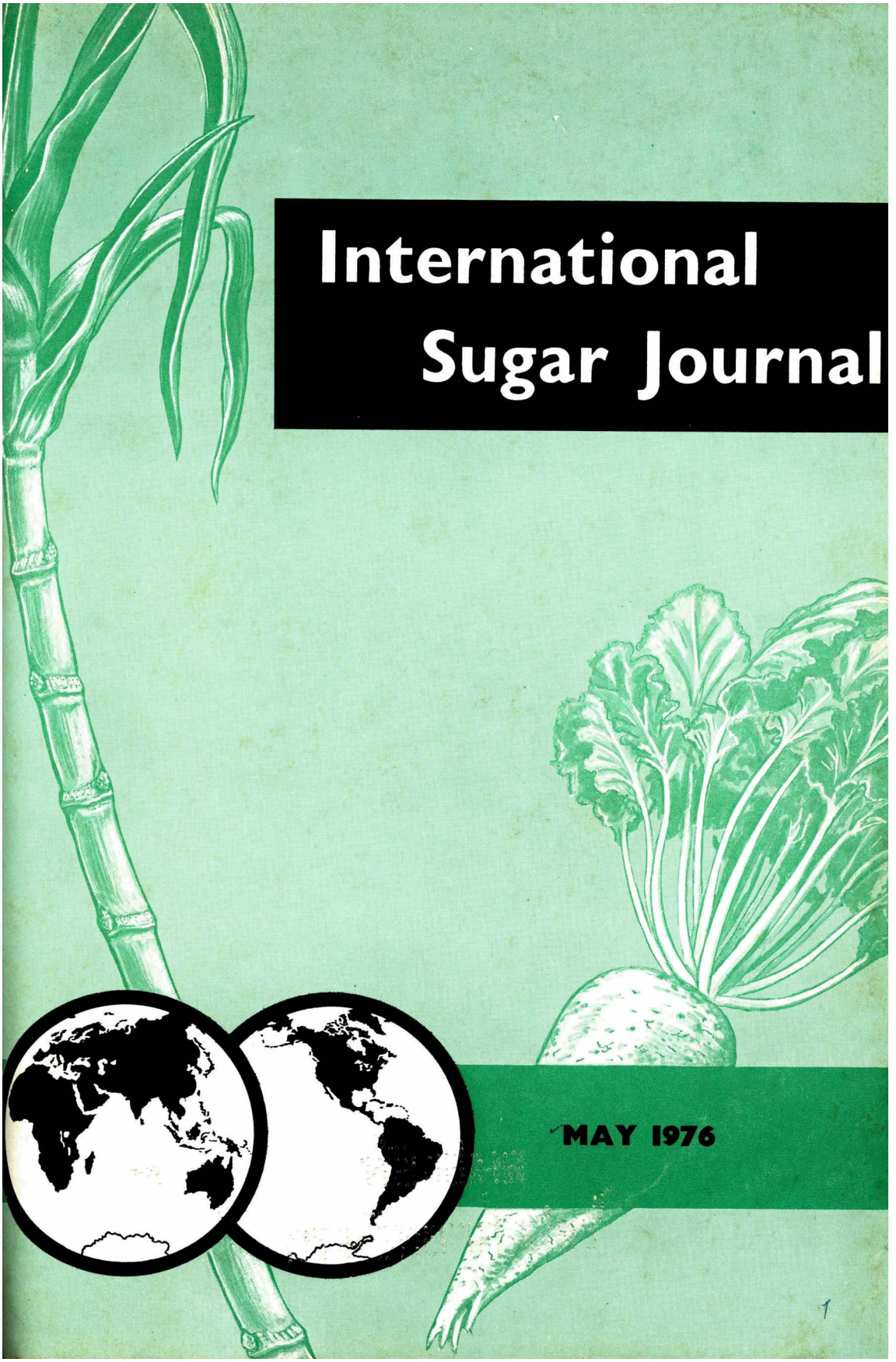
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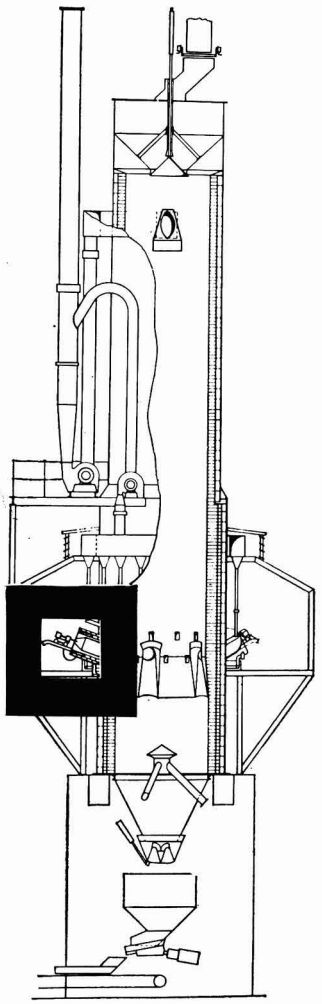

