alkaline solution, an inflammable gas remains which analysis by gas chromatography indicates to contain methane, ethane, propane, and butane and possibly *iso*-pentane and an *iso*-butane. The system used did not allow the detection of hydrogen.

The reactions



have a very low heat of reaction and probably vary in the extent to which they take place with the temperature obtained in the bomb. The more severe conditions give the greater weight losses.

CONCLUSIONS

From these experiments it can be seen that even 122°C (nominal 103 kPa gauge steam pressure) can produce reactions in masseccutes that yield extremely high pressures in a confined space and the larger masses of masseccute in a cut-over pipe must be even more prone to such reactions. It seems most desirable to avoid high temperatures in masseccute pipes unless rupture discs are provided which could vent the products of decomposition reactions into a suitable receiver.

Table I. Tests on accelerated deterioration of masseccutes

Experiment shown in Fig. No.	Material	Weight of dry substance, g	% Void volume	% loss on dry substance	Nominal temperature (°C)	Nominal steam pressure, kPa (g)
2	White sugar magma	271.8	50	not measured	122	105
3	"	271.8	50	7.7	148	349
4	"	284.4	50	0.4	170	698
5	A-masseccute	283.5	50	6.0	122	105
6	"	283.5	50	18.3	148	349
7	"	283.5	50	19.2	170	698
8	C-masseccute	256.4	50	8.2	122	105
9	"	278.5	47	16.0	148	349
10	"	359.1	36.3	gasket leaked	122	105
11	"	382.5	35	gasket leaked	148	349
12	A-masseccute	283.5	50	3.4	100	0

Alternatively it may be possible to clean the pipes by rapid circulation of boiling clarified juice. The highest temperature this would yield would be 100°C and a sample of A-masseccute held at this temperature for two days as shown in Fig. 13 gave a slow build-up of pressure in the bomb to 1000 kPa gauge but there was no sudden exothermic reaction. The weight loss was only 3.4% and again the gas was principally carbon dioxide (91.3% by volume).

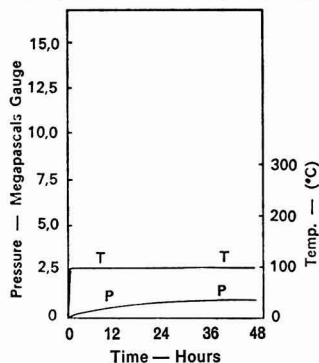


Fig. 13. Pressure development in A-masseccute. Conditions: oven temperature 106°C; normal steam pressure 0 kPa gauge; void volume 50%; weight of dry substance 283.5 g

Another alternative might be to use steam at temperatures lower than 122°C for strictly limited periods.

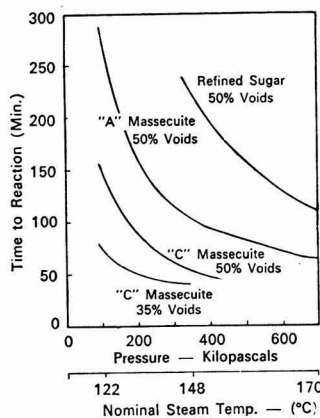


Fig. 14. Relationships between nominal pressure and time for reaction to develop

A summary can be made of the results of Figs. 2 to 11 as regards the time delay before there was a sharp upward inflection in the pressure curve. This has been done in Fig. 14 and it may be seen from this that there is a possibility that very low steam pressures might be safely used for a limited time to clean cut-over pipes.

SUMMARY

Following the steaming of a blocked pan stage cut-over pipe at an Australian mill there was a disastrous pipe failure. This prompted an investigation of the behaviour of heated *A*- and *C*-masseccutes and refined sugar magma. They were held in a 600 cm³ bomb at constant temperature. In most experiments there was an exothermic reaction which was more severe in the impure masseccutes and at the higher

temperatures of the range 122 to 170°C. The delay period between commencement of heating and commencement of the sudden reaction was shortest in impure masseccutes and was further reduced by higher storage temperatures and larger mass of masseccuite.

Frequently pressures of over 10,000 kPa gauge were generated and even at 122°C pressures of around 2500 kPa gauge were obtained from *A*- and *C*-masseccutes. Graphs are given showing pressure and temperature rise under varying conditions.

Analyses are given of the gases taken from the cooled bomb. These contained mainly carbon dioxide but there was also evidence of hydrocarbons. The nature of the reactions taking place is discussed.

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Filtrability studies of carbonated raw sugar syrups

By F. K. MAK and F. H. C. KELLY

Introduction

MANY workers have attempted to study the filtrability of carbonated raw sugar syrups from the point of view of the nature and amount of non-sugars present as well as the effects of filtration temperature, pH and lime dosage. Whilst the three latter parameters are usually confined within a known and specified range, in industrial practice variability in filtration behaviour is generally recognised to be associated with the quantity of inorganic matter, as well as organic matter such as starch, dextran and their products. Of the organic impurities, starch has been found to exercise a significantly adverse influence on the carbonated liquor filtrability^{1,2,3}, a result which led early workers^{4,5} to consider a correlation between sugar crystal size and the amount of surface starch, although, more recently, workers^{6,7} studying the mechanism of starch influence in carbonation indicated that only the amylose component which was preferentially adsorbed on the CaCO₃ particles as a colloid film was responsible for causing excessive filtration difficulties.

Methods used to improve the filtrability of carbonated slurries have been diverse and include hydrolysis of starch with α -amylase⁸ which method is not favoured in practice because it leads to malformation of the sucrose crystals. Improvement based on flocculation of the CaCO₃ precipitates by suitable coagulants is still under investigation, using polyelectrolytes which are mainly hydrolysed polyacrylamides. Improved filtrability in clarified juice with "Separan AP 273" has been reported⁹, whilst "Sedipur TF2" and "Magnafloc LT25" were also reported to give similar results¹⁰.

In this paper the authors report on a series of experiments conducted to investigate the coagulating property of "Separan AP 273" on carbonated liquor, and in the presence of different polar substances

suspected of inhibiting the crystallization of CaCO₃, viz. tyrosine, alanine, chlorogenic acid and starch, all of which are found naturally occurring in cane juices.

Filtration rate as determined by a CSR-type filter¹¹ was found to be related to the particle size distribution of the CaCO₃ precipitate, whilst a study of the particle shape modification by electron microscopy provided a better basic understanding of filtrability behaviour.

Experimental

A 60% w/w aqueous raw liquor maintained at 60°C was limed with Ca(OH)₂ to pH 10.5, and to its clear filtrate was added "Separan AP 273" in proportions varying from 0 to 35 ppm, before the commencement of carbonation. A terminal pH of 8.0 was specified. From this series of experiments the "optimum" addition of "Separan" corresponding to maximum filtration rate was determined, filtration rates being calculated in cm³.min⁻¹ for the first 50 cm³ of filtrate obtained from the filter operated at 40 psig and using a filter medium of Whatman No. 54 paper.

¹ MURRAY: *Proc. 46th Congr. S. African Sugar Tech. Assoc.*, 1972, 1161-32.

² LEE: *Proc. 13th Congr. ISSCT*, 1968, 421-427.

³ VIGH & VUKOV: *Cukoripar*, 1967, 20, 163-164.

⁴ MORITSUGU: *Ann. Rpt. Hawaiian Sugar Planters' Assoc. Expt. Sta.*, 1970, 142-143.

⁵ DUPONT: *I.S.J.*, 1969, 71, 40-44, 72-75.

⁶ RAMSAY & WATTS: *Proc. 41st Conf. Queensland Soc. Sugar Cane Tech.*, 1974, 223-228.

⁷ MURRAY, RUNGAS & VANIS: *Proc. 15th Congr. ISSCT*, 1974, 1296-1306.

⁸ KAGA, SUZUKI & YAMANE: *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1967, 19, 91-95.

⁹ BYRNE: *Proc. 37th Conf. Queensland Soc. Sugar Cane Tech.*, 1970, 267-270.

¹⁰ NOBLE: *Proc. 39th Conf. Queensland Soc. Sugar Cane Tech.*, 1972, 303-314.

¹¹ "Laboratory Manual for Queensland Sugar Mills", 5th Edn. (Bureau of Sugar Experiment Stations, Brisbane), 1970, p. 120.

The polar substances were introduced with the optimal amount of "Separan" into the carbonation system for studying their counter-effect on the optimum condition.

Size distributions of the CaCO₃ were also obtained with a Hitachi Particle Size Analyser whose operating procedure has been described elsewhere¹².

Results

Fig. 1 shows filtrability results obtained while Tables I and II summarize the Mean Aperture (MA) and Coefficient of Variation (CV) from the size analysis.

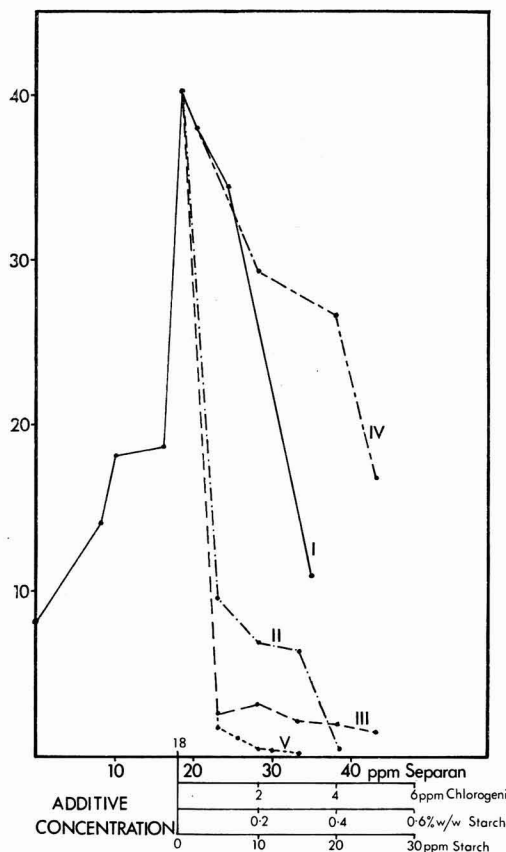


Fig. 1

Filtration rates of raw sugar syrups carbonated in the presence of different polar additives

- I ppm "Separan"
- II 18 ppm "Separan" and ppm tyrosine
- III 18 ppm "Separan" and ppm chlorogenic acid
- IV 18 ppm "Separan" and ppm starch
- V 18 ppm "Separan" and % w/w starch

It can be seen from both Fig. 1 and Table I that "Separan" addition up to 18 ppm improved both filtration rate and particle size, an optimal condition occurring at 18 ppm, associated with a maximum filtration of 40 cm³.min⁻¹ and MA of 8.5 microns. Away from this optimum both filtrability and size decreased markedly, owing to either insufficient

Table I. "Separan AP273" addition and CaCO₃ size distribution

"Separan" addition, ppm	Mean Aperture MA, microns	Coefficient of Variation, CV
0	1.80	0.47
8	4.65	0.35
10	4.70	0.31
12	5.80	0.43
16	6.60	0.43
18 (optimal)	8.50	0.54
20	6.90	0.50
24	4.30	0.48
35	3.30	0.52

Table II. Effect of addition of polar substances with optimal 18 ppm "Separan"

Tyrosine, ppm	MA, microns	CV
1	1.40	0.42
2	1.65	0.36
3	1.45	0.39
4	0.80	0.38
Chlorogenic acid, ppm	MA, microns	CV
1	3.20	0.45
2	2.10	0.43
3	3.70	0.40
4	3.25	0.38
5	2.85	0.53
Rice starch, %w/w	MA, microns	CV
0.10	6.50	0.41
0.15	5.80	0.39
0.20	5.00	0.34
0.25	4.50	0.62
0.30	4.60	0.38

polyelectrolyte to promote coagulation or excess causing redispersion. The authors considered the polar groups in the polyelectrolyte "molecule" to have provided the active sites for primary conglomerate growth in the CaCO₃, whilst flocculation of these primary conglomerates was the effect of a secondary coagulation in which larger but less tenacious flocs were formed. Thus the MA values in Table I refer to the effective diameter of the primary conglomerates whilst filtrability is related to the larger secondary flocs.

The growth-inhibitive polar substances are clearly seen from Table II to have diminished the MA value and filtration rate. Addition of 1-4 ppm of tyrosine to the optimal 18 ppm "Separan" was found to have reduced MA from 8.5 microns to 1.6-0.4 microns. Moreover a moderate CV of 0.4 indicates a fairly uniform distribution of small particles.

A similar effect was obtained with chlorogenic acid, a polyphenolic acid, which gave an average MA around 3.0 microns, but filtrability was decisively reduced to less than 5 cm³.min⁻¹. Both tyrosine and chlorogenic acid have been suspected as colour precursors¹³, the latter being confirmed by more recent studies¹⁴.

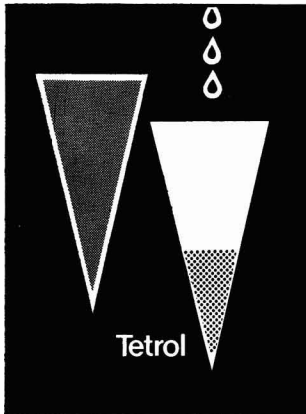
Alanine, the relative amino-acid of tyrosine, gave MA in the colloidal range and filtrability comparable with that found in the presence of tyrosine.

The effect of starch was found to depend on the amount introduced. In macro addition of 0.1-0.3% w/w it was found to have reduced MA and entirely destroyed the filtration efficacy of "Separan"; on the other hand micro-variation with 10-25 ppm of starch addition also showed adverse effect on the optimal condition as may be seen in Fig. 1.

¹² KELLY & MAK: *I.S.J.*, 1971, 73, 323-325.
¹³ GILLET: "Principles of Sugar Technology", Vol. I, Ed. P. HONIG (Elsevier, Amsterdam.) 1953, p. 214.
¹⁴ FARBER & CARPENTER: *I.S.J.*, 1971, 73, 99.

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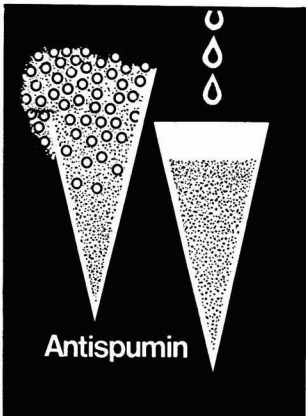
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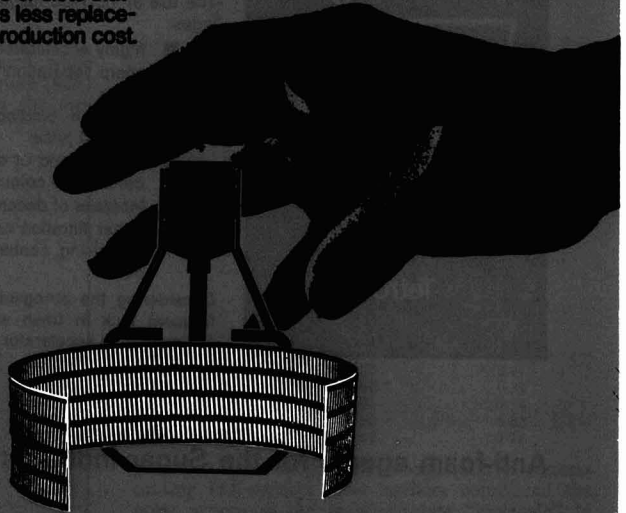
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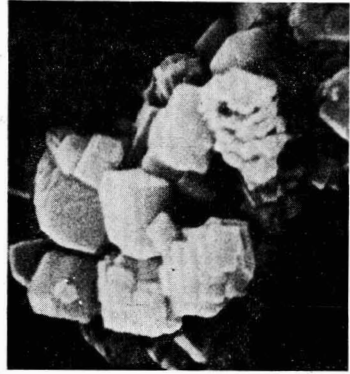
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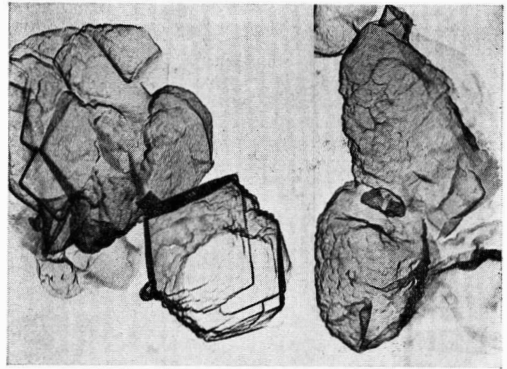
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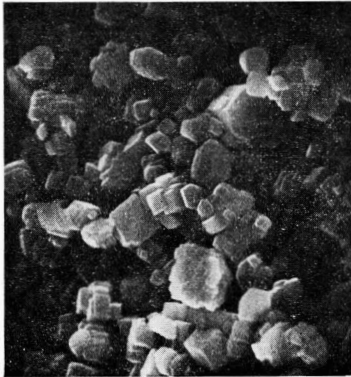
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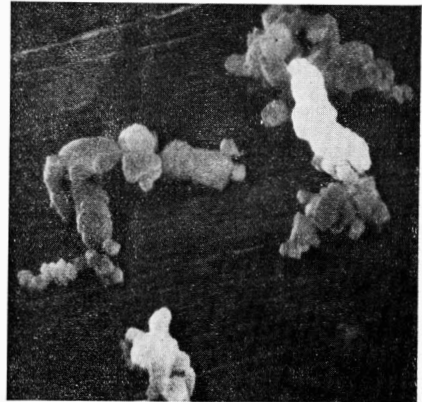
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Fig. 2. Electron micrographs of CaCO_3 precipitates

The authors have also included a morphology study of the CaCO_3 precipitates as providing a fundamental relationship between filtrability and particle size and shape. Figs. 2A–2H show electron micrographs of CaCO_3 precipitates taken at 10,000 \times or higher magnification, revealing morphological changes caused by adsorption of the polar additives during

carbonation of a 60% w/w aqueous refined liquor. Their size factors are summarized in Table III.

In Fig. 2A, showing a precipitate in aqueous refined liquor without polar impurities, a variation in the rhombohedral shape and size is seen whilst the higher magnification of Fig. 2B shows layer growth characteristic of polar crystals¹⁵. Figs. 2C and 2D

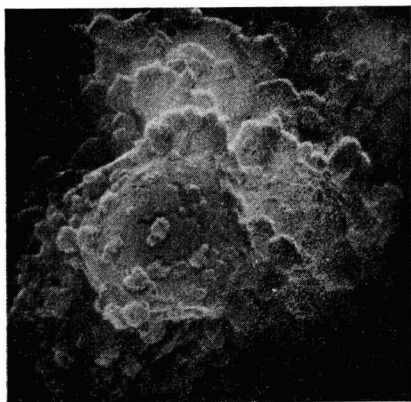


Fig. 2 G ×10,000

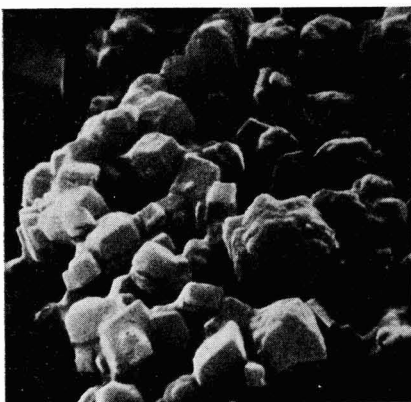


Fig. 2 H ×10,000

Table III

Size distribution of CaCO₃ precipitated from 60% aqueous refined sucrose liquor in the presence of polar additives

Electron Micrograph	MA, microns	CV
Figs. 2A, 2B No additive	6.85	0.37
Figs. 2C, 2D 3 ppm tyrosine	4.10	0.49
Fig. 2E 12 ppm chlorogenic acid	3.15	0.63
Fig. 2F 1 ppm alanine	3.20	0.44
Fig. 2G 4 ppm starch	4.85	0.58
Fig. 2H 10 ppm "Separan"	floc	—

show similar characteristics in the presence of tyrosine although the crystals are uniformly smaller. Fig. 2E is a micrograph of CaCO₃ precipitated in the presence of chlorogenic acid and taken by the replica technique which is considered to give greater surface details of very fine powders. Understandably, the CaCO₃ is predominantly amorphous. Alanine appears from Fig. 2F to have caused elongated nodes resembling the action of chlorogenic acid, whilst starch gave a precipitate (Fig. 2G) with distinct tabular or plate-like features cemented together with amorphous aggregates of the crystallizing material.

It is well known that tabular or plate-like particles do not settle randomly in a stream-line flow environment which is the nature of a system undergoing filtration. Such particles would orient themselves with the short axis parallel to the stream-lines and hence pack tightly on the filter cloth with minimal porosity.

Fig. H shows the primary and secondary conglomerates obtained with 10 ppm of "Separan" where the crystals are largely rhombohedral but held together by an underlying layer of polyelectrolyte.

Crystal structure arrangement possibilities

The atomic structure of calcite based on the X-ray diffraction results of BRAGG¹⁶ is reproduced in Fig. 3

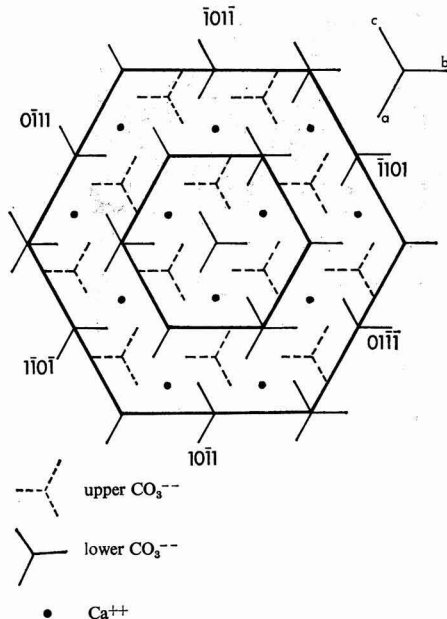


Fig. 3. Atomic structure of calcite rhombohedron

as a projection parallel to the 3 horizontal axes for the unit cleavage rhombohedron in Fig. 4, showing the arrangement of the CO₃⁻ groups occurring in two layers separated by a layer of Ca⁺⁺ ions. Faces corresponding to the positive rhombohedron have also been identified in this atomic arrangement, from which is clear that in crystallising three of the six faces, viz. (0 1 1 1), (1 0 1 1), (1 1 0 1) are more stereospecifically oriented than the remaining faces, viz. (1 1 0 1), (0 1 1 1), (1 0 1 1).

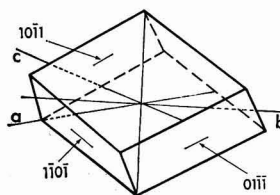


Fig. 4. Positive rhombohedron of calcite

The authors are inclined to believe that the first three faces are thus more susceptible to adsorption of foreign polar molecules to result in a layer pattern

¹⁵ BUNN: "Crystal Growth" (Butterworth, London); *Discussions Faraday Soc.*, 1949, 5, 119-132.
¹⁶ "Crystal Structures of Mineral—The Crystalline State", Vol. 4. (Bell and Sons Ltd.) 1965.

of polar growth on these faces and morphological distortions from the rhombohedral habit. This effect appears most distinctly in Figs. 2D, 2E and 2F.

Larger foreign molecules such as starch are not readily incorporated into the growing crystal but

could retard crystallization and alter the texture of the crystals through stereo hindrance, whilst the large polyelectrolyte molecules are expected to exercise little morphological influence on the rhombohedra, acting only as a coagulant for these rhombohedral crystals.

A review of plant growth-regulating chemicals in sugar cane cultivation

By A. J. VLITOS

(Tate & Lyle Ltd. Research Centre, University of Reading, England)

Paper presented to the 15th Congr. ISSCT, 1974.

Introduction

THIS paper deals with plant growth regulators and more specifically their probable role in sugar cane cultivation in the future. This is a subject of topical interest. In view of severe competition from sugar beet there is a need to improve yields of sucrose from cane. The role of plant growth regulators can be vital in this.

Over the past ten years my colleagues, B. H. MOST, H. CUTLER, A. YATES, and others have established that at least four groups of naturally-occurring plant growth regulators occur in sugar cane at various stages in its development. Auxins, gibberellins, cytokinins and various growth inhibitors have been shown to occur either as free acids or bases, and also as conjugates in which the acid or base is associated with a sugar moiety such as glucose or ribose. The auxins have been isolated from stem apical tissue¹, from the roots² and from the seed³. Gibberellins have been found in extracts and diffusates of immature stem and leaf apical tissues⁴⁻⁸, in bleeding sap from cut stumps of sugar cane stems⁹, in the roots and in dormant and developing lateral buds^{7,10,11}. Cytokinins in sugar cane occur in bleeding sap and in dormant lateral buds⁹. Abscisic acid (ABA) has been isolated from immature stem and leaf apical tissues together with several other unidentified growth inhibitors¹². IAA and abscisic acid have been found so far only as the free acids, while the gibberellins and cytokinins have been found in the free and conjugated forms—but readily water-soluble.

The occurrence of all four types of plant growth regulators in stem apical tissues suggested that the regulatory mechanism in cane involves changes in the balance between the four types. It is characteristic of the hormonal regulation of plant growth that more than one type of growth hormone is involved in any one growth process and that their functions often overlap¹³.

Thus, auxins and gibberellins are both involved in promoting cell elongation, while auxins and cytokinins may both stimulate cell division. In other situations the actions of the same two hormones may be similar or opposed. For example, the presence of cytokinin and auxin enhances growth of callus in tissue culture¹⁴ while these same two hormones oppose one another in the germination of lateral buds¹⁵.

Theoretical considerations

The discovery by MOST that sugar cane is rich in gibberellins and cytokinins and that ABA occurs in apical stem and leaf tissues, led him to the hypothesis

that stem elongation in sugar cane is regulated by variations in the amounts of gibberellin and cytokinin, translocated from the roots to the stem apex¹⁶. These variations are induced by water stress, changes in temperature and other environmental pressures. It has been known for quite a long time that elongation of sugar cane stems under field conditions is inhibited by drought or by low temperature and that there is usually a corresponding increase in the percentage of sucrose extractable from the crop. It has been shown that, when the supply of gibberellins and cytokinins to the stem apex is plentiful, the growth inhibitory effects of abscisic acid are counteracted. Growth is then rapid, and sucrose levels drop. When the gibberellin supply is restricted, growth rate is reduced—more sucrose is then stored, but also there is a tendency for more cellulose to be formed.

In immature, stem apical tissues of fast-growing sugar cane there is sufficient auxin to allow a response of the tissues to gibberellins and cytokinins. There are also sufficient amounts of gibberellins and cytokinins to promote cell elongation and cell division, and to counteract the premature ageing of immature cells by ABA.

In slow-growing cane the supply of gibberellins and cytokinins to the meristem is restricted. Cell division and cell elongation almost cease and the synthesis of ABA is increased. There is then premature maturation of the cells. In this state more sucrose is stored but much of the carbohydrate is incorporated into cellulose and structural materials, but at different rates.

¹ BRANDES & VAN OVERBEEK: *J. Agric. Res.*, 1948, 77, 223-238.

² CUTLER & VLITOS: *Physiologia Pl.*, 1962, 15, 27-42.

³ VLITOS & CUTLER: *Proc. 1960 Meeting B.W.I. Sugar Tech.*, 113-127.

⁴ MOST & VLITOS: "Regulateurs Naturels de la Croissance Végétale", Ed. J. P. NITSCH (CNRS, Paris), 1964, pp. 287-302.

⁵ *idem*: *Pl. Physiol.*, 1966, 41, 1090-1094.

⁶ *idem*: *Proc. 12th Congr. I.S.S.C.T.*, 1965, 610-624.

⁷ *idem*: "Transport of Plant Hormones", Ed. Y. VARDAR (North-Holland, Amsterdam), 1968, pp. 380-392.

⁸ MOST: "Biochemistry and Physiology of Plant Growth Substances", Ed. F. WIGHTMAN and G. SETTERFIELD, (The Runge Press Ltd., Ottawa), 1968, pp. 1619-1633.

⁹ *idem*: *Ann. Rpt. Tate & Lyle Res. Centre*, 1968, 27-29.

¹⁰ *idem*: *ibid.*, 1967, 243-255.

¹¹ *idem*: *Ann. Rpt. Tate & Lyle Central Agric. Res. Sta., Trinidad*, 1966, 257-262.

¹² *idem*: "Growth Inhibitors of Sugar Cane". I. (In preparation).

¹³ THIMANN: *Future*, *Ann. Rev. Plant Physiol.*, 1963, 14, 1-18

¹⁴ SKOOG & MILLER: *Symp. Soc. Exp. Biol.*, 1957, 11, 118-131.

¹⁵ WICKSON & THIMANN: *Physiologia Pl.*, 1958, 11, 62-74.

¹⁶ Tate & Lyle Ltd. *Res. Centre Seminar*, 1969, private circulation.

The so-called "suspended" state is one which represents an ideal and which can serve as a criterion for selecting chemical ripening agents for practical use in the field. The ideal chemical ripener would suspend all growth processes, cell division, cell elongation and differentiation as well as the formation of new cell wall material. All tissues would be maintained in an unchanged condition and all available carbohydrate would move into storage as sucrose. No doubt there is a particular hormonal balance which could produce this effect; in practice it is necessary to settle for something less than the ideal. It is possible to get a gradual progression from a state of rapid vegetative growth, through a phase of suspended growth, to one of slow growth, which can be fitted into the harvesting programme.

Synthetic chemicals and their effects on sucrose storage

In the early work in cane ripening, much attention was given to the possible use of 2,4-D. Some authors reported increases in sucrose content of cane when 2,4-D had been applied as a foliar spray^{17, 18}; others were unable to obtain a similar response¹⁹⁻²². We believe that the variable results might have been due to differences in environmental conditions.

ALLEN²³ found that sub-lethal applications of 2,4-D to cowpeas increased the activity of phosphofructokinase (PFK) activity in the light, but decreased the activity of the enzyme in the dark. At a 12-hour photoperiod and constant temperature of 25-6°C PFK is an important regulator of glycolytic respiration in plants. A reduction in its activity probably indicates a lowered rate of respiration. If 2,4-D has a similar effect on cane tissue then photoperiod and temperature could influence its effectiveness as a ripener. Best results might be expected under short day conditions with warm nights. In fact one may find that in those areas of the tropical world such as Cuba where 2,4-D has given positive results, the photoperiod and night temperatures fit the ideal situation.

Another synthetic auxin, 2,3,6-trichlorobenzoic acid (TBA) has been shown by NICKELL & TANIMOTO²⁴ in Hawaii and by VLITOS & LAWRIE²⁵ to be an effective ripener. Also mixtures of 2,3,6-TBA and MCPA have been found effective by some²⁶ and not effective by others^{26, 27}. Our group has studied the response of cane to this mixture in some detail, and YATES²⁸ published the following results.

The chemical causes an initial acceleration of stem elongation, followed by a long suppression of growth. The initial growth response is largely confined to one immature internode, but the growth of the younger internodes is completely suppressed. Similar results are obtained with applications of MCPA or TBA alone. Senescence of the oldest leaves is accelerated, and the emergence of new leaves can be prevented.

The response of cane to MCPA-TBA mixtures may be interpreted in terms of their possible effects on the internal hormonal balance. In rapidly elongating immature stem tissues the relative levels of the four types of hormones are as follows:

auxin	—	medium
gibberellin	—	high
cytokinin	—	high
ABA	—	low

Treatment with MCPA-TBA raises the auxin level and since this particular synthetic auxin is not readily degraded by cane tissues this increased auxin level would persist. The higher auxin level would initially

enhance the activities of the gibberellins and cytokinins, thus promoting cell elongation and cell division. Soon afterwards the higher level of auxin would tend to promote the synthesis of ethylene. This could lead to auxin destruction, particularly of the native auxin, and to the oxidation of metabolites and certain enzymes. The growth-promoting activity of the gibberellins and cytokinins would be negated and growth would be suspended. Premature senescence of the oldest leaves may be due to ABA. Apart from its effect upon leaf tissues, the MCPA-TBA mixture is an effective ripener. Complementary administration of a gibberellin or a cytokinin might overcome this effect by balancing the increased activity of ABA.

The effect of GA on the accumulation of sucrose by cane has also been studied in recent years. VILLAREAL & SANTOS²⁹ in the Philippines and COLEMAN and his co-authors³⁰ found no significant effect on sugar yields. But in Hawaii³¹ and Queensland³² applications of GA may increase sucrose yields, especially in areas with relatively low (sub-tropical) temperatures.

BULL³², in greenhouse experiments in Queensland, found that weekly applications of GA over a 7- to 8-week period increased the length, fresh weight, sugar and fibre contents of the stalks, but decreased leaf area and weight. The response of young (3 months old) plants was greatest at low temperatures (17°C), but older (6 months old) plants gave the largest response at higher temperatures (35°C).

In terms of its possible effect upon the hormonal balance, treatment of sugar cane with GA would be expected to stimulate stem elongation, particularly when the level of auxin is fairly high (i.e. in slow-growing cane). This hormone might also tend to retard senescence by opposing the activity of ABA. If this is so, the observed reduction in leaf area due to GA may to some extent be compensated for by a delayed senescence of old leaves. It is known that GA does not increase photosynthetic activity per unit leaf area³³.

Preliminary experiments²⁸ with ABA and with "Ethrel" (2-chloroethane phosphonic acid), a compound which releases ethylene in plant tissues, indicate that these chemicals may have potential as cane ripeners. Both retard stem elongation for about two weeks and this is followed by a period of rapid "compensatory" growth. As might be expected, ABA treatment hastens senescence of the older leaves.

Treatment with "Ethrel" causes the loss of apical dominance as evidenced by the development of side

¹⁷ BEAUCHAMP: *Sugar J.*, 1950, **13**, (5), 57-70.
¹⁸ CHACRAVARTH *et al.*: *Proc. 9th Congress I.S.S.C.T.*, 1956, 355-364.
¹⁹ HASKIEW: *Cane Growers' Quarterly Bull.*, 1953, **17**, 52-53.
²⁰ LOUSTALOT *et al.*: *Sugar J.*, 1950, **13**, (5), 78.
²¹ LUGO-LÓPEZ *et al.*: *J. Agric.* (Univ. Puerto Rico), 1953, **37**, 44-51.
²² YATES & BATES: *Proc. 1957 Meeting B.W.I. Sugar Tech.*, 174-189.
²³ *Ph.D. Dissertation* (Texas A & M Univ.), 1969.
²⁴ *Rpts. 1965 Meeting Hawaiian Sugar Tech.*, 152-166.
²⁵ *Proc. 12th Congress I.S.S.C.T.*, 1965, 429-445.
²⁶ GLASZIOU: *Rpt. David North Plant Res. Centre*, 1964, 48-55.
²⁷ ANON.: *Ann. Rpt. Res. Dept. Sugar Manufacturers' Assoc., Jamaica*, 1963, 5.
²⁸ *Ann. Rpt. Tate & Lyle Ltd. Research Centre*, 1968, 21-26.
²⁹ *Proc. 6th Ann. Conv. Philippines Sugar Tech.*, 1958, 87-91.
³⁰ *Proc. 10th Congr. I.S.S.C.T.*, 1959, 588-603.
³¹ TANIMOTO & NICKELL: *Rpts. 1967 Meeting Hawaiian Sugar Tech.*, 184-190.
³² *Aust. J. Agric. Res.*, 1964, **15**, 77-84.
³³ HABER & TALBERT: *Pl. Physiol.*, 1957, **32**, 152-153.

shoots, tillers and strut roots. This is consistent with the finding that ethylene stimulates peroxidase activity in plant tissues, leading to the destruction of auxin³⁴.

Hormone transport is obviously an important step in the response of plants to environmental stimuli. There is evidence that most hormones are translocated in the plant as free acids (auxins) or readily water-soluble conjugates (gibberellins and cytokinins). Several chemicals are known to inhibit auxin transport³⁵. One of these, 2,3,5-triodobenzoic acid, has been tested on sugar cane but was found to be a weak growth retardant³⁶.

Chemicals which suppress the synthesis or activity of enzymes involved in the utilization of sucrose may prove useful as ripeners. Thus ALEXANDER³⁶ found that treatment of sugar cane with 6-azauracil, a pyrimidine analogue which may inhibit RNA synthesis, caused a decline in growth and invertase activity, accompanied by an increase in sucrose content. The leaves of the plants were not affected, but the chemical caused malformation or death of meristematic tissue at the stem apex. ALEXANDER^{36,37} also reports increased sucrose accumulation as a result of treating sugar cane with molybdenum or tungsten, which inhibit phosphatase activity, and with silicon, which inhibits invertase activity. It is interesting to note that co-administration of GA with

6-azauracil or with silicon appears to enhance their ripening effect.

Summary

The future of sugar cane cultivation in many parts of the world may depend on how well plant growth-regulating chemicals can be incorporated into cultivation systems. Economic factors have made it difficult to rely on hand labour to grow and harvest the crop, and competition from sugar beet grown in more highly developed and mechanized areas is bound to influence the future of sugar cane.

Research has shown that certain types of growth regulants influence germination, growth and sucrose storage in a wide range of cane varieties. Field trials have indicated the feasibility of applying such compounds under practical conditions at various times during the development of the crop. There is little doubt that more research is required to determine the long-range consequences of applying new growth regulants on a large scale, but the significance of the contribution of plant physiology to the future of a major world crop is likely to be a most important limiting factor.

³⁴ HALL & MORGAN: "Régulateurs Naturels de la Croissance Végétale" Ed. J. P. NITSCH (CNRS, Paris), 1964, pp. 727-745.

³⁵ MCREADY: *Ann. Rev. Plant Physiol.*, 1966, **17**, 283-294.

³⁶ *Sugar y Azúcar*, 1969, **64**, (2), 21-25.

³⁷ *J. Agric.* (Univ. Puerto Rico), 1965, **49**, 35-59.

Western Australian sugar industry possibility¹

WESTERN Australia expects to have a sugar industry established within five years with an annual output of 200,000 metric tons, Western Australian Premier Sir CHARLES COURT has stated.

He was speaking after a conference between Western Australian and Queensland officials to discuss development of a sugar industry in Western Australia in consultation with Queensland.

He said he thought that Western Australia could not be expected to become a serious threat to the Queensland sugar industry.

By the time the Western Australian industry was in full operation, Queensland could be expected to produce three million tons a year.

The conference was attended by Sir CHARLES, the Queensland Premier J. BJELKE-PETERSEN, WALTER MCPHARLIN, the WA Minister for Agriculture, C. L. HARRIS, Chairman of the Queensland Sugar Board, W. A. BENNETT from CSR Ltd. and various department officers.

Industry sources said the talks between the Queensland and Western Australian governments have been aimed at preventing disruption of present overseas marketing arrangements that might occur if Western Australia developed its own industry without consulting Queensland.

Western Australia has been interested in developing a sugar industry for at least 10 years to provide further diversification in the Ord River area. Trials

began some ten years ago and have been continuing since then.