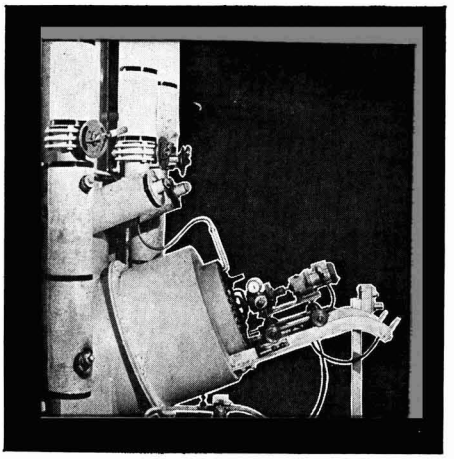

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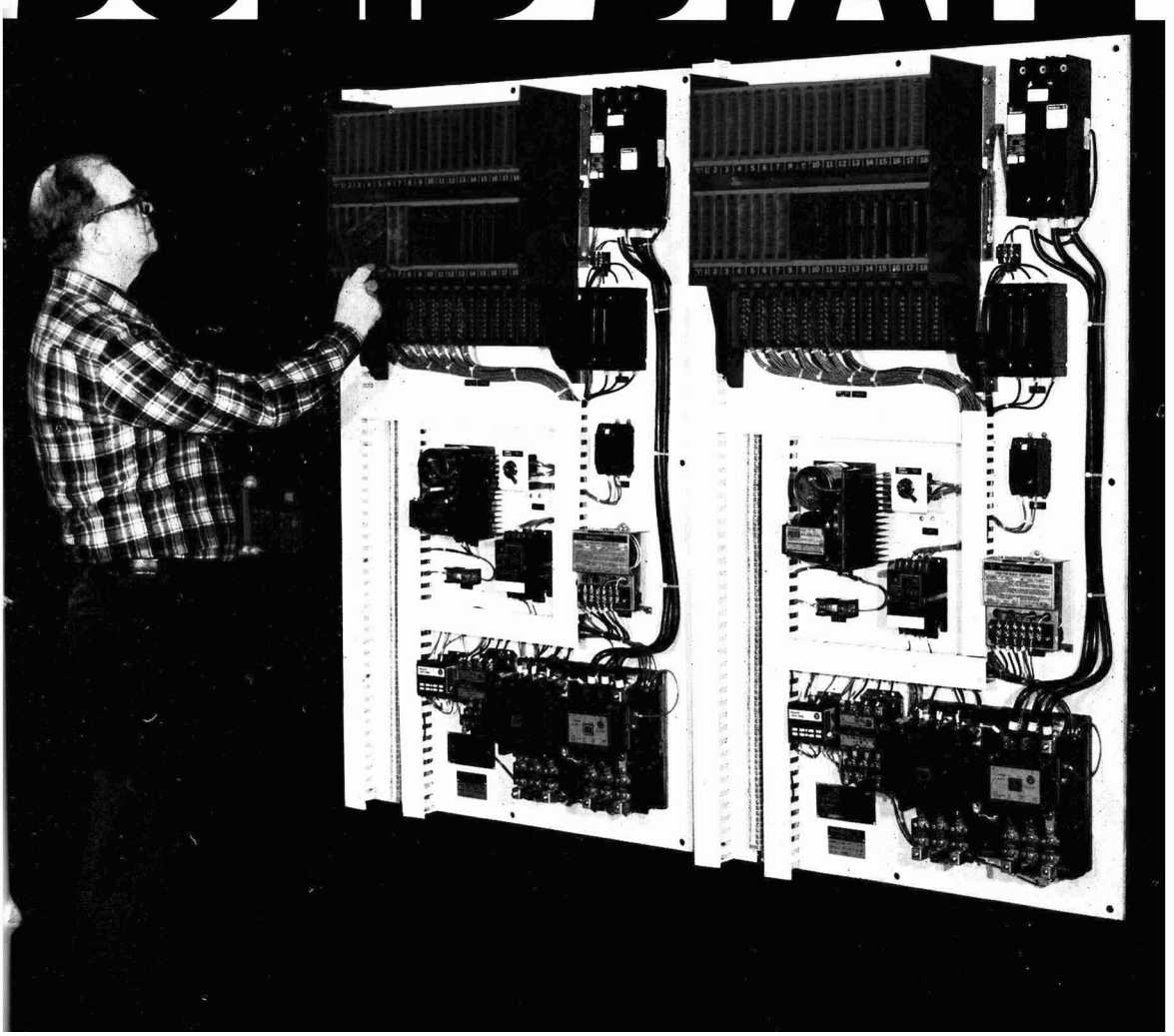