However, it has only been in the last two years that circumstances have improved for the Western Australians to make further approaches to the Queensland government.

The low sugar prices between 1965 and 1968 prevented the Western Australians from serious considering expansion of the industry while Queensland growers were doing so poorly, industry sources said. It was only when a world-wide sugar shortage appeared last year and prices began to rise sharply that the financial incentive to produce emerged.

Assigned areas for sugar production are being increased by 10% to 12% in Queensland this year to meet new long term contracts.

The intention is to increase milling capacity of the existing mills in Queensland—a less expensive and more financially rewarding task than building a new mill.

A new mill in Western Australia could cost upwards of A\$50 million.

Sir CHARLES and Mr. BJELKE-PETERSEN saw the desirability of any development of a sugar industry on the Ord River as being undertaken within the context of the present marketing and production control arrangements relating to the Queensland and NSW sugar industries, they said in a statement.

¹ *Public Ledger*, 4th January 1975.

Sugar cane agriculture



Predators, parasitoids and pathogens of the sugar cane soldier fly, *Inopus rubriceps* (Macquart). A. W. OSBORN. *Proc. 15th Congr. ISSCT*, 1974, 423-427.—Predators of the soldier fly, described as the most damaging cane pest in Australia, are listed; the most important are the Welcome swallow (*Hirundo neoxena*) and the freshwater herring (*Potamalosa richmondia*). The diapiiid wasps *Neurogalesus militis* and *N. inopodos* are parasitoids of the soldier fly. Of pathogens, the green muscardine fungus *Metarrhizium anisopliae* is the most important one mentioned and has been responsible for destruction of significant numbers of the pest in Queensland.

* * *

Entomogenous fungi on sugar cane pests in Taiwan. Z. N. WANG and L. S. LEU. *Proc. 15th Congr. ISSCT*, 1974, 428-433.—Experiments on control of cane root-damaging pests by entomogenous fungi are described. The fungi included *Isaria sinclairii*, *Metarrhizium anisopliae* and *Beauveria bassiana*. The degrees of parasitization of 12 pests are tabulated, and information is given on the effects in cane fields, where the average mortality was 6.5-18.5% higher two years after treatment than in untreated controls.

* * *

Beneficial effects of white leaf-infected plants on the leafhopper, *Matsumuratettix hiroglyphicus* Matsumura. C. T. CHEN, C. S. LEE and S. M. LEE. *Proc. 15th Congr. ISSCT*, 1974, 434-438.—Investigations indicated that *M. hiroglyphicus* fed on healthy cane and then on white leaf-infected Bermuda grass (*Cynodon dactylon*) did not live as long as hoppers fed on infected cane followed by diseased Bermuda grass. All leafhoppers transferred to healthy grass died within a week.

* * *

Laboratory observations on the biology of *Eldana saccharina* Walker, a pest of sugar cane in the northern region of Tanzania. J. N. WAIYAKI. *Proc. 15th Congr. ISSCT*, 1974, 439-443.—Laboratory observations on the biology of the stalk borer *E. saccharina* are reported. While it is a major pest of sugar cane in Tanzania, Uganda and South Africa, it is only a minor pest in West Africa, where the species appears to be much bigger.

* * *

Egg production and nymphal development of *Saccharosydne saccharivora* (Homoptera: Delphacidae) on sugar cane and three other gramineae. D. W. FEWKES, K. HAGUE and M. R. DEMIDECKI-DEMIDOWICZ. *Proc. 15th Congr. ISSCT*, 1974, 444-452.—The rearing of the West Indian cane fly *S. saccharivora* on cane, sorghum, *Panicum fasciculatum* and *Andropogon selloanus* has been investigated, showing that female mortality was lower and egg production higher on the cane than on the other hosts.

Yellowing of sugar cane leaves caused by *Phaenacantha saccharicida* Karsch (Hemiptera: Lygaeidae). S. W. TAN and C. A. JOHNSON. *Proc. 15th Congr. ISSCT*, 1974, 453-456.—Yellowing of cane leaves observed in Malaysia with two varieties was found to be due not to nutrient deficiency but to feeding by *P. saccharicida* (plant sucking bug) nymphs and adults on the partially opened spindle leaves in both plant and ratoon cane. Heavy infestation of the pest caused not only reduction in active photosynthetic tissue but also growth restriction in the plant. It is not yet known if the pest is the vector of any virus infection.

* * *

The ecology of *Eldana saccharina* Walker and associated loss in cane yield at Arushachini, Moshi, Tanzania. J. N. WAIYAKI. *Proc. 15th Congr. ISSCT*, 1974, 457-462.—After heavy infestations of *E. saccharina* during 1966-69, a thorough ecological study was made of the pest, which proved to be a ground borer which causes more damage to plant cane than to ratoons. Larvae remaining in stubble after harvest attacked the next crop. Reductions in juice Brix caused by the pest have been determined. Adults had two peaks of activity just before the onset of the rainy seasons. Since the moth is a good swimmer, it may have spread within East Africa along the rivers. Although there are no known parasites, control through better harvesting methods, particularly the burning of cane, is regarded as one means of reducing populations of the pest. Treatment with hot water and 6% methoxyethyl mercuric chloride or 50% "Dieldrin" at 52°C for 20 minutes has proved effective.

* * *

Population dynamics of the Australian sugar cane leafhopper, *Perkinsiella saccharicida* Kirkaldy. A. W. OSBORN. *Proc. 15th Congr. ISSCT*, 1974, 463-467. A study of the causes of fluctuations in numbers of this pest showed that the pattern followed closely the variations in mean minimum temperatures, the population per acre increasing with rise in minimum temperature. In the winter months, nymphs have been observed developing on cane tillers protected by leaf sheaths.

* * *

Population dynamics of a sugar cane cicada *Mogannia iwaskii* Matsumura in Okinawa Island. Y. ITO and M. NAGAMINE. *Proc. 15th Congr. ISSCT*, 1974, 468-474.—A study of the distribution of *M. iwaskii*, which has become quite abundant on cane in some parts of Okinawa, has shown that there is a heavily infested area surrounded by a virgin area with a narrow transient zone less than 1 km wide. This suggests that the cicada has escaped predation in the infested area, since preliminary tables show that normally more than 90% of eggs laid are lost between hatching and the end of the first winter, most deaths apparently occurring between hatching and nymph

establishment on the cane root system; predation by ants is a partial cause of this. Reasons for the initial increase in the population are not yet known.

* * *

A study of overwintering populations of *Diatraea saccharalis* (F) in Louisiana. L. D. KIRST and S. D. HENSLEY. *Proc. 15th Congr. ISSCT, 1974, 475-487.* From an investigation of the overwintering habits of this borer it was established that survival of larvae was greater underground in cane stubs and seed pieces rather than in crop residues left on the soil surface after harvest; cane tops and frost-killed tillers were found to rot rapidly in the field, making them unsuitable as overwintering habitats. While low temperatures played an important role in reducing survival of the larvae, under the conditions studied the low temperature effects appeared more closely correlated with the number of days on which the temperature was below 0°C than with short periods when the temperature was below -6°C. No relationship was found between weekly rainfall and mortality fluctuations. No varietal difference was found between the numbers of overwintering larvae on N:Co 310 (a resistant cane variety) and CP 44-101 (a susceptible variety) in an artificially infested small plot. In a normally infested cane field, the number of overwintering larvae was estimated at 308 per ha.

* * *

A survey of the damage caused by *Elasmopalpus lignosellus* (Zeller) (Lepidoptera: Phycitidae) to sugarcane in Jamaica. A. C. SCHAAP. *Proc. 15th Congr. ISSCT, 1974, 488-497.*—A survey showed that the greatest amount of cane damage by the jumping borer *E. lignosellus* was in irrigated areas and the eastern wet area, although a high soil moisture content was associated with a borer attack of reduced intensity. Seasonal distribution was characterized by a low initial attack followed by a sharp increase after mid-March, and it is suggested that damage can be reduced by prompt irrigation after harvest (where irrigation is the normal practice) and maintenance of good shoot populations. No relationship between varietal differences or shoot populations and infestation was apparent. Since the moths move into freshly harvested fields shortly after burning, it is suggested that they are attracted by the smoke.

* * *

Sugarcane white grubs (Scarabaeoidea) and their control in South Africa. A. J. M. CARNEGIE. *Proc. 15th Congr. ISSCT, 1974, 498-512.*—Information is given on various white grubs which have damaged cane in southern Africa and on the population fluctuations of *Hypopholis sommeri* and *Schizonycha affinis* in Natal cane fields and adjacent wattle groves. Life cycles, biology and feeding habits are reported. Of seven insecticides tested for their effect on the scarab beetle, "Dieldrin" at 2 kg a.i. per ha (in 650 litres of water) proved the most suitable and had a residual effect of up to 4 years.

* * *

Relative resistance of *Saccharum spontaneum* clones to the sugarcane borer. R. D. JACKSON and P. H. DUNCKELMAN. *Proc. 15th Congr. ISSCT, 1974, 513-515.*—Of 31 clones of *S. spontaneum* tested for their resistance to *Diatraea saccharalis*, only two were not damaged. No clones tested outdoors contained as many larval tunnels as did the two control varieties, N:Co 310 and CP 52-68.

Control of top borer, *Scirpophaga nivella* (F.), by means of systemic insecticides. J. S. SANDHU, G. M. TRIPATHI and M. S. DUHRA. *Proc. 15th Congr. ISSCT, 1974, 516-520.*—Of four insecticides tested against *S. nivella*, the best was "Phorate" followed closely by "Carbofuran", both applied at the rate of 3 kg a.i. per ha in the beginning of July when the third brood (the most destructive) appears. Both chemicals reduced incidence and increased cane yield compared with the untreated control.

* * *

How useful are preventive sprays at low levels of infestation? D. P. GOWING, S. HAJRASULIHA and N. BANIBASSI. *Proc. 15th Congr. ISSCT, 1974, 521-525.* From trials in which cane fields infested with *Sesamia cretica* (sorghum borer) were sprayed from tractor or aircraft, it is concluded that the methods were not economically justifiable in view of the initial low infestation and the failure to reduce the level at harvest (possibly because of interference with parasites), although spray treatment in seed fields at ratooning and repeated spraying during the autumn could provide some protection and maintain the later ratoons in the commercial fields free from reinfestation. However, other measures such as pre-harvest cane burning and trash removal, plus reliance on natural control factors such as climatic conditions, seem preferable to preventive spraying.

* * *

Comparison of *Bacillus thuringiensis* Berliner and "Azinphosmethyl" for control of the sugarcane borer *Diatraea saccharalis* (F.). M. S. AL-BADRY and S. D. HENSLEY. *Proc. 15th Congr. ISSCT, 1974, 526-531.* Comparative tests are reported in which "Azinphosmethyl" ("Guthion") and two formulations of *B. thuringiensis*, "Dipel" and "Thuricide", were applied to ratoon cane. Results showed that "Thuricide" failed to provide effective control of *D. saccharalis*, while "Dipel" was effective only when applied in heavy doses at frequent intervals. "Guthion" gave much more effective and economical control than did the bacterium formulations.

* * *

Residual effect of calcium silicate applied to sugarcane soils. L. ROSS, P. NABABING and Y. WONG YOU CHEONG. *Proc. 15th Congr. ISSCT, 1974, 539-542.* On soils of low Si content, calcium silicate at planting gave annual increases in yield over a 6-year cycle. While application of 14.2 tons per ha was uneconomical, half that amount was generally profitable, and a net return could be expected if the third leaf lamina SiO₂ content was 1.4% on dry matter or if the acid-soluble soil Si content was below 77 ppm. Although little of the applied silicon was recovered in the plant or soil, soil and leaf analyses indicated that further yield increases could be expected from the silicate already applied.

* * *

Sugarcane response to calcium silicate slag applied to organic and sand soils. G. J. GASCHO and H. J. ANDREIS. *Proc. 15th Congr. ISSCT, 1974, 543-551.* Results of experiments, in which calcium silicate slags were applied to organic and sandy soils, showed that the treatment reduced cane leaf freckling (a symptom associated with low silicon levels) and increased cane and sugar yields. Application of calcium silicate did not appreciably affect the P, Ca,

Mg, Cu, Fe, Mn and Zn concentrations in the leaf tissue. Increases in yield due to the calcium silicate occurred whether soil and leaf P contents were high or low.

* * *

Magnesium in sugar cane culture. O. SANCHEZ and H. F. CLEMENTS. *Proc. 15th Congr. ISSCT, 1974, 552-567.*—Full details are given of investigations on the effects of magnesium application on cane growth parameters. These indicated that Mg caused an increase in sucrose, reducing sugars, dry matter and plant height, but there was no correlation between Mg application and (1) leaf emergence and (2) leaf chlorophyll content.

* * *

The effect of filter press mud on the availability of macro- and micronutrients. M. PRASAD. *Proc. 15th Congr. ISSCT, 1974, 568-575.*—Experiments to determine the effect of filter cake on macro- and micronutrient availability in a sandy and a clay soil are reported. Results showed that the filter cake caused a slight increase in the pH and K content, and caused a drop in mineral N after one month, but a very slight increase in mineral N after four months. Filter cake application also caused substantial increases in available P, and the replacement of superphosphate with filter cake as a P source is suggested. After eight months, the availability of Ca, Mg, Mn and Zn increased as a result of filter cake application, but Fe availability did not, although waterlogging coupled with filter cake application considerably increased the Fe levels. High filter cake application rates caused a marked drop in soil Al contents.

* * *

The response of sugar cane to three forms of phosphate fertilizer in three successive cultivations. Y. C. PAN and K. L. EOW. *Proc. 15th Congr. ISSCT, 1974, 576-585.*—Phosphate was applied to cane growing on an acid clay soil of high aluminium content and the results determined over three successive years. No significant difference in cane yield was found between the three different forms of fertilizer used (rock phosphate, dicalcium phosphate and triple superphosphate) nor between the levels used (80 and 120 kg.ha⁻¹), but all caused an increased cane yield compared with the untreated control.

* * *

The effect of gamma-BHC and nitrogen levels on ionic balance in sugar cane. B. SINGH and S. P. JAISWAL. *Proc. 15th Congr. ISSCT, 1974, 601-607.* The effect of gamma-BHC and nitrogen application on cane yield and cation-anion balance was examined, the organic anion concentration being determined as the difference between the inorganic cation and inorganic anion concentrations. Nitrogen at 75 and 150 kg.ha⁻¹ increased cane yield compared with the control and reduced the total anions; at 75 kg.ha⁻¹ it caused an increase in the total cations and organic anions, but at 150 kg.ha⁻¹ the value fell, but was still higher than without N application. The same pattern was observed with the same levels of gamma-BHC application, with or without N. A positive correlation was established between yield and (i) cation content and (ii) organic anion content. The results indicated that the concentration of cations, particularly K, must be maintained at a sufficiently high level for a higher yield and optimum organic anion content to be attained.

P fixation: a growth-limiting factor in some soils of the South African sugar industry. J. H. MEYER. *Proc. 15th Congr. ISSCT, 1974, 586-600.*—Investigations were conducted on pot-grown ryegrass to determine more accurately the P requirements of soils having a high P fixation property. Results showed a marked growth response to broadcast and banded single superphosphate at levels well above those normally recommended on the basis of conventional extraction procedures. It was concluded that the ability of soils to adsorb P can vary widely and cannot be predicted by conventional acid extraction procedures; however, preliminary findings suggest that the accuracy of P fertilizer predictions can be increased by using a rapid phosphate desorption procedure.

* * *

Advances in sugar cane fertilization in Cuba. J. ALOMÁ, H. PÉREZ and I. CUÉLLAR. *Proc. 15th Congr. ISSCT, 1974, 608-617.*—The results of 101 trials, covering 214 harvests and representing the soils of the various cane areas of Cuba, are summarized. They indicate that there is generally no significant response to N fertilizer applied to plant cane, while in ratoon crops 100-150 kg.ha⁻¹ will have a positive effect. There is only slight response to P, while there tends to be a response to K at 100-150 kg.ha⁻¹ applied from 1st ratoon onwards. Positive results have also been given by application of 100 metric tons of filter cake per ha. Results are affected by agricultural practices associated with fertilizer application.

* * *

The effect of time of application on the utilization of fertilizer nitrogen by plant cane. R. A. WOOD. *Proc. 15th Congr. ISSCT, 1974, 618-629.*—Two field experiments using labelled N fertilizers were carried out on two different soils. Results showed that application of all or a large proportion of an N dressing to the furrow at cane planting time could cause severe leaching losses even where the soil was of heavy texture. More efficient N recovery was obtained by top-dressing some weeks after planting, but even under conditions which favoured N uptake, only 25-30% of the N applied as sulphate of ammonia would be recovered by the above-ground parts of the average cane crop, while a further 8-10% would be retained by stubble and roots. The highest recoveries were obtained when KNO₃ was applied as a top-dressing.

* * *

Effect of fertilizer application upon sucrose % cane. H. FRITZ. *Proc. 15th Congr. ISSCT, 1974, 630-632.* Experiments have shown that the sucrose content % cane can alter in two ways: (1) it can be reduced relative to the moisture content when the latter is increased, e.g. by N application, and (2) it can be increased in proportion to the dry solids content when the latter is positively affected by K application.




* * *

Applications of phosphate and potash and their effect on the juice quality of cane crops following heavy nitrogen fertilization. M. LAKSHMIKANTHAM. *Proc. 15th Congr. ISSCT, 1974, 633-636.*—Application of P and K in varying quantities to cane after application of large quantities of N (up to 336 kg per ha) did not significantly improve the sucrose content which had been reduced by the N.

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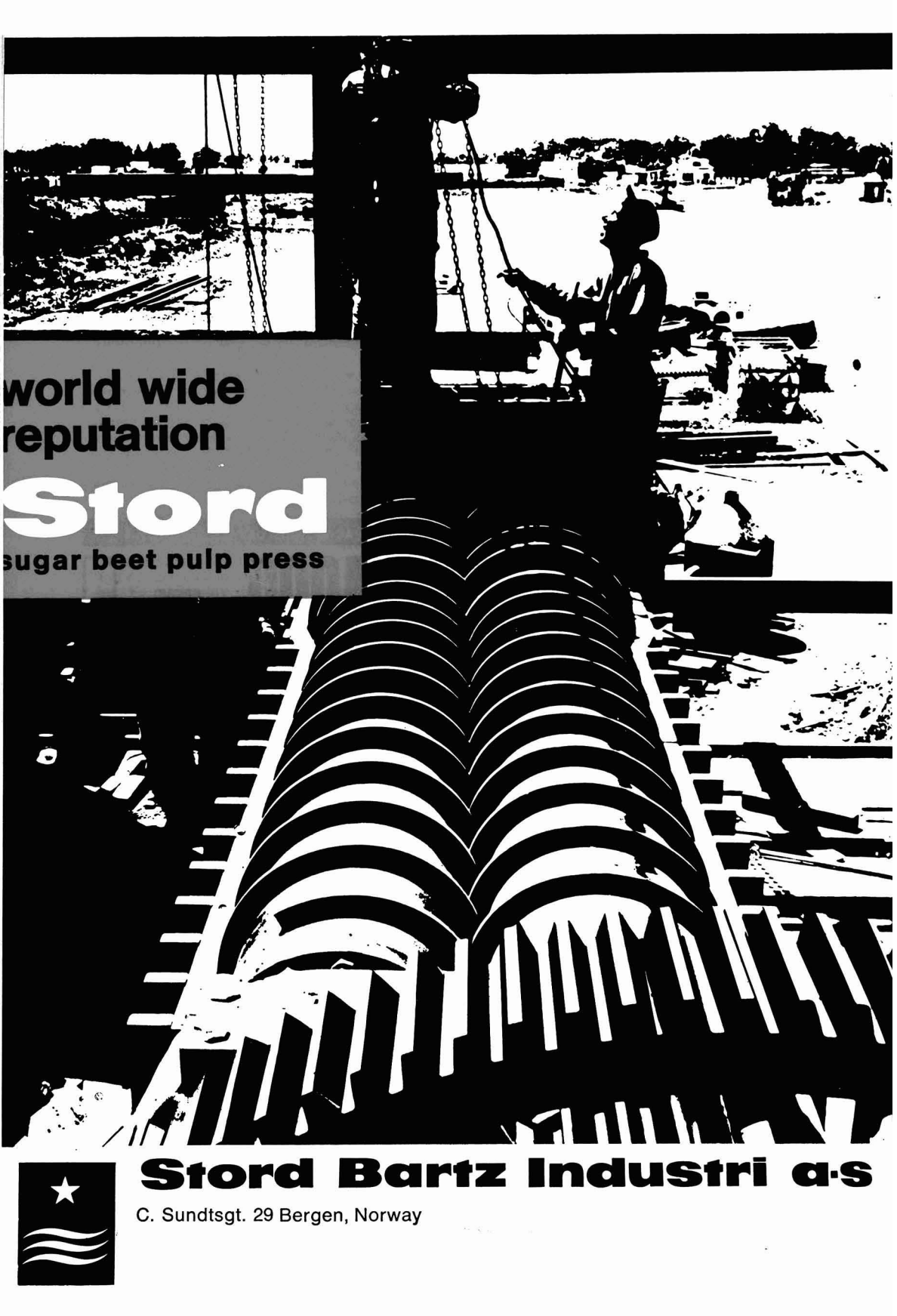
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Drip irrigation. D. J. MARTIN. *Proc. 15th Congr. ISSCT, 1974, 637-638.*—The author briefly describes the drip irrigation system used in Hawaii to replace furrow irrigation, and outlines the advantages of the new system.