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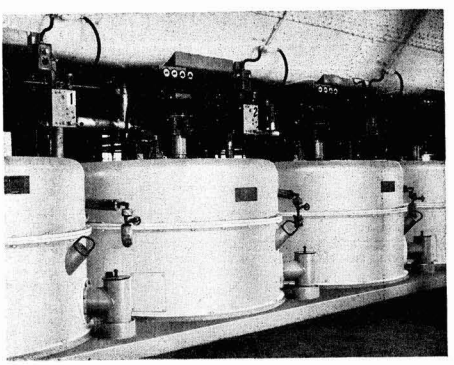

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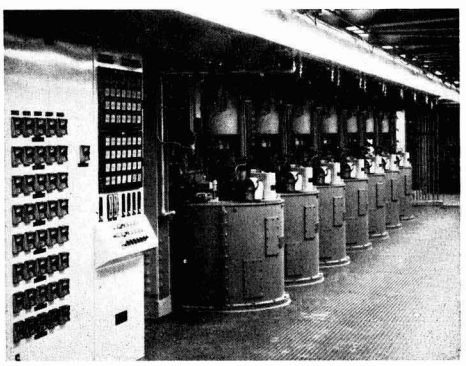

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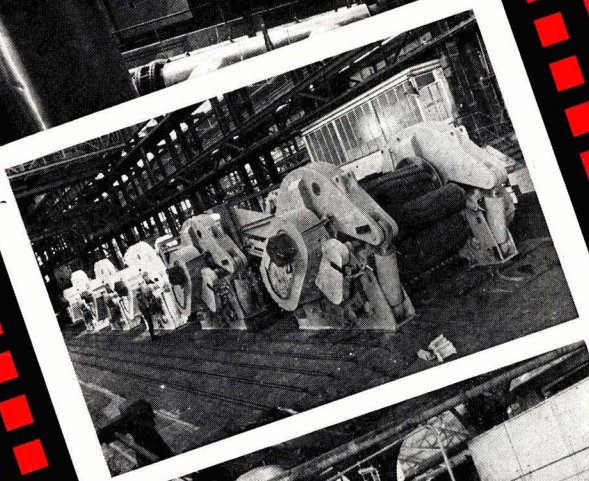

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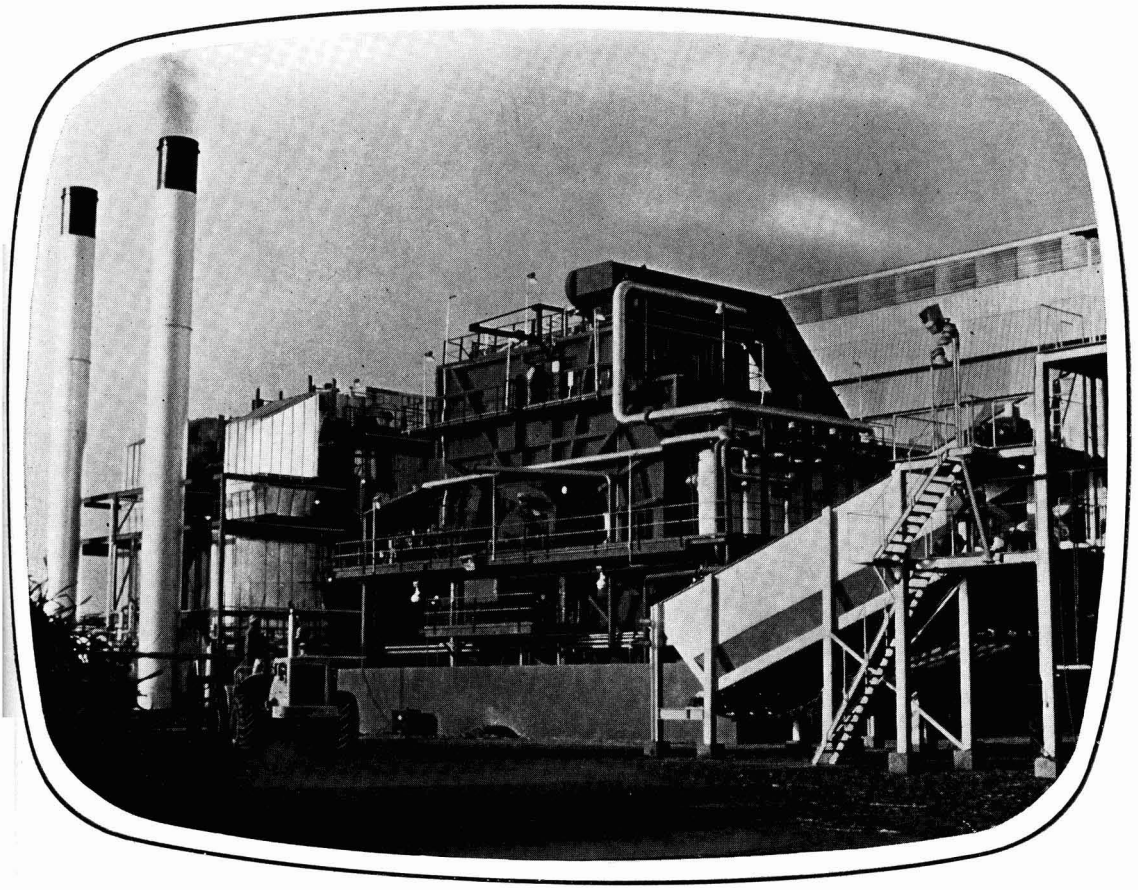

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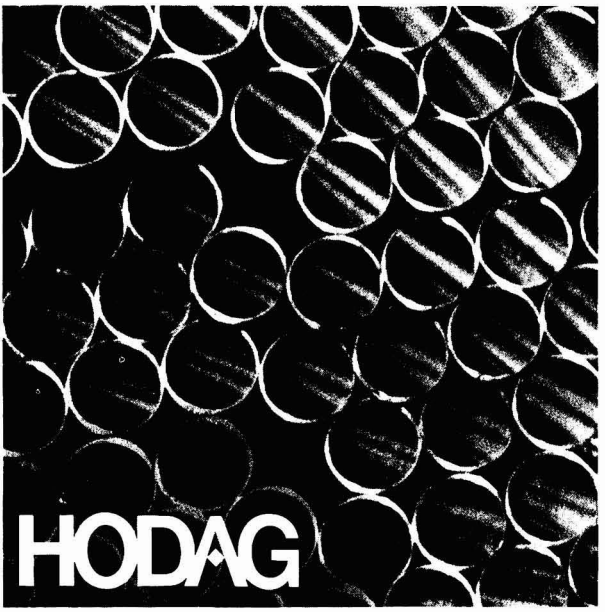