* * *

Cane yield and water use efficiency on a sandy loam soil. L. RAMDIAL. *Proc. 15th Congr. ISSCT, 1974, 649-654.*—In an investigation of furrow irrigation on sandy loam soil (which has a low water-holding capacity) it was found that furrow slope had no effect on water usage (slopes of 0.3 and 0.4% were examined) and did not significantly affect cane yield, while furrow length also did not have significant influence on cane yield or water usage, although longer furrows tended to be more productive than shorter ones. The larger the stream size (flows of 5.0, 7.5 and 10.0 litres.sec⁻¹ were tested), the higher was the yield. There was interaction between slope and furrow length, while water losses through percolation increased with stream size irrespective of slope and were greater with the longer furrows. Greatest water utilization efficiency was obtained with the maximum stream size and longer furrows coupled with the steeper slope. Hence, furrows of 120 m and high stream flows are recommended, the more so since under these conditions a higher bank can be developed which can be easily wet by irrigation and leads to better mechanical cane loading, while all mechanical operations can be made more efficient and irrigation labour requirements reduced.

* * *

Sugar cane irrigation in Tucumán. F. A. FOGLIATA. *Proc. 15th Congr. ISSCT, 1964, 655-667.*—See FOGLIATA: *I.S.J.*, 1974, 76, 209; 1975, 77, 13.

* * *

Consumptive use of water by sugar cane in the Philippines. A. C. EARLY and R. P. GREGORIO. *Proc. 15th Congr. ISSCT, 1974, 668-678.*—Determination of cane water consumption is discussed and values of potential evapotranspiration obtained by various authors are tabulated. Experiments on cane water consumption determination from soil moisture depletion and from the moisture balance obtained from lysimeter readings are reported, and ratios between mean daily water consumption and evapotranspiration and evaporation data tabulated. The value to the farmer of estimating cane water consumption is briefly discussed.

* * *

The decline in rate of evapotranspiration of fully canopied sugar cane during a winter stress period. P. K. MOBERLY. *Proc. 15th Congr. ISSCT, 1974, 694-700.* The rate of evapotranspiration (Et) was measured in three mechanical weighing lysimeters during the dry winter periods of 1971/72 in South Africa, and the results related to Class A Pan evaporation (Eo). The proportion of the total available moisture removed from the soil profile at an Et:Eo ratio equivalent to that of well-watered cane was very similar to the proportion of total available moisture held in the soil between a tension of 0.1 and 1.0 bar as measured in the laboratory. Since this comprised 60-70% of the total available moisture held between tensions of 0.1 and 15 bars, it is considered as possibly more realistic to regard only the water held between 0.1 and 1.0 bar to be freely available to the cane and to introduce factors to cover reduced availability at tensions greater than 1 bar.

The yield response of sugar cane to irrigation in the Philippines. A. C. EARLY. *Proc. 15th Congr. ISSCT, 1974, 679-693.*—Experiments to determine the effect of irrigation on cane yield are reported. Controlled irrigation gave increased yields compared with rain-fed cane, although varietal differences occurred in the response to irrigation. In further experiments, sugar yield fell with increase in the total quantity of water applied to plantation cane, but cane yield rose. Sugar yield rose with increase in total estimated effective precipitation plus irrigation where total annual rainfall was low, and fell with increase in the above factor when the total annual rainfall was high. A review of the literature on cane response to irrigation is given in tabular form.

* * *

Monitoring maturity of sugar cane during drying-off. J. E. LONSDALE and J. M. GOSNELL. *Proc. 15th Congr. ISSCT, 1974, 713-725.*—A number of methods were tested for suitability in monitoring cane maturity during drying-off; they included measurement of the moisture contents of 3-6 sheath, 4/5 joint, 8-10 internode and spindle, determination of the number of green leaves and measurement of refractometer Brix. Highest correlation was established between cane sugar content and refractometer Brix, which is recommended for use by farmers as the simplest and cheapest method of determining cane maturity where laboratory facilities are not available. Counting the number of green leaves is of use in preventing excessive desiccation, although correlation of this factor with sugar content was poorest of the methods tested. For large estates, full cane analysis is the best method for determining maturity, while measurement of spindle moisture content is the most suitable for monitoring moisture stress. Tissue moisture was found to be affected by varietal differences and decreased with age; it generally increased from January to May (coincident with the peak growing period), although spindle moisture was less affected by season than was 3-6 sheath or 4/5 joint moisture. Spindle moisture was apparently unaffected by N and P fertilization, while P application did not affect 8-10 internode moisture.

* * *

A theoretical salt effect limit for sugar cane considering soil physical properties. S. VALDIVIA V. and J. PINNA C. *Proc. 15th Congr. ISSCT, 1974, 736-742.*—Investigations showed that in fine and moderately fine textured soils, there is a highly significant correlation between moisture content and bulk density which is not true of medium textured, loam or coarse textured soils, in which the bulk density stays constant with variation in moisture content. A highly significant correlation was also established between air space and soil moisture content in fine or coarse textured soils. The relationships found can be used to estimate the theoretical limiting salinity at which cane is affected, as is demonstrated. The limit can be raised by increasing aeration or decreasing the soil compaction.

* * *

Measurement of available water and root development on an irrigated sugar cane crop in the Ivory Coast. R. BARAN, D. BASSERAU and N. GILLET. *Proc. 15th Congr. ISSCT, 1974, 726-735.*—A study of the water-soil plant relationship on a site treated by overhead irrigation is reported, in which a neutron probe was used to measure the depth of soil used by the roots and the available water in the soil. Soil was found

to be involved in the water nutrition of the plant to a depth of at least 2 m, whereas the available water in the soil used by the roots represented only 9% of the total volume of soil used. Root development in the lower levels was found to be greater when the crop was irrigated less frequently, although no significant difference was found between cane or sugar yields with variation in rooting depth. It is suggested that, in view of the high cost of overhead irrigation, soils should be selected according to the depth to which cane roots penetrate.

* * *

High seed propagation ratios by the use of low seed rates in sugar cane. R. R. PANJE. *Proc. 15th Congr. ISSCT, 1974, 743-745.*—In an experiment aimed at studying the effects of seed rate on crop formation and yield of square-planted cane, the output of buds per planted bud was assessed. It was found that at 15½ months, the stalk population per ha could reach almost the normal 100,000 even when buds were planted at 90 × 90 cm spacing, at which the propagation ratio of buds produced to buds planted was 172:1. It is suggested that, in production of commercial seed, 2-bud setts could be planted at this spacing and, under good growing conditions, the ratio raised to 200:1.

* * *

Effect of inter-row spacing on sugar cane yields in Louisiana. R. J. MATHERNE. *Proc. 15th Congr. ISSCT, 1974, 746-750.*—Experiments are reported in which the effects of inter-row spacing on cane yields were determined and results compared with standard spacing. While rows 0.9 and 1.1 m apart gave consistently highest yields and stalk populations, they are too narrow to permit easy handling. On the other hand, dual drills 38.1 cm apart in 1.8 m-spaced rows did not give consistently higher yields than standard rows, unless the planting rate was doubled; single wide drills 1.8 m apart did not give higher yields than the standard row, but should help reduce labour requirements with mechanical planting (by obviating the need for men to follow the planters in order to place properly any cane which falls outside the drill). Dual drills 0.5 to 0.9 m apart in 2.1-2.7 m rows are to be studied.

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Effect of inter-row spacing on tiller mortality, stalk population and yield of sugar cane. R. S. KANWAR and K. K. SHARMA. *Proc. 15th Congr. ISSCT, 1974, 751-755.*—The effects of five inter-row spacings (60, 90, 120, 150 and 180 cm) on cane tiller mortality, stalk population and yield were studied at a seed rate of 50,000 3-bud setts per ha. Results showed that tiller population increased with decrease in spacing, although tiller mortality also rose with spacing reduction, so that the differences between the stalk populations per ha for the various spacings were not significant, while the row stalk populations rose with increase in spacing and the canes became thicker. Although differences in yield for the 60-150 cm spacings were not significant, there was a marked drop in yield with 180 cm spacing. Cane sugar content with the 60 cm spacing was lower than for other spacings (which were little different) in December, but by February the differences between all five spacings had become negligible.

Studies on the transplanting of sugar cane in Taiwan. K. H. TANG and W. T. CHEN. *Proc. 15th Congr. ISSCT, 1974, 756-760.*—The growth of pre-germinated cane plantlets raised in soil-filled polyethylene bags prior to transplanting was better than for nursery-raised stalk cuttings and normal top cuttings, and was also better for plantlets raised in October than in other months. Cane yield and sugar yield were greater by 19% and 17%, respectively, for the plantlets than for normal top cuttings during the two seasons of the investigations.

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Factors influencing the rate of sucrose inversion in harvested sugar cane in Egypt. M. H. AMIN, G. E. SAYED and A. T. HABIB. *Proc. 15th Congr. ISSCT, 1974, 761-768.*—Experiments showed that deterioration (juice pol and apparent purity reduction, increase in reducing sugars and glucose ratio as well as weight loss) was slower in harvested, untopped cane which was sprinkled daily with water during storage in covered heaps than in untopped cane stored for the same period (6 days) in uncovered heaps and sprinkled daily. Fresh cane was used as control in all tests.

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Height of topping and its effect on the quality of several varieties of sugar cane. R. A. WOOD. *Proc. 15th Congr. ISSCT, 1974, 769-777.*—Trials conducted at three different periods in the year showed that the effect of topping height on estimated recoverable sugar is greatest in February-April and becomes progressively less marked as the season advances. Age of cane at harvest apparently had little effect on optimum topping height. Hence, the height at which cane can be topped without detriment to the sugar content increases as the season progresses; early in the year the cane should be topped at the base of the 7th or 8th leaf sheath for most varieties; later in the season, topping should be done at the base of the 5th sheath to avoid loss of recoverable sugar. A decrease in reducing sugar content of internodes 6-12 as the season advances is associated with the increase in the topping height required to prevent loss of recoverable sugar.

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Influence of age on sugar cane ripening in Cuba. H. MUÑÍZ, F. PÉREZ and R. ESPINOSA. *Proc. 15th Congr. ISSCT, 1974, 778-788.*—An investigation of the effect of cane age on pol, juice purity, fibre and reducing sugars content was made for a number of varieties in each month of harvest. From the results, which are given in detail for each variety (B 4362, PR 980, C 87-51, B 42231 and My 53174), recommended planting dates are derived.

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Development of the sugar industry in Sudan. R. B. L. MATHUR. *Proc. 15th Congr. ISSCT, 1974, 789-793.* A survey is presented of cane agricultural practices in Sudan, with mention of the two sugar factories and their location. Some cane and sugar yields are given for a number of years up to 1970/71.

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Effect of competition by *Panicum repens* L. on sugar cane, and eradication by herbicides. S. Y. PENG and L. T. TWU. *Proc. 15th Congr. ISSCT, 1974, 794-808.* Although control of *Panicum repens* (torpedo grass) should be based on eradication of the rhizomes

rather than on killing the aerial parts, since the rhizomes reproduce vegetatively in the soils, as has been found where success in control of the weed in plant cane is followed by a smaller response in ratoon crops where rhizome regeneration has reached 50% of the rhizome population in untreated plots. Significant cane yield increases (62–98% compared with untreated controls) have been obtained by three cross-ploughings combined with the use of “Dalapon” in various mixtures with 2,4-D, “Paraquat”, “Bromacil” and “Terbacil” (each at 5 kg a.i. per ha) in seven repeated applications during the fallow period, killing more than 90% of the rhizomes.

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Influence of organic arsenical herbicides on yield and quality of sugar cane. R. P. COSSIO. *Proc. 15th Congr. ISSCT, 1974, 809–819.*—Since investigations have shown that organic arsenical herbicides (DSMA and MSMA) used for Johnson grass control have caused a reduction in cane growth during a critical period of 15–20 days after application, resulting in a reduced cane and sugar yield compared with untreated plots, pre-planting treatment is recommended, or, where the weed is present in a field of growing cane, spot treatment should be used. The question of juice and bagasse arsenic content after herbicide application has also been studied¹.

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Herbicides for increasing the efficiency of pre-monsoon water use in spring-planted sugar cane. P. N. CHOUDHARY and V. S. MANI. *Proc. 15th Congr. ISSCT, 1974, 820–827.*—See *I.S.J.*, 1974, **76**, 145.

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Rational organization and economical management of a large sugar cane plantation. L. M. BLAQUIER, J. CALIZAYA, M. BERTOLETTI and M. COMÍN. *Proc. 15th Congr. ISSCT, 1974, 828–837.*—Details are given of a study made with the aim of rationalizing use of the cane plantation of 30,000 ha at Ledesma S.A. in Argentina. As a result of the programme devised, the plantation is divided into 140 ecologic units, each of 100–400 ha; each unit grows only one cane variety which is selected as most suited to the soil and water-table conditions, and an agronomic programme is set out for each unit, although the master plan guides the decision on which variety to plant, taking into consideration the whole of the plantation. Thus, each partial decision to replant becomes integrated within a long-term general plan. Irrigation is also rationalized, and a particular procedure has been adopted in the introduction of new varieties. While the system has only started relatively recently, so that a final evaluation of the results is not possible, highly promising results have already been obtained.

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The Tully CAPA—a computer-processed extension service to cane growers. P. BORGNA, D. F. MADDISON and R. P. VICKERS. *Proc. 15th Congr. ISSCT, 1974, 846–848.*—A short description is given of the Comprehensive Area Productivity Analysis (CAPA) scheme at Tully which is based on a master file of the 310 cane farms in the mill area and which receives information on cane deliveries and analyses, as well as field officers' reports and farmers' reports on fertilizer usage, so that a complete harvesting and production record is kept for each farmer.

Management by objectives in cane sugar. W. W. PATY. *Proc. 15th Congr. ISSCT, 1974, 838–845.*—The MBO (Management by Objectives) programme at the Waialua Sugar Co. in Hawaii, introduced to increase the profit margins, is discussed and data covering 1972 and 1973 are tabulated to show how results, particularly in field operations, compare with the established norms.

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Digital simulation of a sugar cane producing-processing district in the Philippines to test alternative irrigation policies, harvesting policies, and irrigation capacity development. A. C. EARLY. *Proc. 15th Congr. ISSCT, 1974, 849–862.*—A digital simulation programme written to represent a cane district was used to evaluate and establish irrigation and harvesting policies based on soil moisture conditions. Advantages and disadvantages of the system are discussed.

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Incomplete factorials in sugar cane research. A. MARTÍNEZ G. *Proc. 15th Congr. ISSCT, 1974, 863–870.*—The design and analysis of fertilizer experiments in incomplete blocks are described mathematically and an example given as illustration.

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Sugar cane yield models for production simulation. F. Y. PANOL. *Proc. 15th Congr. ISSCT, 1974, 871–883.*—Discrete time form models of cane tonnage harvested per ha and of rendement are presented for a 10,000-ha zone in the Victorias Mill District of the Philippines, where the cane harvest, in some cases, lasts throughout the year. Formulated by multiple regression using the least squares method, the models have been developed primarily for application in computer simulation, the monthly data used for the tonnage models concerning the period 1951–69, while the weekly rendement data cover the period 1960–69. Close agreement was found between estimated and true tonnage, while slight discrepancies occurred between estimated and true rendement. The simulation models indicated that some climatic factors affect cane growth and yield more by the sequences of their occurrence than by the absolute values and that there is an increasing time trend in cane production and a decreasing trend in rendement. It was also concluded that a stoppage or slow-down in operations during August–September would give an optimum harvest cycle.

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Ten years of yield decline research. R. E. COLEMAN. *Proc. 15th Congr. ISSCT, 1974, 884–892.*—The author reviews the work carried out by the US Dept. of Agriculture during the last ten years on cane variety yield decline, and indicates that a solution to the problem still seems remote. However, while the overall results of the work have proved inconclusive, some useful knowledge has been obtained.

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Automation of phosphorus analysis in leaf and soil samples. H. SINGH. *Proc. 15th Congr. ISSCT, 1974, 893–898.*—A description is given of an automatic procedure developed for phosphorus determination in cane leaves and soil (specifically for Fiji where many of the cane soils are P-deficient); the amidol-sodium metabisulphite method of ALLEN² is used as

¹ COSSIO: *I.S.J.*, 1974, **76**, 280.

² *Biochem. J.*, 1940, **34**, 858–865.

basis. Tabulated results for both the automatic and the TRUOG-MEYER method shows close agreement, while the automatic method is more reproducible.

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Test for zinc in sugar cane soils of Hawaii. T. C. JUANG, M. ISOBE and G. UEHARA. *Proc. 15th Congr. ISSCT, 1974, 899-904.*—Six extraction methods were tested for their level of assessment of zinc in 31 soil samples. The method using 0.1N HCl as extractant was found to be the best, and a significant correlation was established between the amount of zinc extracted by this means and zinc uptake and dry weight yield of corn. The method also indicated that of 99 soil analyses made by the Hawaiian Sugar Planters' Association, 65% contained less than 7.6 ppm zinc and the rest contained less than 3 ppm zinc. It has been found that the requirement for additional zinc increases with increase in rainfall, in the degree of soil weathering and in exposure of subsoil.

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The mechanism of leaching in vertisols (cracking clays). L. RAMDIAL. *Proc. 15th Congr. ISSCT, 1974, 905-913.* Investigations of water and salts redistribution within furrows, banks and soil blocks two days after irrigation or heavy rain, showed that as cracks formed in the surface soil, salts were accumulated along the crack walls and throughout the entire ped, outlined by the cracking, as the crack depth increased. These salts were found to be leached along the furrows and into drains by irrigation water, thus permitting good cane growth on the cracked soil. The water content in the peds decreased towards the crack walls but increased along the crack depth.