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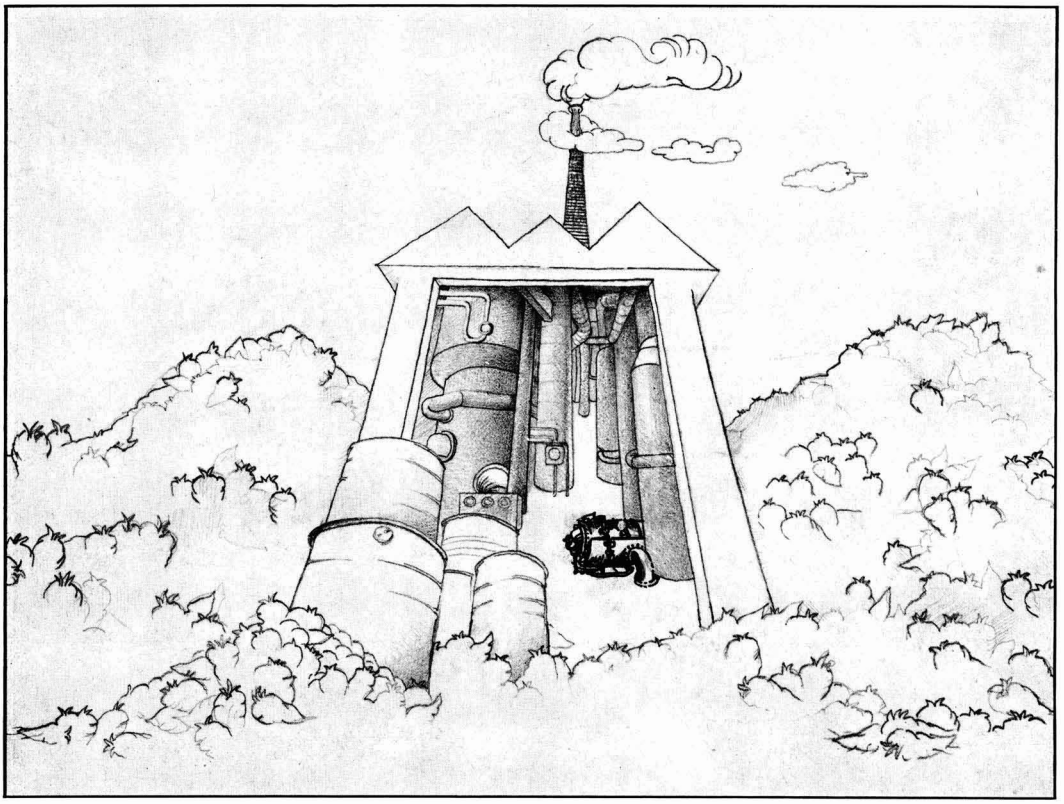

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Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Une étude des condensats et de leur apport dans les effluents des sucreries. 1ère partie. Etudes de la composition des condensats. J. D. BLAKE. *p.* 131–137

Les constituants solubles des condensats du 1er et du 2ème effet d'evaporation de deux sucreries australiennes ont été examinés. Quoique l'on ait trouvé de faibles quantités de composants non-volatils tels que le saccharose et des acides organiques, les matériaux volatils se sont révélés les principaux constituants. L'éthanol était de loin le plus important; il était présent dans des concentrations qui étaient largement responsables pour les teneurs en COD des condensats. On a détecté de faibles quantités d'autres alcools, d'acides organiques volatils, d'aldéhydes et de l'ammoniaque. La teneur en azote organique était insignifiante. On attire l'attention sur l'erreur commise par l'emploi de la méthode au phénol et à l'acide sulfurique pour la détermination de la teneur en hydrates de carbone des condensats; l'erreur est due à la présence de dérivés du furfural.

* * *

La réaction de la canne à sucre et autres récoltes au virus de la mosaïque. N. RISHI, K. S. BHARGAVA et R. D. JOSHI. *p.* 137–139

On décrit des études au cours desquelles on a déterminé la sensibilité de variétés de canne à sucre, de maïs, de sorgho et de bajra (*Pennisetum typhoides*) à l'égard des souches *A* et *F* du virus de la mosaïque de la canne. Les auteurs avertissent contre le danger de cultiver des variétés sensibles des trois autres récoltes au voisinage des champs de canne.

* * *

Elution multiple avec recyclage partiel. J. DOBRZYCKI. *p.* 139–142

Après le cycle de service d'un lit poreux, p.eex. de noir animal et de résine échangeuse d'ions, la phase solide du lit, imprégnée du résidu de la solution percolante, est usuellement lavée avec un solvant pour éliminer la majeure quantité de la solution interparticulaire. La consommation de solvant et la dilution y afférente peuvent être réduites si l'effluent est divisé en fractions et si les fractions les moins concentrées sont réutilisées pour l'élution préliminaire des portions non-lavées suivantes de la couche poreuse. On établit des équations mathématiques qui décrivent la répartition massique au cours de telle élution à recyclage et on discute de leur utilisation.

Eine Untersuchung über Kondensat und seinen Beitrag zur Belastung des aus Zuckerrohrmühlen abzuführenden Abwassers. Teil I. Untersuchungen über die Zusammensetzung des Kondensats. J. D. BLAKE. *S.* 131–137

Die löslichen Bestandteile des Kondensates aus der ersten und zweiten Verdampferstufe in zwei australischen Zuckerfabriken wurden untersucht. Während geringe Mengen von nichtflüchtigen Komponenten wie Saccharose und organische Säuren gefunden wurden, erwiesen sich die flüchtigen Substanzen als die Hauptbestandteile. Aethylalkohol war bei weitem am stärksten vertreten. Er war in Konzentrationen vorhanden, die wesentlich zum CSB-Wert des Kondensates beitrugen. Weiter wurden geringe Mengen von anderen Alkoholen, flüchtigen organischen Säuren, Aldehyden und Ammoniak gefunden. Der Gehalt an organischen Stickstoffverbindungen war unbedeutend. Der Verfasser weist auf den Fehler hin, der durch die Verwendung der Phenol-Schwefelsäure-Methode bei der kolorimetrischen Bestimmung des Kohlenhydratgehalts von Kondensat entsteht. Dieser Fehler wird durch die Anwesenheit von Furfurolderivaten hervorgerufen.