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Investigation of the clay fraction of some soils in the Natal cane belt. J. LE ROUX. *Proc. 15th Congr. ISSCT, 1974, 914-920.*—X-ray diffraction studies of the clay fractions of a number of Natal soils were followed by quantitative analysis of the various crystalline minerals by selective dissolution, cation exchange and thermogravimetric techniques. Results are tabulated and discussed.

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Do north-south lines produce the highest yields of cane and sugar? D. P. GOWING. *Proc. 15th Congr. ISSCT, 1974, 921-922.*—An investigation involving two varieties of cane harvested over four seasons on an irrigated plantation in Iran showed that geographic orientation of the furrow had no detectable effect on cane yield or sugar content.

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An investigation into the problem of poor sugar cane growth on some sandy soils of the Natal sugar belt. P. K. MOBERLY, R. H. G. HARRIS and E. MILLARD. *Proc. 15th Congr. ISSCT, 1974, 923-931.*—From field experiments and soil analyses at a number of sites on the wind-blown sandy soils along the coastal belt of Natal, it was concluded that the main cause of poor cane growth was nematode activity. While "Temik" has given encouraging results, control has still not been adequate, and studies are being made on the residual effects of the nematicide and on the effects of re-application.

Sucrose enhancement in field-scale sugar cane trials with "Polaris" in Florida, Hawaii and Louisiana. G. W. SELLECK, K. R. FROST, R. C. BILLMAN and D. A. BROWN. *Proc. 15th Congr. ISSCT, 1974, 938-945.*—Tests on "Polaris" are reported in which the application rates were 4 kg.ha⁻¹ in Louisiana and Florida and 5.3 kg.ha⁻¹ in Hawaii (the 85% powder was dissolved in 47-94 litres of water per ha). Results for a number of cane varieties showed that application 4-10 weeks before harvest increased the cane sugar content by an average of 10%, best results being obtained when natural ripening conditions were poorest. (See also FROST & SELLECK: *I.S.J.*, 1974, 76, 174).

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Field trial with "Polaris" as a sugar cane ripener. I. The effects on juice quality. Y. C. PAN and Y. P. LEE. *Proc. 15th Congr. ISSCT, 1974, 946-952.*—Application of "Polaris" at 4.48 kg.ha⁻¹ in 545 litres of water with surfactant at 0.1% v/v produced a 12-25% increase in cane sugar content in tests in Malaysia. Effects of the chemical on cane yield and flowering were not determined. On cane grown on a 12-month cycle, application about 9 weeks before harvest was optimum. It was found that "Polaris" can suppress reducing sugar formation and maintain the sugar content for about 7 days after burning.

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Chemical ripening of sugar cane with "Ethrel" and "Polaris". H. ROSTRON. *Proc. 15th Congr. ISSCT, 1974, 953-965.*—Pot and field experiments with "Ethrel" and "Polaris" ripeners applied to N:Co 376 cane are reported; rates of application were 0.5, 0.9 and 2.0 kg a.i. per ha in the case of "Ethrel" and 2.8, 3.4 and 4.8 kg a.i. per ha for "Polaris". Results indicated that both improved the juice purity, sugar content and sugar yield compared with the control, maximum cane sugar content being attained 8 weeks after spraying. From 6 weeks after spraying, the response to "Polaris" was linear up to the highest rate of application, whereas with "Ethrel" the response was curvilinear, although the latter chemical was more effective than "Polaris" at the same application rate. Both chemicals induced moisture stress symptoms in the cane plants, reduced leaf size and apparent photosynthesis, and increased cane dry matter content. While adequate soil moisture was necessary for effective chemical ripening, severe moisture stress did not reduce the ripening effect once it had taken place. The adverse effect of "Ethrel" on some cane varieties may indicate that they are more sensitive to the chemical than is N:Co 376.

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Photosynthetic action spectra of *Saccharum* species. A. G. ALEXANDER and O. BIDDULPH. *Proc. 15th Congr. ISSCT, 1974, 966-983.*—Photosynthetic action spectra were determined for nine *Saccharum* clones at twelve wavelengths in the range 400-710 nm at constant quantum flux. Maximum photosynthesis occurred in the blue wavelengths at 480 nm for all but one clone; in the red wavelengths several peaks were obtained at 620-640 nm and 670 nm, while green light made relatively large contributions even at high optical densities. A tentative evolutionary progression is proposed: (a) a consistently high blue sensitivity from oldest to youngest species; (b) a high red sensitivity in the oldest species, diminishing in

younger species; and (c) recurrence of red peaks in modern hybrids containing *S. spontaneum* and *S. sinense* germplasm. The CO₂ compensation point in white light was zero for all clones, and a positive rate relationship was obtained between photosynthesis in white light and dark respiration.

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Juvenility, senility, climate and flowering in *Saccharum*. R. JULIEN, G. C. SOOPRAMANIAN and D. LORENCE. *Proc. 15th Congr. ISSCT, 1974, 984-990.*—Experiments on cane flowering induction in two commercial varieties (S 17 and M 351/57) and in a variety of *S. spontaneum* are reported from Mauritius. (Heavier flowering had earlier been recorded in young plants of S 17 than in older ones.) Results indicated that a minimum number of mature internodes was necessary for floral induction, although varietal differences occurred. However, since old canes with a high number of mature internodes failed to flower, it is suggested that there is an optimum number of internodes necessary for induction. Absence of flowering in the commercial varieties at one site was associated with high maximum day temperatures.

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Radiant energy interception, root growth, dry matter production and the apparent yield of two sugar cane varieties. H. ROSTRON. *Proc. 15th Congr. ISSCT, 1974, 1001-1010.*—Field measurements of the apparent maximum productivity of N:Co 376 and CB 36/14 cane showed that while, theoretically, there would appear to be considerable scope for breeding varieties with a higher yield potential, in practice it may not be easy to increase yields beyond those obtained with current varieties as grown in South Africa. Differences in stalk population, leaf angle and leaf breadth between the two varieties did not alter leaf area indices, and energy interception by the canopy did not seem to differ appreciably between the two. Under good growing conditions, the yield potential of both was the same, despite large differences in stalk population, and the only notable differences in growth between them were apparent at the root laboratory when soil fertilizer and nematodes may have been a problem. The results show either that the two varieties have similar rates of net photosynthesis per unit leaf area, or that, for practical purposes, differences in photosynthesis do not affect cane yield. The probability is that N:Co 376 is popular because it is more adaptable to soil, weather and management conditions than are other varieties. It is suggested that increasing cane sucrose content could be an easier way of increasing sugar yield.

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The relationship of sugar yield and its components to some physiological and morphological characters. E. L. ROSARIO and R. B. MUSGRAVE. *Proc. 15th Congr. ISSCT, 1974, 1011-1020.*—Net carbon exchange (NCE) and other leaf physiological and morphological characters were studied in relation to sugar yield and its components. From the correlation found between NCE and the number of millable stalks at harvest, it is concluded that NCE affects tiller survival of plants under competition. Since it is concluded that varieties (of which 14 were tested) of high NCE response possess a high competitive ability and hence are more tolerant to population stress, increasing the planting density would give a higher cane yield per unit area, so that the Philippine

practice of constant planting densities (33,000 stools per ha) is not to be recommended. High NCE varieties were also found to have an erect, narrow and thick leaf, so that mutual shading effects would be minimal. Specific leaf weight was shown to be a good index of selection for high NCE response.

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Aspects of modelling sugar cane growth by computer simulation. T. A. BULL and D. A. TOVEY. *Proc. 15th Congr. ISSCT, 1974, 1021-1032.*—A conceptual model of cane growth is outlined and the sub-model describing photosynthesis production and preliminary partitioning of dry matter explained in greater detail. The parameters included in the sub-model are: potential maximum photosynthesis rate, actual photosynthesis rate, gross photosynthate, respiratory losses, net photosynthesis and senescence. Testing of the sub-model by comparing its output with harvest data for several cane varieties grown in containers with adequate water and nutrient supply revealed that there is little provision in the sub-model for "compensatory growth" following moisture stress; on the other hand, "compensatory growth" may not be a valid concept, and final yield may be far more affected by growth conditions early in establishment of the crop than by conditions later in the season.

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The loss of sugar from stalk tissue of hot water-treated sugar cane. G. T. A. BENDA and J. E. IRVINE. *Proc. 15th Congr. ISSCT, 1974, 1040-1047.*—Gas-liquid chromatography was used to determine the movement of total sugars from cane stalk tissue to water placed in setts (averaging 36.5 cm in length) after drilling to form a 0.9 cm diameter continuous duct, sealed at each end with rubber membranes. Analysis showed that hot water treatment at 50°C for 1-2 hr increased the movement of the sugars into the distilled water; this effect could persist for at least 4 days after completion of the heat treatment and was much more pronounced when treatment was for 40 minutes at 70-74°C. When water was retained in the setts for about 20 hours, the sucrose concentration relative to levulose and dextrose was much lower than in the surrounding tissue, and the dextrose:levulose ratio was also lower than in the tissue. In the untreated control setts, the sugars concentration in the water was lower but the relative concentrations were similar to those in the treated setts. The levulose, dextrose and sucrose proportions in the water were similar to those in the surrounding tissue.

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Capacities and economics of an existing system of cane transport. P. A. KOOPMAN. *Proc. 15th Congr. ISSCT, 1974, 1058-1064.*—Comparison of the transport costs per ton of cane per km with various systems as used at Kiliba, Zaire, showed that the three most economical combinations for distances up to 16 km were: a Ford "County 754" tractor towing three Thomson trailers; a Volvo truck, and a Ford "County 754" towing a Michot trailer. There was quite an appreciable jump in costs after these. The highest hourly capacity was that of 4 Thomson trailers, but with increase in distance that of the Volvo truck was about the same.

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Pneumatic removal of extraneous matter by sugar cane harvesters. J. ABREU C. *Proc. 15th Congr. ISSCT, 1974, 1124-1135.*—See ABREU & BRITO: *I.S.J.*, 1974, 76, 307.

Sugar beet agriculture



Potassium and sodium requirement. A. P. DRAYCOTT and M. J. DURRANT. *British Sugar Beet Rev.*, 1974, 42, 90-94.—Addition of NaCl to soil tended to increase beet sugar yield by a greater amount than did addition of K_2O , the effects of both fertilizers being greater on mineral than on organic soils, and 240 units of K_2O per acre (1 unit = 1.12 lb) being of little advantage over 120 units per acre, with or without addition of NaCl. No evidence was found in the tests of damage to soil structure or hindrance to seedbed preparation by NaCl. Soil texture and analysis for exchangeable K gave only a rough guide to K_2O and NaCl requirements. Since the effect of NaCl on yield is particularly noticeable during dry springs and can be omitted without loss of yield only when there is heavy rainfall in spring, the authors advocate application of both fertilizers so as to be certain of obtaining maximum yields. Optimum amounts are given for UK soil types.

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Effect of variety quality on the economics of sugar beet processing. J. F. T. OLDFIELD. *British Sugar Beet Rev.*, 1974, 42, 105-108.—Beet properties which are associated with variety and which adversely affect processing economics are discussed, including the degree of bolting and root "fanginess", root brittleness, marc content and raffinose and non-sugars contents. The possibility of reducing storage losses by improved beet breeding to increase frost resistance and slow the respiration rate is also suggested, although it is also conceded that even the above-mentioned factors are not always a direct result of variety but may be the consequence of adverse weather conditions. The method for estimating beet sugar yield adopted in 1973 by the British Sugar Corporation is mentioned, in which the press juice is analysed for K, Na and amino-acids and the total expressed as mg impurity per 100 g sugar.

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Dynamics of nitrogen and sugar beet growth. J. HEBERT. *Sucr. Franç.*, 1974, 115, 259-264.—Results are given of a study on the effects of nitrogen application (in the form of ammonium nitrate) at the rate of 150 kg.ha⁻¹ on beet growth at two sites in the region of Soissons in northern France. The study was concerned with the distribution of nitrate N as a function of beet uptake, values of both factors being given for various dates after sowing, covering the range 40-180 days, as was the beet growth (expressed as kg dry solids per ha). The question of optimum N dosage to give maximum beet and sugar yield is discussed.

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Strains of *Cercospora beticola* resistant to "Benomyl" in the U.S.A. E. G. RUPPEL and P. R. SCOTT. *Plant Disease Reporter*, 1974, 58, 434-436.—Isolates of *C. beticola*, the causal agent of leaf spot, from beet fields sprayed with "Benomyl" in Texas were found to be resistant to the fungicide *in vitro*. On the other hand, isolates taken from beet in Texas, Colorado and

Maryland which had not been sprayed with the fungicide were found in the experiments to be sensitive to it. Growth rates in culture did not show any differences in vigour between the resistant and sensitive isolates, and attempts to induce "Benomyl" resistance by growing sensitive isolates on increased quantities of "Benomyl" were unsuccessful. No resistance to the fungicide has been reported from other areas of the US, and it is therefore suggested that the resistant strain has developed locally and become predominant through excessive use of "Benomyl". It is not thought to have been introduced with seed from Oregon which supplies other areas.

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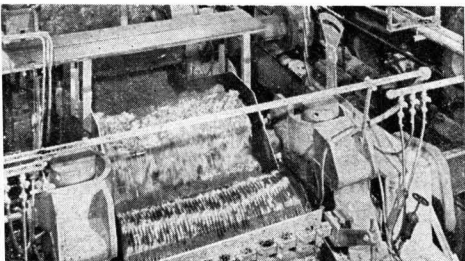
Effect of mineral fertilization on sugar beet yield. T. MAZUR and J. KOC. *Gaz. Cukr.*, 1974, 82, 136-136a. While N-P-K addition in various quantities and proportions gave higher beet yield than did application of farmyard manure, only two out of the seven doses tested gave the same sugar yield as did organic manure and one gave a higher sugar yield. This was a 10:8:17 N:P:K mixture applied at the rate of 315 kg.ha⁻¹.

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Deficiency diseases in sugar beet. R. VANSTALLEN. *Le Betteravier*, 1974, 8, (77), 8-9.—The adverse effects of magnesium, boron and manganese deficiencies on beet are discussed, with information given on the symptoms and the quantities of each element taken up by the beet and applied to the soil in various forms. While Mg and B deficiencies are easily recognizable, a typical Mn deficiency symptom is rare because of the considerable variation in solubility of the element with soil pH; in lime soils of high pH, Mn is present only in an insoluble form and cannot be absorbed by the beet, so that deficiency symptoms occur, while in acid soil it is highly soluble, and in very acid soil the beet leaves exhibit symptoms of Mn toxicity which cannot be reduced by liming, although this treatment is recommended for subsequent crops.

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Relationship between growth of irrigated and non-irrigated sugar beet and the dynamics of nitrogenous substances. V. ŠVACHULA. *Listy Cukr.*, 1974, 90, 97-102.—During the period 1967-71 experiments were conducted on beet to determine the effect of thermodynamic parameters of climate and controlled irrigation on growth of leaves and roots and on the amide nitrogen and total nitrogen content. It was found that all were dependent on the internal energy of the bioenergetic system. Controlled irrigation increased leaf and root growth considerably, in comparison with the values obtained for non-irrigated beet, and also reduced the amide-N and total N content. However, the greatest difference between irrigated and non-irrigated beet lay in the form of the internal energy curve, since irrigation and rain contributed heat to the energy system.



Cane sugar manufacture

Hard fibre and pith in sugar cane. A simple method for evaluating millability of new sugar cane varieties. J. T. SNOW. *Proc. 15th Congr. ISSCT, 1974, 1169-1174.*—A simple laboratory method for separating hard fibre quantitatively from pith, involving segmentation of the cane samples, digestion in a blender, filtration, leaching in a rotary perforated drum and drying of the subsequent fibre and pith fractions, was used in the determination of the fibre:pith ratio for eight commercial cane varieties as a contribution to evaluation of milling qualities. Marked differences in the ratio occurred between the varieties, although good correlation was established between the ratio for a given variety and milling performance. While cane maturity affected the ratio (young cane having significantly more pith than fibre but mature cane having an approximate 1:1 ratio), crop age, site location and soil had little effect on the ratio, which is recommended as a useful guide to the millability of new cane varieties.

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Mechanistic studies of cane mud flocculation. E. WHAYMAN and O. L. CREES. *Proc. 15th Congr. ISSCT, 1974, 1175-1182.*—Batch settling tests on limed cane juice with partially hydrolysed polyacrylamide flocculants¹ are described, in which the dependence of settling rate on polymer molecular weight was determined as well as the effect of particle zeta-potential on optimum chemical composition of the flocculant. It was found that adsorption occurs through the acrylate group in the copolymers, but the role of chain extension and the effect of percentage hydrolysis on molecular dimensions remains unknown. That the flocculation results fitted reproducible patterns, thus removing guesswork from the selection of flocculants, is seen as highly encouraging.

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Operation of syrup mills in Venezuela. F. CORDOVEZ Z. *Proc. 15th Congr. ISSCT, 1974, 1183-1186.*—See CORDOVEZ: *I.S.J.*, 1972, 74, 180; HINE: *ibid.*, 1973, 75, 116.

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A method for determining the degree of mixing and dead space of a continuous crystallizer. C. H. CHEN, H. T. CHENG and J. F. TONG. *Proc. 15th Congr. ISSCT, 1187-1195.*—A method is described which has been developed for determination of the degree of mixing and dead space in a continuous crystallizer, in which a radio-active tracer is injected into the inlet stream and the mean residence time established. Computer processing of values of this and other parameters gives age-distribution functions. Comparison of the experimental data with values calculated from BISCHOFF's model permits the degree of mixing, dead space and by-passing to be estimated, as is demonstrated by results for a system of eight low-grade crystallizers in series.

Effect of method of extraction of cane juice quality. G. E. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Proc. 15th Congr. ISSCT, 1974, 1215-1223.*—While there was little difference between mill and diffusion primary juices in terms of purity, reducing sugars, Brix and glucose ratio, it was found that a 4% drop in juice purity in the milling process was accompanied by a 53.8% increase in reducing sugars % sugar compared with a 13.3% rise in the same parameter when the diffusion juice purity fell by 1.9%, so that diffusion secondary juice was superior to mill secondary juice in terms of purity, reducing sugars and starch content. Highest purity diffusion juice was obtained at a diffusion temperature of 70-75°C and maintenance of press water pH of 5.5-7.0 without addition of lime; under these conditions, reducing sugars destruction and starch content were minimal, while increase in temperature and/or pH during diffusion raised the starch content and reduced juice purity. Whatever quantity of milk-of-lime was added to the press water, the resultant diffusion juice had a pH of 5.5-5.8, indicating a high buffering capacity. Diffusion temperature was the governing factor as regards starch extraction and/or destruction.

* * *

Control of vacuum pans. R. J. BATTERHAM, J. A. FREW and P. G. WRIGHT. *Proc. 15th Congr. ISSCT, 1974, 1326-1338.*—The automatic control of pan boiling is discussed in terms of mass balance and non-mass balance methods and measurement of important variables. Scale-up of laboratory schemes is examined, and automatic control of raw sugar boiling using a computerized system incorporating level and temperature measurements, pan refractometer and a special crystal content meter is described^{1,2}.