* * *

Die Reaktion von Zuckerrohr und anderen Kulturpflanzen auf den Mosaikvirus. N. RISHI, K. S. BHARGAVA und R. D. JOSHI. *S.* 137–139

Die Verfasser berichten über Untersuchungen, bei denen die Empfindlichkeit einiger Sorten von Zuckerrohr, Mais, Sorghum und Bajra (*Pennisetum typhoides*) auf die Stämme *A* und *F* des Rohrmosaikvirus bestimmt wurde. Sie warnen vor dem Anbau von empfindlichen Sorten der anderen drei Pflanzengattungen in der Nähe von Zuckerrohrfeldern.

* * *

Mehrstufen-Elution mit teilweiser Rücknahme. J. DOBRZYCKI. *S.* 139–142

Nach dem Arbeitszyklus eines porösen Bettes, z.B. von Knochenkohle und Ionenaustauscherharz, wird die feste Bettphase nach Tränken mit dem Rest der durchlaufenden Lösung normalerweise mit einem Lösungsmittel gewaschen, um den grössten Teil der zwischen den Partikeln befindlichen Lösung zu entfernen. Der Verbrauch an Lösungsmittel und die auftretende Verdünnung kann reduziert werden, wenn das Effluat in Fraktionen aufgeteilt wird und die Fraktionen niedrigerer Konzentration für eine Vorelution der folgenden ungewaschenen Teile der porösen Schicht wiederverwendet werden. Es werden Gleichungen aufgestellt, mit denen man die Massenverteilung bei einer solchen Rücknahme-Elution beschreiben kann. Die Verwendung dieser Gleichungen wird diskutiert.

Un investigación de aguas condensadas y su contribución a la disposición de efluente de ingenios azucareros. Parte I. Estudios sobre composición de aguas condensadas. J. D. BLAKE. *Pág.* 131–137

Se han examinado los constituentes solubles de aguas condensadas de los primeros y segundos efectos de los evaporadores en dos ingenios australienses. Mientras que se han observado pequeñas cantidades de componentes no-volátiles tal como sacarosa y ácidos orgánicos, las materias volátiles fueron los constituentes mayores. Con mucho el más importante fué étanol, siendo presente en concentraciones que explican en grande parte los niveles de COD (demanda química de oxígeno) en las aguas condensadas. Pequeñas cantidades de otros alcoholes, ácidos orgánicos volatiles, aldehidos y amóniaco se observaron. Fué insignificante el componente de nitrógeno orgánico. El autor llama el atención sobre el error que previene del uso del método de fenol-ácido sulfúrico para determinar colorimetricamente el contenido de carbohidratos en aguas condensadas; el error es causado por le presencia de derivados de furfural.

* * *

Reacción de caña de azúcar y otras cosechas al virus de mosaico. N. RISHI, K. S. BHARGAVA y R. D. JOSHI. *Pág.* 137–139

Se relatan estudios en que se determinaron las susceptibilidades de variedades de caña de azúcar, maíz, sorgo y "bajra" (*Pennisetum typhoides*) a razas *A* y *F* del virus de mosaico. Los autores previenen contra la cultivación de variedades susceptibles de los tres otras cosechas cerca de campos de caña de azúcar.

* * *

Elución múltiple con reciclo parcial. J. DOBRZYCKI. *Pág.* 139–142

Después del ciclo de servicio de un cama porosa de, por ejemplo, carbón de hueso o résina para cambio de iones, el fase sólido de la cama, remojado con el resto de la solución percolante, es lavado usualmente con un disolvente para eliminar la mayoría de la solución entre los partículos. El consumo de disolvente y la dilución acompañando pueden reducirse si el efluente es dividido en fracciones y las fracciones las menos concentradas se re-usan para la elución preliminar de las siguientes fracciones no-lavadas de la capa porosa. Ecuaciones matemáticas se desarrollan que describen partición de masas mientras tal elución por reciclo, y su uso es discutido.