* * *

A study of crystal content in automatic sugar boiling. C. J. LU. *Proc. 15th Congr. ISSCT, 1974, 1339-1355.* Problems involved in automatic boiling are discussed. A mathematical relationship has been established between massecuite crystal content, inter-crystal distance and crystal size, whereby the inter-crystal distance decreases linearly with increase in size of the growing crystal, while the crystal content increases in proportion to the cube root of the crystal size. Hence, before syrup feeding is started, the crystal space should be adjusted until equal to the crystal size in order to obtain a smooth boiling. Three conventional instrumentation methods are compared; it is pointed out that, while all the methods so far developed cannot fully meet requirements of optimum boiling, mobility control (which responds to both viscosity and crystal content) describes the "sugar-growing environment" better and operates more reliably than

¹ CREES *et al.*: *I.S.J.*, 1974, 76, 148.

² BATTERHAM *et al.*: *ibid.*, 116.

³ FREW *et al.*: *ibid.*, 1975, 77, 55.

other methods of control. Maintenance of an optimum growing environment with respect to viscosity and crystal content will permit application of the method to all stages of low- or high-grade boiling.

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Factory-scale tests of sugar production from sweet sorghums in Mexico. J. ACOSTA C. and B. A. SMITH. *Proc. 15th Congr. ISSCT, 1974, 1356-1362.*—Factory-scale tests on white sugar production from sorghum, which are discussed, gave results which were similar to those obtained in pilot-scale tests¹, although juice purities were lower. The sugar boiled from the mingled and remelted C-sugar had an average pol of 98.8, a starch content of 0.006% and a carbonate ash content of 0.22%. Because of concern over harvesting operations and deliveries to the factory, but in view of the promising results obtained in processing, the authors consider extensive field investigations to be economically justifiable. These would also have as aim selection of suitable sorghum varieties and determination of suitable sugar production periods.

* * *

Operation of a "Saturne" diffuser in Mauritius. J. T. D'ESPAGNET and J. F. R. RIVALLAND. *Proc. 15th Congr. ISSCT, 1974, 1499-1511.*—Experience with operation of the "Saturne" diffuser at St. Antoine is reported and difficulties encountered, particularly problems with percolation as a consequence of variation in cane quality and preparation (in which respect the authors consider the diffuser in question to be too inflexible), are discussed. From calculations of pol losses in bagasse % fibre it is concluded that the diffuser has enabled the factory to increase capacity slightly and improve a little on the extraction performance of the previous milling tandem. (See also *I.S.J.*, 1973, 75, 267-271; 1974, 76, 372.)

* * *

Modifications to cane carriers and knives to improve extraction at Montelimar, Nicaragua. R. SCHAER. *Proc. 15th Congr. ISSCT, 1974, 1512-1522.*—Extraction at Montelimar is by means of a BMA diffuser preceded by a 3-roller crusher and followed by a dewatering mill. Details are given of modifications to the two cane conveyor-knife set systems used; cane preparation was improved by reversing the direction of rotation of the larger (64-knife) set and by installing an eccentric circular hood over the knives with a narrow gap between the hood and knife pitch circumference. The diffuser (installed in 1965) has contributed to a higher sugar recovery than with the previous milling tandem, while lost time due to breakdowns is very low with the diffuser, the maintenance costs of which are much lower than for the mills.

* * *

Prediction of the extraction performance of a diffuser using a mathematical model. P. W. REIN. *Proc. 15th Congr. ISSCT, 1974, 1523-1537.*—A mathematical model describing the process in a moving-bed cane diffuser is explained. While the validity of the model has been demonstrated on a pilot scale, strict comparison between calculated values and data obtained for a BMA diffuser operating in South Africa has not been possible because of difficulties in sampling and analysing wet diffuser bagasse with consequent inaccuracy of data. The model, con-

sidered to give a reasonable prediction of performance, is used to discuss the effects of primary variables (juice flow pattern, degree of cane preparation, imbibition level, temperature and residence time) on diffuser performance.

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Development of computer control at Fairymead mill. G. MITCHELL, R. DEICKE and D. B. BATSTONE. *Proc. 15th Congr. ISSCT, 1974, 1538-1545.*—See MOONEY: *I.S.J.*, 1974, 76, 116; BATSTONE & MITCHELL: *ibid.*, 1975, 77, 55.

* * *

A mathematical model of vacuum pan crystallization. P. G. WRIGHT and E. T. WHITE. *Proc. 15th Congr. ISSCT, 1974, 1546-1560.*—The establishment of a mathematical model describing the pan boiling process is explained, the more important parameters being evaluated from data obtained for an experimental pan at a Queensland factory. The use of such a model for simulation of batch and continuous boiling is briefly outlined.

* * *

The drying of raw sugar in fluidized and spouted beds. R. H. WEILAND, G. LOW and L. S. LEUNG. *Proc. 15th Congr. ISSCT, 1974, 1561-1567.*—Experiments are reported on raw sugar drying in an experimental fluidized bed dryer and in a spouted bed dryer (in which drying air passes up through the bed of sugar but does not maintain it in a suspended state as in a fluidized bed dryer). In all the tests, the wet sugar was mixed with dry material before the start of drying, since fluidization was not possible at a raw sugar moisture content greater than 0.6%. On the other hand, stable spouting and drying were possible with raw sugar of 1.5-1.7% moisture content. For fluidized bed drying at air flow velocities of 0.86 and 1.5 m.sec⁻¹ and for spouted bed drying at air flow rates of 1.37 and 3.5 m.sec⁻¹, the air flow rate had no measurable effect on the drying rate, which tends to support the argument that drying rates are governed by the heat transfer and diffusion processes taking place inside single sugar crystals and not by interfacial processes such as evaporation from the particle surface. Hence, minimum air rates consistent with bed stability and easy control are advocated. A drying time of 1 minute for fluidized bed dryers and 2 minutes for spouted bed dryers was found sufficient to bring the wet sugar very close to its equilibrium moisture content. The spouted bed type is preferable because of greater stability, resistance to shock loads and low air pressure requirements; on the other hand, attrition rates (fines production) may be greater than in a fluidized bed dryer.

* * *

A preliminary survey of power requirements for cane preparation. R. H. RENTON. *Proc. 15th Congr. ISSCT, 1974, 1575-1582.*—A table is presented of the degree of cane preparation obtained and the power consumed by knife sets at South African sugar factories. The data, referring to five types of knife set installation, are discussed. It is shown that good operation of only two knife sets can give excellent results, while poor knife performance can be balanced by intensive shredding. Where a heavy-duty shredder was utilizing only 40% of the total power consumed, outstanding results were still achieved with good knife set opera-

¹ SMITH *et al.*: *ibid.*, 1974, 76, 116.

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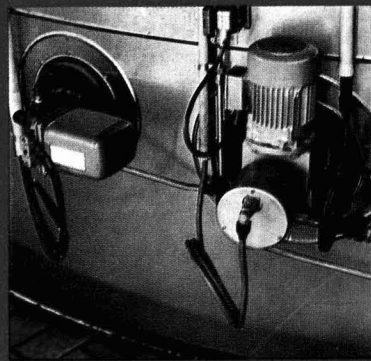
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tion. An approximate relationship has been established between preparation index and power consumption per ton of fibre per hour.

* * *

Photographic analysis of the action of a cane shredder. R. N. CULLEN and J. A. MCGINN. *Proc. 15th Congr. ISSCT, 1974, 1583-1589.*—High-speed photography at film speeds of 5,000 frames per second (120 metres of film representing about 1.5 second of shredding) was used to analyse the performance of a pilot-scale shredder. At shredding rates equivalent to 300 metric tons per hour, hammer swingback was not observed at any stage before or across the grid in the case of heavy or light hammers. Cane comminution took place in two distinct phases: an impact phase before the grid bar system, and a grid bar phase in which hammer impact was again the major factor. Measured velocities of cane particles on impact were about 7% of the hammer tip speed above the grid bar and about 30% of the tip speed as the hammers moved across the grid.

* * *

An evaluation of very fine shredding. B. ST. C. MOOR. *Proc. 15th Congr. ISSCT, 1974, 1590-1603.*—Descriptions are given of three shredders capable of giving a cane preparation index greater than 90: the Silver shredder, Walkers extra heavy-duty shredder, and the Mirrlees Watson shredder installed at Tongaat. The performance of the Tongaat shredder is discussed¹.

* * *

Bulk sugar cane handling system at Usina Sta. Lydia. L. A. R. PINTO and F. BRIEGER. *Proc. 15th Congr. ISSCT, 1974, 1611-1621.*—Details are given of the system introduced in 1972 at this Brazilian sugar factory for reception and handling of whole-stalk and chopped cane; changes to the previous arrangements were made necessary by the adoption of chopped-cane harvesting. Although washing of burnt whole-stalk cane at the plant involves sugar losses averaging 3-4%, the amount of soil introduced with it makes washing on the main carrier necessary; chopped cane is fed to the main carrier after the washing station.

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Rock removal for cane dry-cleaners. B. A. MCELHOE and D. K. LEWIS. *Proc. 15th Congr. ISSCT, 1974, 1622-1629.*—Some further data are given relative to the cane dry-cleaner at Pioneer Mill Co., Hawaii².

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Present and future trends in plant for steam generation in the sugar industry. G. S. HALL. *Proc. 15th Congr. ISSCT, 1974, 1630-1641.*—A survey of modern steam generation plant is given with emphasis on combustion equipment. It is pointed out that, while bagasse is a cheap fuel, its value in the manufacture of paper and particle board may argue in favour of pith, coal or oil as fuels in the future.

* * *

Boiler plant as an integral part of a cane sugar factory. N. MAGASINER. *Proc. 15th Congr. ISSCT, 1974, 1642-1679.*—The nature of the steam load imposed on the boiler plant by sugar factory processes is discussed, in which it is shown that, while changes in mill or centrifugal loads have only a small effect on the total steam demand, changes in steam demand resulting from start-up or striking of the pans have a greater effect, the magnitude of which is governed by the number and type of pans and the way in which they are operated. Otherwise, steam consumption will be relatively steady apart from when cane

shortages occur. The design characteristics of cane sugar factory boilers with bagasse-fired furnaces are surveyed, and ideas are put forward on means of simplifying instrumentation and control circuits; the design of bagasse fuel handling plant and its effect on boiler control and operation are also discussed. Boiler effluent disposal problems are examined and basic parameters for the design of gas cleaning equipment are suggested; the performance of existing gas cleaning equipment is reviewed. Integration of the boiler plant into the factory system is discussed and the relative costs of components considered. The need to simplify boiler plant design to ensure maintenance-free operation is stressed.

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Emissions from bagasse-fired boilers. B. W. FLOOD, A. S. HONEY and B. M. MUNRO. *Proc. 15th Congr. ISSCT, 1974, 1680-1687.*—Problems encountered in meeting the requirements of Queensland and New South Wales regulations concerning boiler emission are reported and the selection of fly-ash collectors discussed, with mention of the CSR wetted-louvre type which has been installed and tested at a sugar factory³. Among subsidiary topics investigated at the same time as the programme on particulate emission were disposal of collected fly-ash, for which two systems are generally in use, and secondary air injection which was found to be of little value as a means of reducing smoke density. Dark smoke emission, which coincided with avalanches of bagasse down the grate, can be reduced but not necessarily eliminated by installation of fly-ash collectors.

* * *

Effect of pan structure and operation on capacity. C. A. LEE. *Proc. 15th Congr. ISSCT, 1974, 1688-1695.* It is pointed out that, since pans of the same design and rapidity ratio for a given massecuite can give different results as a consequence of differences in steam and other working conditions, it is preferable to use automatic control rather than pans of high rapidity ratio, particularly since skilled pan operators are scarce.

* * *

Stainless steel in the sugar industry. C. G. W. ROFFEY and I. A. ELSDON-DEW. *Proc. 15th Congr. ISSCT, 1974, 1696-1707.*—After a brief general discussion on stainless steel, the authors examine the wear and corrosion resistances of specific types of stainless steel and consider the various pieces of sugar factory equipment and components where stainless steel can be applied to advantage, as well as areas where use of stainless steel is not recommended. Particular mention is made of stainless steel application in wet scrubbers for flue gas from coal- and/or bagasse-fired furnaces. Relative costs of stainless steel are mentioned, and tables given of basic analyses of the stainless steels referred to in the article.

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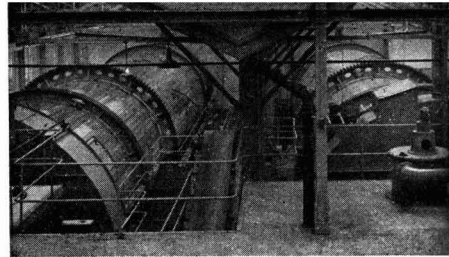
The design of a washing process for the extraction of juice from cane. J. FARMER. *Proc. 15th Congr. ISSCT, 1974, 1719-1735.*—A description is given of the "Hi-Extractor" diffuser installed at Honokaa and aspects of its operation and control examined. Performance and costs are briefly mentioned.

¹ MOOR: *I.S.J.*, 1974, 76, 213.

² MCELHOE & LEWIS: *ibid.*, 245.

³ FLOOD & FREW: *ibid.*, 1975, 77, 85.

Beet sugar manufacture



Operation of steeply-angled conical centrifugals of 500 kg capacity. J. WOLAŃSKI. *Gaz. Cukr.*, 1974, 82, 86-90.—The damage resulting from the failure of the braking system on a Polish-built batch centrifugal having a steeply-angled conical basket and the sequence in which it occurred are described. The machine had a maximum speed of 980 rpm and was being used for 1st massecuite curing.

* * *

The heat content of sugar solutions and massecuites. D. E. SINAT-RADCHENKO and V. D. POPOV. *Kharch. Prom.*, 1973, 17, 17-19.—A nomogram is presented for use in calculating the heat content of pure and factory sugar solutions, massecuites and crystal sugar in the temperature range 0-140°C, 0-90% dry solids, purity of 40-100 and massecuite crystal content of up to 75%.

* * *

Transfer of beet nitrogenous non-sugars in diffusion. G. P. VOLOSHANENKO, S. S. MIROSHNICHENKO and K. D. ZHURA. *Kharch. Prom.*, 1973, 17, 106-111. Studies showed that the contents of almost all forms of beet nitrogen, apart from peptide, undergo practically no change with variation in diffusion feed water pH. The minimum transfer of peptide N from cossette to juice occurred at pH 6 with both healthy and deteriorated beet. For minimum peptide N transfer, diffusion should last no longer than 60 minutes when deteriorated beet are being processed, whereas with healthy beet it should be longer than 60 minutes.

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Effect of raw juice liming on peptide nitrogen behaviour. S. S. MIROSHNICHENKO, G. P. VOLOSHANENKO and K. D. ZHURA. *Kharch. Prom.*, 1973, 17, 111-114. Investigations of peptide N behaviour as a function of the amount of lime added to raw juice showed that for maximum removal of peptide N, 2-2.5% CaO on weight of juice should be added and the liming period be about 10 minutes.

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The DDS diffuser and its economic features. A. F. ANDERSEN. *Zeitsch. Zuckerind.*, 1974, 99, 303-307. The DDS beet diffuser and its operation are explained and the main advantages of the system discussed.

* * *

Kinetics of scale formation in sugar factory (juice) heaters. I. I. SAGAN' and YU. S. RAZLADIN. *Izv. Vuzov, Pishch. Tekh.*, 1974, (2), 103-105.—The time taken for the layer of scale in a juice heater to reach a constant thickness (a phenomenon established in earlier studies) depends on a number of factors, including the type of juice being heated, heating conditions, heater construction and the hydrodynamics. It was found that the time was greatest with 1st carbonation juice followed by 2nd carbon-

ation juice and finally by raw juice, and generally rose with increase in flow rate from 2 to 3 m.sec⁻¹ but not from 1 to 2 m.sec⁻¹.

* * *

Study of the kinetics of 1st carbonation and its optimization conditions. L. P. REVA, I. M. FEDOTKIN, V. M. LOKHVIN, V. A. SHESTAKOVSKII and V. E. YAKOVENKO. *Sucr. Belge*, 1974, 93, 249-261.—See *I.S.J.*, 1974, 76, 151.

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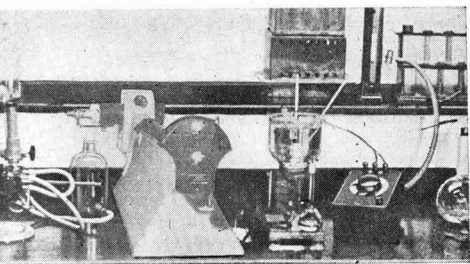
Kinetics of massecuite electrical resistance change during sucrose crystallization. V. I. TUZHILKIN, V. V. YAROSHEVICH and I. N. KAGANOV. *Izv. Vuzov, Pishch. Tekh.*, 1974, (2), 146-147.—Investigations showed that electrical resistance during massecuite boiling is not so much governed by sugar transfer from solution to crystalline state as by the change in composition of the mother-liquor (particularly the reduction in its concentration and viscosity) which accompanies crystal formation. However, this does not mean that formation of crystals (which, as is well known, are non-conductive) does not affect massecuite resistance to a certain extent.

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Study on the possibility of storing thick juice of low purity. L. BOZHKOV. *Nauch. Trud., Vissch. Inst. Khraanit. Vkus. Prom.*, 1971, 18, 289-296; through *S.I.A.*, 1974, 36, Abs. 74-754.—Ten 10-litre samples of thick juice at 63.7 or 68.5°Bx, 90 purity, taken from Kolarov factory, Plovdiv, Bulgaria, on 15th October 1970, were stored at 14-20°C for 6 months, uncovered or covered with 1.5 mm naphtha or paraffin, in glass, metal or plastic containers, with or without pH adjustment from 8.1 to 9.5 by NaOH; analyses were performed after each month for purity *Q*, colour *C*, reducing sugars content *i* and pH, and every 2 months for ash and Ca salts contents, which showed only small changes. Final values of all these parameters are tabulated, and graphs against time for two samples show that whereas *Q* decreased at almost constant rate, deterioration of *C*, *i* and pH became much faster after about 3 months. Since purity and pH values were better with plastic or glass containers than with metal ones, metal storage tanks should be coated with epoxy resin or varnish; with paraffin, most parameters were inferior to those with naphtha. Increasing the initial pH had beneficial effects, particularly on *C* and *i*. High Brix is desirable, but the juice must never become supersaturated during storage. Possible changes in the manufacturing process are suggested for dealing with low-purity juices.

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Beet tail processing in sugar factories. S. DUŠEK and J. DYNŤAR. *Listy Cukr.*, 1974, 90, 102-111.—A survey is given of processes and equipment for sugar extraction from beet tails, and a description is given of the system used at Opava.



Laboratory methods & Chemical reports

The theory of sugar crystallization. V. M. KHARIN. *Izv. Vuzov, Pishch. Tekh.*, 1974, (2), 89-94.—Equations are developed for calculation of the crystallization rate in massecuite boiling and cooling based on the theory of regularly available interfaces in relation to diffusion during free movement in the mother liquor.

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Comparative assessment of the technological value of sugar beet on the basis of analysis of press and diffusion juice. I. VAVRA, L. PETROV and R. MILETIC. *Tehnika*, 1973, 28, 553-556; through *S.I.A.*, 1974, 36, Abs. 74-735.—Raw juice and clarified juice obtained by laboratory methods from beets from Sremska Mitrovica, Beograd, Osijek and Senta factories, Yugoslavia, during the 1969-70 and 1971-72 campaigns were analysed. The dry solids, sucrose, ash, calcium salts and reducing sugars contents, purity, pH and colour are tabulated. Raw juice obtained by pressing of brei, A, had a lower purity and reducing sugars and ash contents than that, B, obtained by extraction in a laboratory diffuser. The purity and colour of clarified juice A were greater than those of clarified juice B, while its calcium salts content was lower. The technological value of beet should be assessed from juices which are more like those obtained under factory conditions.