INTERNATIONAL SUGAR JOURNAL

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Notes & Comments

European sugar beet area, 1976

F. O. Licht KG have recently published their first estimate of the areas to be sown to sugar beet this year[1], and the figures appear elsewhere in this issue.

"In view of the fact that the tight supply situation of the past few years has eased to a certain extent despite the unsatisfactory crop results in major producing areas in 1975/76, it has been widely expected that European sugar beet areas in 1976 will show no marked increases against the previous season. Although an estimate of sugar beet areas at such an early stage necessarily involves a considerable degree of uncertainty there is strong presumption that the increase in areas, above all in the West European countries outside the EEC, will prove to be higher than thought earlier.

"The area in the EEC countries will remain more or less unchanged although the increase and decrease rates in the individual countries vary widely. The highest proportional increases are expected in Italy (20,000 hectares/7·69%) and the United Kingdom (13,064 hectares/6·76%). On the other hand, decreases are likely to occur in Belgium/Luxembourg (19,600 hectares/16·39%), and Denmark (6000 hectares/6·98%). The overall increase rate for the EEC countries of 0·79% seems to be insignificant. However in some West European countries outside the EEC there are indications that substantial expansion in the area under sugar beet will be achieved although it is not absolutely clear whether the indicated areas will actually be reached. In Spain the area sown to summer sugar beet in October–November 1975 was no less than 116,600 hectares, compared with 72,500 hectares sown to summer sugar beets in the previous season (these beets are harvested in June/July of the following year). The area under winter sugar beets in 1975 (sown in March-April 1975) was 118,000 hectares. Even if it is assumed that the area under winter sugar beets in 1976 shows no marked increase against last year (definite figures are not yet available) the overall area is most likely to grow at a substantial rate. Also in Yugoslavia, which has embarked on a policy of expansion, a considerable increase is expected. Decreases are assumed to occur in Austria (1·44%) and Greece (2·92%). The overall increase rate for West Europe is estimated at 2·38% which contrasts with an actual increase of 19·74% in the previous season. Nearly half of the total area in Europe planted to sugar beet is to be found in the Soviet Union. The effects of poor weather conditions upon so large a crop have been clearly demonstrated by the low results of the 1974/75 and 1975/76 campaign. In fact the results in 1975/76 are apparently so disastrous that official Soviet sources refrain from publishing any figures at all. Consequently there will be most likely considerable efforts to increase output in the coming season. The information available suggests that the increase in area will be in the region of about 2% or some 70,000 hectares. Based only upon the average yields of recent years, this increase in area would result in no more than 173,000 tons of extra sugar. If the area estimate proves to be realistic, better weather conditions will be needed to produce a substantial improvement in production.

"The unsatisfactory crop results in 1975/76 have apparently induced Governments in all East European countries to expand areas although the increase rate in 1976 is probably only half that of last year. The estimated individual increase rates are as follows: German Democratic Republic 2·61%, Czechoslovakia 2·50%, Hungary 5·54%, Poland 6%, Rumania 2·91%, Bulgaria 3·67% and USSR 1·90%.

"The total sugar beet area in Europe in 1976 is projected at 7·842 million hectares against 7·652 million hectares in 1975. On the basis of average sugar yields per hectare established over the past four years, sugar production in the EEC could be around 10,800,000 metric tons, raw value. Production in West Europe could reach 15 million tons and production in East Europe could be in the region of 14 million tons. This is to say that production in Europe could be around 29 million tons as against 26·8 million tons in 1975/76. In this context however it has to be borne in mind that average yields established over the past four years were abnormally low because of the unfavourable crop results in 1974/75 and 1975/76. In any case it will be growing conditions which will exert a major influence upon sugar production in 1976/77."

* * *

USSR 1975 sugar beet crop[2]

Last year's Soviet sugar beet crop was apparently only 66 million metric tons compared with the planned 94 million, western observers have calculated from figures in a speech by Prime Minister ALEXEI KOSYGIN.

In a report to the Soviet Communist Party Congress on 1st March on the 1976-80 economic plan, KOSYGIN said a projected annual average beet output of 95 to 98 million metric tons would be 19 to 22 million tons up on the 1971-75 annual average.

This gave an average of 76 million tons for the last five years, or a total of 380 million tons and, by subtracting the declared 1971-74 output of 313·6

[1] *Daily Sugar Information Service*, 1976, **19**, (40), 153–155.
[2] *Public Ledger*, 6th March 1976.

million tons, observers produced a 1975 figure of 66·4 million tons.