* * *

Comparative assessment of the technological value of fresh and wilted sugar beet. I. VAVRA, L. PETROV and R. MILETIC. *Tehnika*, 1973, 28, 763-766; through *S.I.A.*, 1974, 36, Abs. 74-736.—Raw juice and clarified juices obtained from fresh or wilted Yugoslavian beet during the 1970-71 campaign were analysed (see preceding abstract). Comparison of press juice and diffusion juice gave results qualitatively similar to those previously obtained, the colloids content of diffusion juice being lower than those of press juice; it is considered that assessment of the technological value of beet should be based on analysis of diffusion juice. The effects of the extent of wilting (% weight loss) on the composition of raw and clarified juices were studied; with increasing degree of wilt, the reducing sugars content increased, the colloids content decreased and the ash content remained almost constant. The calcium salts content and colour of clarified juice increased with increasing wilting.

* * *

Comparative assessment of the technological value of fresh and frozen sugar beet on the basis of analysis of juices obtained by pressing and diffusion. I. VAVRA, R. MILETIC and L. PETROV. *Tehnika*, 1973, 28, 959-962; through *S.I.A.*, 1974, 36, Abs. 74-737.—Raw juice extracted by pressing or diffusion from fresh, frozen or thawed Yugoslavian beet, and clarified juice obtained from it, were analysed and compared. With frozen beet, the purity of press juice was lower than that of diffusion juice, but after clarification the

reverse was true. The purities of diffusion juices from fresh and frozen beet did not differ significantly, but were greater than that of diffusion juice from thawed beet. The contents of reducing sugars, ash and colloids in raw beet juice were in the order: fresh beet < frozen beet < thawed beet. The calcium salts content and colour of clarified juice from thawed beet were greater than those of clarified juice from fresh or frozen beet.

* * *

Effect of temperature and sucrose concentration on effectiveness of action of the enzyme invertase in the preparation of sugar syrups. V. G. CHICHUA and G. G. MIKELADZE. *Ferment. Spirt. Prom.*, 1973, (6), 40-41; through *S.I.A.*, 1974, 36, Abs. 74-794.—55, 60 and 70% sucrose solutions were kept at 50, 60 or 70°C for 4 hr in the presence of 1% (on weight of sugar) invertase powder having an activity of 1100 units per g; samples were analysed hourly. The % sucrose decomposition is graphed against time: for 60 and 70% solutions, the extent of inversion increased with increasing temperature, but for 55% solutions it was greater at 60°C than at 70°C.

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The "purity loss" concept as a simple measure of process efficiency. T. T. OOMMEN. *Proc. 15th Congr. ISSCT*, 1974, 1224-1228.—See OOMMEN: *I.S.J.*, 1971, 73, 92; RAO: *ibid.*, 1973, 75, 185.

* * *

Sucrose habit modification and crystal growth. G. MANTOVANI, C. A. ACCORSI and G. VACCARI. *Proc. 15th Congr. ISSCT*, 1974, 1229-1235.—Single crystals of sucrose grown in a solution containing KCl (10 g per 100 g water) developed preferentially *d* faces, although the shape factor *K* was not affected. A linear relationship was established between *d* face development and percentage of the salt, which was found to be uniformly distributed throughout the sucrose crystal. Single sucrose crystals grown from a mixture of 60% affination sugar obtained in the barium saccharate process (baryta sugar) and 40% other sugars did not display elongation along the *b*-axis as found by other authors; although preferential development of some faces and elongation along the *a*-axis occurred, the *b:a* and *b:c* axial ratios were different from those observed for sucrose crystallization in the presence of raffinose. Possible reasons are suggested for the absence of *b*-axis elongation, but further tests are to be conducted in order to establish the mechanism of the non-sugar involved.

* * *

A new exhaustibility relationship for Hawaiian fina molasses. T. MORITSUGU, B. J. SOMERA and G. E. SLOANE. *Proc. 15th Congr. ISSCT*, 1974, 1236-1245. Empirical formulae have been established for calculation of molasses exhaustibility: $Y_c = 33.160 -$

$$4.028 \left(\frac{RS}{Ash} \right) + 0.161 \text{ (refractometer sucrose purity),}$$

where the ash is the total carbonate ash, and $Y_c =$

$$33.253 - 5.351 \left(\frac{RS \% \text{ Ref. Sol.}}{\text{Cond. Ash}} \right) + 0.134 \text{ (refractometer sucrose purity),}$$

where the conductimetric ash (Cond. Ash) is $1000 \times$ conductivity determined at 28% refractometer solids. Y_c is the expected purity of final molasses at 600 poises and 50°C, $RS =$ reducing substances and $\text{Ref. Sol.} =$ refractometer solids. Correlation coefficients for both formulae are higher and the standard errors lower than for formulae derived earlier by the HSPA.

* * *

Observations on the occurrence and nature of polysaccharides in sugar canes. P. HIDI, J. S. KENIRY, V. C. MAHONEY and N. H. PATON. *Proc. 15th Congr. ISSCT, 1974, 1255-1265.*—A description is given of the modification of the NICHOLSON & HORSLEY method for determining dextran in cane juice and raw sugar¹ which is used in Australia for routine purposes, and measurements of dextran over a 5-year period at 11 factories in Australia and Fiji are presented. (See also RICHARDS & STOKIE: *I.S.J.*, 1974, 76, 103-107.)

* * *

Cane juice alpha amylase. G. E. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Proc. 15th Congr. ISSCT, 1974, 1266-1276.*—The properties of partially purified α -amylase extracted from cane juice were studied and the activity of the enzyme in the more important cane varieties grown in Egypt were determined. Maximum activity occurred at pH 5.5-6.0 and 60°C, after which it fell, although even prolonged exposure to 60°C (e.g. 20 minutes compared with 10 minutes) caused a fall in activity in terms of starch hydrolysis. Activity also increased with substrate concentration or enzyme concentration to a maximum, after which it stayed constant. Concentration of the enzyme was greater in the top part of mature cane than in the lower parts; cane of the highest amylase activity exhibited the greatest difference between the concentrations in the parts of the stalk, and *vice versa*. Amylase activity generally increased in harvested cane, and the starch content of the juice fell with time after cutting.

* * *

Further studies on enzymic hydrolysis of dextran in mill juices by dextranase and fungal α -amylase. R. H. TILBURY and S. M. FRENCH. *Proc. 15th Congr. ISSCT, 1974, 1277-1287.*—Mixed juice samples from sugar factories in Puerto Rico and Jamaica were used in studies of dextranase activity. Values of initial enzyme velocity V , mean substrate concentrations (expressed as dextran % juice w/v) and kinetic constants V_{max} and K_M indicated differences in the nature of the substrates between the two countries, suggesting that each location for dextranase treatment should be considered individually. In both cases V was dependent on substrate concentration. Fungal α -amylase exhibited little activity in hydrolysis of "dextrans" in Puerto Rican juices, while in Jamaican juices its mean activity was about 60% of dextranase activity at similar enzyme concentrations, from which it is concluded that so-called "dextran" determined by haze analysis was a variable and heterogeneous mixture of poly-

saccharides. Mixtures of dextranase and fungal α -amylase showed additive rather than synergistic effects, and no economic advantages would accrue from use of mixtures of the two enzymes. From experimental data it is calculated that 6-7 units of dextranase per 100 ml juice would be needed to hydrolyse two-thirds of the dextran in mixed juice containing moderate-to-high levels of dextran; for hydrolysis, 20 minutes at 50°C would be required. Treatment costs are estimated.

* * *

Notes on cane starch and its determination. E. C. VIGNES. *Proc. 15th Congr. ISSCT, 1974, 1288-1295.* The physico-chemical properties of cane starch are compared with those of other common starches and some photomicrographs reproduced of cane starch granules. Because of wide differences between starch contents of raw sugar as published in the literature, the author recommends searching for a better method than those used at present.

* * *

Filtering quality of raw sugar: mechanism of starch influence in carbonatation. J. P. MURRAY, F. M. RUNGAS and M. VANIS. *Proc. 15th Congr. ISSCT, 1974, 1296-1306.*—In a study of the adverse effect of starch on raw sugar filtrability, analysis of the mechanism of the starch-carbonatation interaction revealed that starch does not perform as a single entity but rather in the form of its two major components, amylopectin and amylose, the latter having by far the greater effect on filtrability. The behaviour of both components in carbonatation is examined.

* * *

Raw sugar quality. F. H. C. KELLY. *Proc. 15th Congr. ISSCT, 1974, 1307-1317.*—Thirteen criteria listed for raw sugar quality are discussed individually, viz. pol, moisture content, total impurities content, concentration of specific impurity groups, concentration of specific impurity components, total crystal colour, colour distribution within the crystal, concentrated colour inclusions, average crystal size, crystal size uniformity, crystal shape, absence of conglomerates and filtrability. The question of updating certain analytical practices, particularly with regard to the pol:sucrose ratio, is examined and refining costs are briefly discussed.

* * *

Automated determination of chloride and phosphate in cane juice, molasses and sugar. W. C. CHENG, H. I. SHIUE and H. T. CHENG. *Proc. 15th Congr. ISSCT, 1974, 1372-1379.*—A method is described which is based on formation of a colour complex, ferric chlorothiocyanate, from ferric ammonium sulphate (in nitric acid) and mercuric thiocyanate in the presence of Cl^- ; the colour is measured at 480 nm. For phosphate determination, the method used is based on formation of an ascorbic acid-molybdate-phosphate complex, the colour of which is measured at 719 nm. Application of a Technicon "Auto-Analyzer" has given results for chloride having a standard deviation of 2.3 ppm and a coefficient of variation of 0.99% in the measuring range 0-800 ppm, while for phosphate the standard deviation was 0.305-0.869 ppm at a C.V. of 0.34-0.63% over a measuring range below 15 ppm.

¹ KENIRY *et al.*: *I.S.J.*, 1969, 71, 230-233.

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Quantitative gas chromatography of carbohydrates in cane molasses. K. J. SCHÄFFLER and C. LOKER. *Proc. 15th Congr. ISSCT, 1974, 1380-1387.*—A gas chromatographic method for the separation of fructose, glucose and sucrose in cane molasses is described in which inositol was used as internal standard for fructose and glucose, and trehalose for sucrose determination. Drying is not necessary, and the molasses sample can be silylated directly, the sugars being separated by a single temperature-programmed procedure. Comparison of results for sucrose with values obtained by the LANE & EYNON method showed a mean difference of 2.5% absolute, the gas chromatographic values being lower. (Isotope dilution analysis showed that the LANE & EYNON method overestimated the sucrose content.) Comparison of the glucose and fructose values revealed a mean difference between the two methods of 2.7% absolute.

* * *

Infra-red spectrophotometric characteristics of caramels and melanoidins. S. K. D. AGARWAL, P. C. JOHARY and D. S. MISRA. *Proc. 15th Congr. ISSCT, 1974, 1388-1392.*—Characteristics of the infra-red spectra of caramel prepared by direct heating of sugar and by reacting glucose with alkali and of melanoidin prepared from glucose and glycine after dialysis are discussed.

* * *

The role of high and low molecular weight colorants in sugar colour. J. C. TU, A. KONDO and G. E. SLOANE. *Proc. 15th Congr. ISSCT, 1974, 1393-1401.*—The work reported earlier¹ has been continued to determine changes taking place in the levels of high and low molecular colorants during raw sugar manufacture. While correlations, of greater or lesser significance, have been established between sugar crystal colour and the level of high molecular weight colorants in syrup and crystals, only poor correlation has been found between low M.W. colorants and crystal colour; a preferential inclusion of high M.W. colorants in the crystal during boiling has been indicated.

* * *

Chemical and physical properties of coloured degradation products of sugars. J. C. WILLIAMS. *Proc. 15th Congr. ISSCT, 1974, 1402-1411.*—Investigations involving molecular weight determination of colorant fractions by vapour pressure osmometry and by gel permeation on a column of "Sephadex G50" showed that the latter method is suitably accurate. Colorants obtained from reducing sugars degradation were found to be carboxylic acids, so that fractionation by ion exchange chromatography on a DAE-cellulose column was possible. Results indicated that the molecular weight of colorants tended to increase with increase in the net molecular charge, although there was a spread of molecular weights within each group of colorants of the same net charge. Application of the findings to refining processes such as the "Talo-floc" processes and membrane techniques such as reverse osmosis is briefly demonstrated.

* * *

The development of colour in stored raw sugar. R. SAMANIEGO and S. SOLAIMAN. *Proc. 15th Congr. ISSCT, 1974, 1412-1425.*—Examination of possible causes of raw sugar browning during storage at 40°, 60° and 70°C showed that increase in colour intensity was greatest at pH values in the range 4-10, the rapid

rise with increase in pH in this range being associated with caramels rather than melanoidins, the colour intensity of which remained almost constant over pH 4-11. Spectra in the ultraviolet region tended to form a peak between 260 and 280 nm, while spectra of caramel, heated raw sugar and deteriorated sugar exhibited peaks at 430 nm and 280 nm. Maximum increase in raw sugar colour occurred at 40°C (46% compared with 15.4% at 60°C), while the increase at 70°C was almost the same as at 40°C. On the other hand, the sugar was exposed to 40°C for 2 months and to the other two temperatures for only 8 days. The coloration is attributed to interaction between caramelization products; possible ways of avoiding the problem are briefly discussed.

* * *

Proposal for the evaluation of cane and sugar in identical units at standardized factory efficiency. A. VAN HENGEL. *Proc. 15th Congr. ISSCT, 1974, 1446-1455.* A simple formula is derived for evaluating cane in terms of sugar recovery, and the merits of the formula as regards incentives to cane growers and processors are assessed. The formula takes the form: $C = aS - bN - cF$, where $C = \%$ pure crystallizable pol in cane, $S = \%$ pol in cane, $N = \%$ non-pol in cane, $F = \%$ fibre in cane, $a =$ unit fraction of recovery of pol in sugar, molasses and bagasse combined, $b =$ pol loss in molasses per unit of non-pol in cane, and $c =$ pol loss in bagasse per unit of fibre in cane. Calculations involved are based largely on South African conditions.

* * *

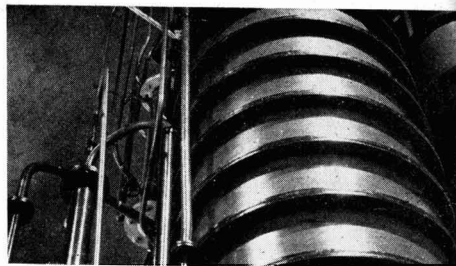
The application of direct cane testing to the South African sugar industry. E. J. BUCHANAN and M. A. BROKENSHA. *Proc. 15th Congr. ISSCT, 1974, 1456-1469.*—The system of direct cane sampling and analysis adopted by South African sugar factories is described in detail. The sample, averaging 60 kg, passes through a sliding hatch sampler or a bifurcated hatch sampler at the head of the cane elevator at the point where the shredded cane falls by gravity into the feed chute to the 1st mill. The sample, which represents a full carrier width, is conveyed through a closed transverse screw conveyor to a prebreaker. The system also includes a two-stage sub-sampler; the final sample size is about 1.5 kg. Analytical precision is high and the mechanical efficiency of the equipment is excellent provided routine maintenance is carried out.

* * *

A survey of the use of computers in the processing of cane testing data in South Africa. J. C. WILLIAMS. *Proc. 15th Congr. ISSCT, 1974, 1470-1474.*—The computerized system used for central data processing, transmitting and recording in South Africa is briefly described. Input includes all data referring to cane consignments and analyses, as well as quota allocation and land ownership and usage, while provision is also made for logging data sent by individual farmers on such items as soil type and analysis, rainfall, fertilizer usage, time of planting, etc. Data are transmitted to the cane testing laboratories, individual sugar companies and to the Central Cane Board.

¹ *I.S.J.*, 1974, 76, 3-6.

By-products



Possibility of getting higher yields of fodder yeast from vinasse. A. G. ZABRODSKII, A. N. OSOVIK, E. A. POLYANSKAYA and E. STRIZHENYUK. *Ferment. Spirt. Prom.*, 1973, (1), 40-43; through *S.I.A.*, 1974, 36, Abs. 74-772.—Theoretical and practical yields of fodder yeast from vinasse are discussed, and tests performed at Luzhansk experimental alcohol distillery in 1971 are reported with tabulated results. In the recommended method, yeast is grown on undiluted vinasse at 8-9°Bx, with addition of urea, H_3PO_4 , HCl and antifoam, at pH 3.3-3.5, 32-35°C, in two stages lasting 6 and 8-10 hr; 5-10% of the vinasse is fed to the second stage which has a central air supply fed a total of 55 volumes of air. The yield from vinasse from 1 m³ alcohol was about 280 kg, compared with about 250 kg by a single-stage process; it consisted of 55-65% fodder yeast, 15-25% saccharomycetes and about 20% dried-out vinasse solids.

* * *

Suitability of bagasse for dissolving-grade pulp. I. R. P. YADAV, S. S. SHEKHAWAT and A. K. JAYASANKAR. *Indian Pulp Paper*, 1972, 27, (3-4), 47, 49, 51, 53-55; through *S.I.A.*, 1974, 36, Abs. 74-785.—The effects of various factors in the prehydrolysis and kraft pulping of bagasse on the yield and quality of pulp obtained were studied. The depithed bagasse: water ratios tested for prehydrolysis were 1:1, 1:2, 1:3, 1:3.5, 1:6 and 1:10; the optimum ratio was 1:3.5. The effects of the prehydrolysis factor "P", the "H" factor and the active alkali charge (14.0, 14.5, 15.0 or 15.5% as Na_2O) were also investigated. The bleaching conditions and the characteristics of bleached pulp produced under optimum conditions are presented; the yield was 32.5%. It is concluded that bagasse is a suitable raw material for dissolving-grade pulp.

* * *

Utilization of bagasse: a by-product of (the) sugar industry. A case for establishing a few pulp units in UP. S. K. MITTAL and D. NARAYAN. *Indian Pulp Paper*, 1972, 27, (5-6), 3-5, 7-8; through *S.I.A.*, 1974, 36, Abs. 74-786.—A brief technical and economic survey of the production of pulp and paper from bagasse is given, with particular reference to Uttar Pradesh. The main technical aspects mentioned are the fermentation of bagasse during storage and the depithing of bagasse. A world list of chemical bagasse pulp and paper plants and a list of cane sugar factories in Uttar Pradesh are included.

* * *

The soybean-bagasse board. J. LÓPEZ H. *Proc. 15th Congr. ISSCT*, 1974, 1771-1781.—The use of soybean glue as a binder in the production of bagasse board is described. It is stated that the soybean-bagasse board approaches nearer to wood in appearance and behaviour than does resin-bonded bagasse board. Details are given of the manufacturing processes used

in experiments, and economic aspects of both types of bagasse board production are compared.

* * *

World market potential for bleached bagasse pulp—a technical review. E. J. VILLAVICENCIO. *Proc. 15th Congr. ISSCT*, 1974, 1782-1792.—Bagasse fibre physical composition is briefly discussed and its cellulose, hemicellulose and lignin contents compared with those of a number of hardwoods. Analyses and cooking of bagasse from different sugar cane varieties are tabulated and comparative evaluation made of soda, kraft and alkaline sulphite cooks of bagasse fibre. Bagasse bleaching methods and the resultant pulp properties (including brightness) are discussed, and the physical characteristics of bleached bagasse pulp finally compared with those of bleached hardwood kraft pulp.

* * *

Wet bulk storage of bagasse. R. MORGAN, J. BRUIJN, C. GONIN and L. MCMASTER. *Proc. 15th Congr. ISSCT*, 1974, 1793-1820.—Investigations into bulk storage of wet bagasse are reported in detail. Three different methods of bagasse treatment were compared: (1) the Ritter system¹ involving treatment of the bagasse with a biological liquor comprising mainly lactic acid bacteria, (2) treatment with backwater (a composite of flow streams surplus to internal factory requirements), and (3) addition of organic acids such as formic and sulphuric acids. Within the anaerobic section of the storage pile, no cellulose-digesting bacteria were identified and no lactic acid-producing bacteria were present; even that lactic acid present in the Ritter solution could not be found in the bagasse pile. It was thus concluded that the wet bulk storage process is controlled by a fall in pH resulting from the presence of volatile organic acids, particularly acetic and butyric acids². Organic acid contents were found to be very similar, and the nature of the liquid used for bagasse conditioning did not appear to be significant, while it was found to be more important that the pile be of adequate size to minimize undesirable surface effects and maintain the highest possible proportion of bagasse in an anaerobic state. The backwater and organic acid treatments caused increase in the cellulose and lignin contents and a decrease in alkaline solubility with time; it is suggested that this was due to the fact that material, other than the residual sugars in bagasse, was lost during storage through acid hydrolysis of the pentosan fraction. (That no decrease in the pentosan content was observed was attributed to an insufficiently sensitive laboratory determination method.) The Ritter method was found to be better than the other two treatments as regards pulp physical strength, wetness and chemicals consumption.

¹ PATURAU: "By-products of the cane sugar industry" (Elsevier Amsterdam), 1969, pp. 36-38.

² *I.S.J.*, 1975, 77, 30.

Commission Internationale Technique de Sucrierie

15th General Assembly, 1975

BY kind invitation of the Verband der Zuckerindustrie Oesterreichs the 15th General Assembly of the CITS will be held in Vienna from Monday, 12th May to Friday, 16th May 1975. The meeting will take place in the Wiener Kongresszentrum of the Hofburg.

The themes of priority for the conference are:

1. The principles of the extraction of beets, and
2. The behaviour of non-sucrose substances in the sugar manufacturing process.

At the present time, 40 papers have been accepted for presentation during the three working days. Most of these papers originate from the main sugar institutes at Bratislava, Braunschweig, Budapest, Ferrara, Kanpur, Kiev, Lille, Moscow and Vienna, as well as from several research laboratories and sugar companies, including British Sugar Corporation Ltd., Centrale Suiker Mij., Raffinerie Tirllemontoise S.A., Süddeutsche Zucker A.G. and Tate & Lyle Ltd.

The programme of the meeting is as follows:

Monday, 12th May

1.00–6.00 p.m.: Registration and collection of conference documents at the Kongresszentrum Wiener Hofburg (Schweizerhof, Zugang Bot-schafterstiege).

6.00 p.m.: Welcoming cocktail party by the Austrian Society of the Sugar Industry at the Palais Schwarzenberg, Wien 3, Schwarzenbergplatz 9.

Tuesday, 13th May

8.00–9.00 a.m.: Registration.

9.00–12.00 a.m. and 2.00–5.00 p.m.: Working session in the Kongresszentrum Wiener Hofburg, Zemon-tiensaal.

Evening: Opera: "Tales of Hoffmann" by Jaques Offenbach.

Wednesday, 14th May

9.00–12.00 a.m. and 2.00–5.00 p.m.: Working session.

Thursday, 15th May

9.00–12.00 a.m. and 2.00–5.00 p.m.: Working session.

8.00 p.m.: Banquet in Palais Pallavicini, Wien 1, Josefplatz, by invitation of the Austran Sugar Industry.

Friday, 16th May

10.00 a.m.–3 p.m. Visit to the Sugar Research Institute or to Tulln sugar factory.

3.30–11 p.m.: Excursion to Burgenland, Eisenstadt, Rust, Neusiedler See.

UK–Mexico sugar trade agreement.—Negotiations have started for the purchase by the UK of 200,000 tons of Mexican sugar and 200,000 tons of molasses. This was announced during the recent Royal visit to Mexico during which the royal yacht "Britannia" was made available to British and Mexican businessmen for trade talks. A spokesman of UNPASA, the Mexican producers' organization, stated that the deal would involve some \$100 million.

* * *

Central American sugar expansion¹.—Guatemala, Honduras and Belize are planning to increase sugar production, according to the US Department of Agriculture Foreign Agriculture Service. Guatemala, with an output of 358,650 short tons in

Brevities

1974, is aiming to raise production by 10% a year for the foreseeable future. Its 1973/74 crop was enough to meet domestic requirements, the 1974 US quota and 70,000 short tons to other markets. Honduras' 1973/74 output, at 80,000 short tons, fell short of the 100,000 tons target although the figure showed a rise on last year of 23%. Hurricane Fifi last September, although not as damaging to sugar as to other crops, was expected to hold back production to 85,000 tons in 1974/75 but, after this season, there should be plenty for export. Belize's sugar output for 1973/74 was 102,000 short tons, against 78,500 tons in the previous season. A 9% increase in production is envisaged between 1974 and 1977.

* * *

Pakistan sugar expansion².—The first of a series of commodity policy studies sponsored by the UN Development Programme includes a forecast that domestic consumption of white sugar in Pakistan will rise to one million tons by 1980/81 while demand for open-pan sugar will increase to 1.5 million tons. To cover the increased domestic demand for sugar, assuming no improvement in the sucrose content, about 31 million tons of cane would be required by 1980/81, representing a 37% increase over the average production of 22,800,000 tons of cane per year obtained between 1969/70 and 1971/72. If cane yields remain constant at approximately 15 tons per acre, the area under cane will need to be expanded from the present average of 1,450,000 acres to 2,000,000 acres by 1980/81. Besides major improvements in cane yields, an increase in the sucrose content of cane and product recovery, and the appropriate expansion of the factory sector for making white sugar are imperative to satisfy the future demand for sugar in Pakistan.

* * *

Record Mexican sugar production³.—Mexican centrifugal sugar output reached a record in 1973/74 of 2,835,000 metric tons, raw value, 2% more than in the previous season, according to USDA reports from Mexico City. 1974/75 production is forecast at 2.9 million tons, raw value. All exports of sugar went to the US under quota and are estimated at 500,000 tons; exports from the 1974/75 crop could reach 600,000 tons. Domestic consumption in Mexico in 1973/74 reached a new record of 2,285,000 tons, up 5% from the previous season. For 1974/75 consumption is again forecast to rise by 5%.

* * *

French sugar production expansion⁴.—French sugar producers are of the opinion that it will be possible to expand French sugar production to 5–5.5 million tons annually within a reasonable time. French sugar production is presently around 3 million tons, raw value, and it is apparently planned to increase production within two or three years to 4 million tons. The French sugar beet area of about 500,000 hectares represents only 3% of the overall arable land in France and, according to agricultural sources, this percentage could be increased to 4 or 5% without any difficulty. The sources pointed out that the present area under sugar beet is large enough to produce 4–4.5 million tons of sugar per year.

* * *

Thai sugar export association⁵.—Some 22 privately-owned sugar factories are reported to be in the process of organizing themselves into a new sugar exporting company for the purpose of handling their own exports, thus by-passing the Thailand Sugar Corporation, a semi-government organization. These millers represent 60% of the total productive capacity. A quantity of 40,000–50,000 tons of sugar is reported to have been offered to Kuwait for a barter deal against Kuwait crude oil. Any deal of this nature is unlikely to take place in the short term as there are only about 10,000 tons available in the country and for two months the government has allowed no exports of sugar because of domestic shortages.

¹ *Public Ledger*, 4th January 1975.

² *Commodities Bull.*, 13th December 1974.

³ *Public Ledger*, 4th January 1975.

⁴ F. O. Licht, *International Sugar Rpt.*, 1975, 107, (1), 6.

⁵ *Standard and Chartered Review*, January 1975, 33.

UK sugar imports and exports, 1974

	1974	1973	1972
	(long tons, <i>tel quel</i>)		
<i>Imports</i>			
Australia	351,757	315,209	450,560
Barbados	49,347	110,126	99,283
Belize	28,936	20,445	25,302
Fiji	134,786	114,331	139,858
Guyana	150,765	182,444	216,058
India	25,234	25,148	25,011
Jamaica	135,925	258,786	231,758
Malawi	2,112	0	0
Mauritius	412,048	277,744	413,336
Swaziland	87,291	72,236	86,914
Trinidad	68,624	129,791	151,940
West Indies—St. Kitts	14,978	14,798	15,602
Other Commonwealth	1,254	41	8
Total Commonwealth	1,463,057	1,621,099	1,855,630

Argentina	64,674	40,027	0
Belgium	52,188	11,888	11,360
Brazil	153,958	73,974	18,362
Costa Rica	0	5,200	0
Cuba	66,758	126,176	40,474
Czechoslovakia	0	2,005	27,208
Denmark	61,717	0	3,923
Dominican Republic	32,297	40,637	29,840
Finland	60	0	17,410
France	114,806	47,719	3,170
Germany, East	938	9	148
Germany, West	110,117	43	20
Guatemala	20,427	33,814	10,892
Holland	12,553	1,788	14,835
Ireland	12,546	10,535	10,179
Mozambique	7,874	0	12,696
Norway	19	15	4
Poland	5,009	0	492
Salvador	0	0	11,520
South Africa	22,991	4	18,205
Spain	150	0	0
Sweden	391	1	2,489
Switzerland	545	15	10
USA	126	30	402
Venezuela	0	0	24,764
Other countries	280	764	2
Total imports	2,203,481	2,015,743	2,114,035

<i>Exports</i>			
Algeria	14,218	20,126	35,484
Azores	0	2,032	0
Bahamas/Turks & Caicos Is.	2,412	296	1,160
Bahrain	722	118	59
Barbados	263	131	208
Belgium/Luxembourg	252	76	57
Belize	110	174	685
Bermuda	78	236	807
Cyprus	5,640	11,992	6,522
Egypt	5,905	31	4
French Pacific Territories	149	87	275
Germany, West	1,139	3,987	2,106
Ghana	659	730	499
Gibraltar	917	859	963
Greece	19,758	39,216	82
Holland	405	2,093	6,675
Hungary	25,432	0	0
Iceland	3,302	3,045	4,684
Iran	705	536	369
Ireland	2,167	8,061	5,240
Israel	32,097	20,193	10,080
Ivory Coast	1,550	0	3
Jamaica	1	372	4,350
Kenya	22,026	42,632	31,505
Kuwait	172	671	150
Lebanon	668	915	654
Leeward Is.	2,566	771	2,518
Liberia	109	165	291
Libya	1	705	20
Madeira	0	0	935
Malta	1,452	236	1,268
Niger Republic	1,016	0	0
Nigeria	18,550	23,067	16,340
Norway	38,692	49,054	56,164
Oman	1,311	86	89
Portugal	1	6,413	10

	1974	1973	1972
	(long tons, <i>tel quel</i>)		
Saudi Arabia	2,576	254	1,126
Sierra Leone	1,873	1,968	2,499
Spain	18	2	2,393
Sudan	0	0	9,350
Sweden	3,064	288	320
Switzerland	49,245	58,521	38,830
Trinidad & Tobago	364	713	421
Trucial States	1,134	232	244
Tunisia	21,498	27,640	34,075
Turkey	10,380	15	0
USA	45	2,574	14,157
Windward Is.	2	602	3,073
Yugoslavia	0	9,601	0
Other countries	2,855	1,462	1,769
Total exports	297,499	342,978	298,513

Brevities

Ivory Coast sugar industry¹.—The Ferkessedougou sugar factory in the northern Ivory Coast has started production; the plant has an initial output capacity of 20,000 tons, rising to 60,000 tons for 1975/76 and 100,000 tons later. The Government intends to build four similar plants to produce 400,000–500,000 tons annually.

* * *

Philippines sugar production, 1974/75².—The Philippine Sugar Association has set production in the Philippines for 1974/75 at 2,849,000 short tons, *tel quel*. This compares with a revised final output for 1973/74 amounting to 2,695,993 tons.

* * *

New Egyptian sugar factory³.—A new sugar factory is to be built at Paliana in Upper Egypt which will eventually have a production capacity of 150,000 tons of sugar per year.

* * *

New Brazilian sugar factory⁴.—Usina Abraham Lincoln, installed 92 km from Altamira, in Amazonas, started operations in the first half of October 1974. The factory was erected in twelve months by Zanini S.A. Equipamentos Pesados for the Instituto Nacional de Colonização e Reforma Agrária (INCRA). It has a crushing capacity of 2000 tons per day and will produce white sugar for local consumption, eventually satisfying one-third of requirements.

* * *

Japan sugar consumption reduction urged⁵.—The Japanese Government has appealed to the nation to reduce sugar intake by 10%. Japan's annual consumption totals 3,000,000 tons, of which 80% is imported. A 10% cutback could slow prices down, and the Ministry of Agriculture has noted that makers of food containing sugar had already agreed to the appeal.

* * *

Bagasse paper project in Peru⁶.—The Peruvian Government, through the state enterprise Induperu, has contracted with two Mexican companies and one US company for the establishment of a bagasse newsprint plant to be in production by 1977 with an initial capacity of 30,000 tons per year, to be expanded to 112,000 tons per year in 1980.

* * *

Ecuador sugar expansion⁷.—According to a USDA report, six out of the seven sugar factories in Ecuador propose expansion of their processing capacities within the next few years. It is also proposed that at least one new sugar factory with an annual capacity of 50,000 tons should be erected. Up to now, however, the Government of Ecuador has given no incentive for setting up a factory of such a size.

¹ F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (36), 12.

² C. Czarnikow Ltd., *Sugar Review*, 1975, (1212), 2.

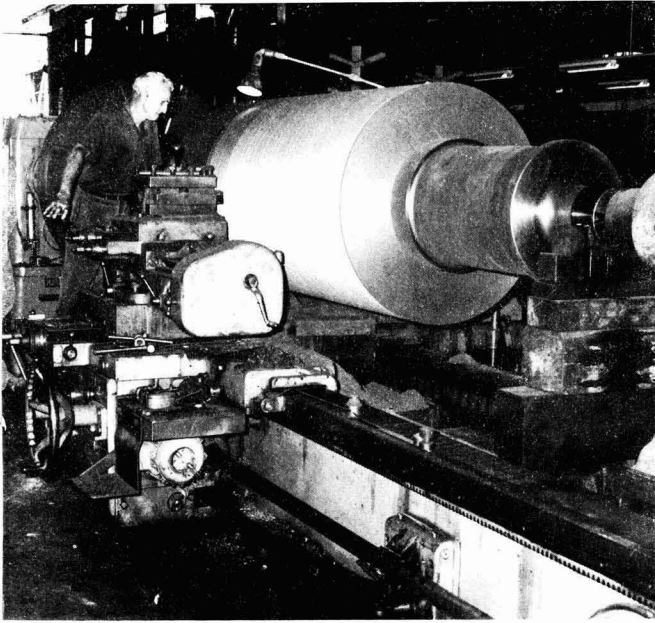
³ F. O. Licht, *International Sugar Rpt.*, 1974, **106**, (35), 12.

⁴ *Brasil Acuc.*, 1974, **84**, 326.

⁵ *Public Ledger*, 4th January 1975.

⁶ *Brasil Acuc.*, 1974, **84**, 323.

⁷ F. O. Licht, *International Sugar Rpt.*, 1975, **107**, (1), 9.



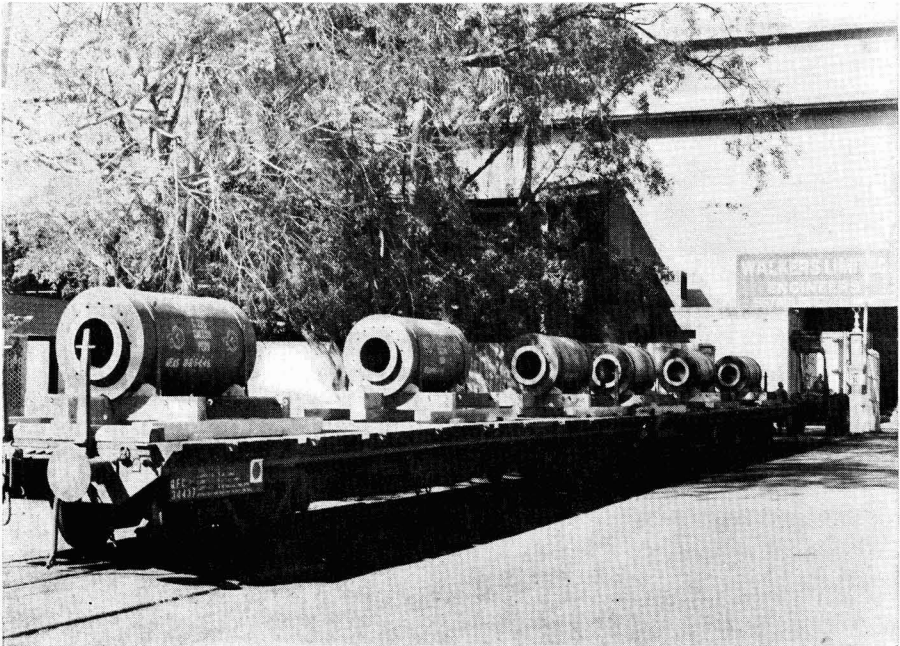
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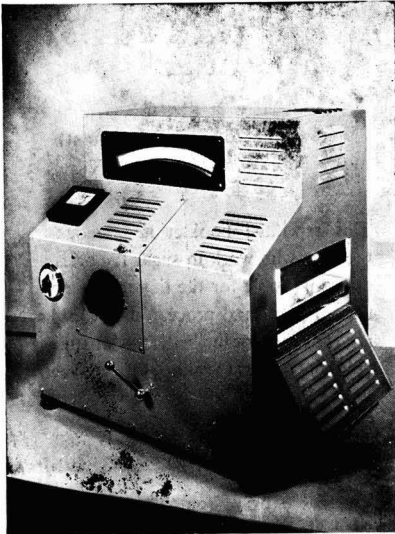


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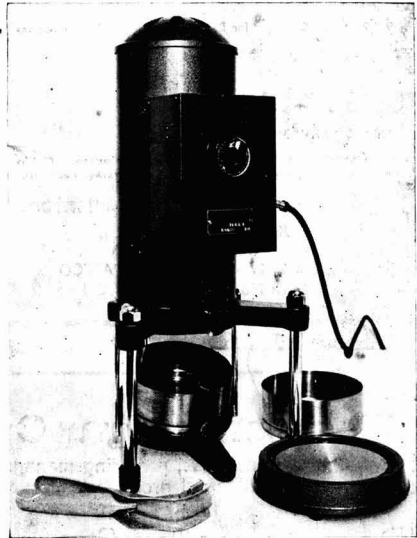
The scale range is graduated 0/100%, moisture and the maximum temperature of determination is 200°C controllable by a resistance knob.

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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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.

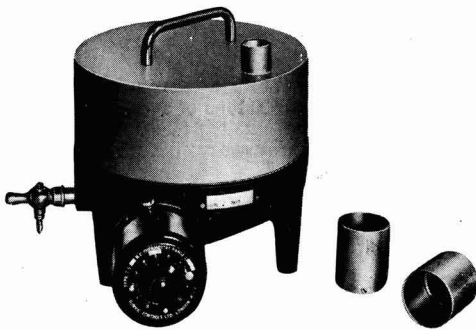
Four sample containers are provided to fit into recesses in the body of the oven, and two additional containers are provided as spares.

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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.

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