Even allowing for a margin of error of 2 million tons either way due to rounding off in KOSYGIN'S figures, this would be the worst crop since 1963, when 44·1 million tons were produced.

* * *

Latin American and Caribbean sugar exporters' meeting

The fourth meeting of the sugar exporters' group[1] took place in Cali, Colombia, and formally approved statutes and created a permanent organization with the aim of seeking fair and remunerative prices on the world market. The Spanish name for the group has provided an acronym, GEPLACEA, which controls 70% of the supplies of sugar to the world market if those of the Philippines, admitted as an observer, are included.

A committee of experts from Argentina, Barbados, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, Guatemala, Guyana, Mexico and Venezuela are to make studies for the negotiation of a new International Sugar Agreement.

The Export Director of Brazil's Instituto do Açúcar e do Alcool has stated, however, that the Group is not a cartel; he emphasized that its role is to exchange information on sugar marketing and production techniques.

* * *

Soviet purchases of world sugar

Rumours of purchases of sugar by the USSR were confirmed in mid-March but the extent of these has not been made completely clear. A statement from Manila that 200,000 tons of sugar were to be shipped by 25th March and a further 200,000 tons at a later unspecified date was denied by a Soviet spokesman who said that only 200,000 tons in all had been bought. Subsequently there were reiterations of the Philippine claim and the Soviet denial. A further 200,000 tons of sugar had been bought by the USSR from Western European sources and these quantities, together with purchases from Cuba and other socialist countries, were said to complete the needs of the USSR[2].

It is reported[3] that Poland is in a position to supply at least 200,000 metric tons since little sugar has been sold to the world market since Poland declared *force majeure* on shipping contracts with French operators nearly two years ago. Czechoslovakia appears to have a much smaller surplus of 80,000 tons because of crop difficulties and East Germany may have an extra 50–60,000 tons earmarked for the USSR.

One trade source in New York said that it is more economical for the USSR to take sugar from East European countries because such transactions are usually part of barter agreements; the USSR may also prefer to transport the sugar by rail and road rather than pay the more expensive freight charges for transport by sea.

* * *

World sugar prices

During March the London Daily Price for raw sugar strengthened from £163 per ton to £183 by the 8th and reached £192 on the 22nd, subsequently falling to £176 at the end of the month. The LDP(W) also rose to £199 on the 8th but fell to a dip of £191 on the 17th, returning again to £199 on the 22nd before a subsequent drop to £190 on the 31st March.

An important factor affecting the sugar price was the emergence of the USSR as a purchaser from the world market. There had been anticipation of the need to make up for a poor Soviet beet sugar crop, and although it is still not completely clear how much sugar has been acquired, at least 400,000 tons has been removed from the market, with consequent strengthening of prices.

The GEPLACEA countries have shown themselves willing to withhold sugar from the market in order to maintain prices and their apparent agreement in March to continue this has strengthened the market.

The Philippines stock position has been eased also by large contracts with two US refiners; one is reported to be for a supply of 650,000 tons of sugar a year for the next five years with a clause for a 5-year extension, while the other is stated to be for delivery of 500,000 tons a year for five years. The price is to be deferred and will be based on the US refined sugar price at the time of delivery, with a minimum under which the Philippines need not supply the sugar. However, the sales have correspondingly removed a source of demand from the market and, with a guaranteed margin and risk to be borne by the Philippines, the two refiners are likely to market their sugar aggressively, so that the remainder will be tough in negotiations for their own purchases, which might push raw sugar prices down.

* * *

Brazil sugar exports 1975[4]

Brazil has in recent years become one of the world's leading exporters of sugar. Though domestic consumption has increased substantially, the expansion of production has enabled shipments to exceed one million tons ever since 1966. A major setback was sustained in July of last year when frosts destroyed sugar cane and other crops in several states and this brought a necessary limitation to the exportable sugar tonnage. Even so, the quantity actually shipped amounted to 1,730,000 tons, which was no mean achievement, though it represented a fall of 570,000 tons on the year before.

The ending of the US Sugar Act lessened the need for Brazil to pay special attention to the US market while, coincidentally, the dramatic fall in the US demand for overseas raws lessened the call there might otherwise have been on Brazil to fill this traditional outlet. Consequently the drop in total exports during the year was almost exactly matched by the fall in shipments to the USA, and for the first time for many years several other destinations received more sugar than the USA. Japan figured prominently with nearly 350,000 tons while Iraq and the EEC both took more than 200,000 tons.

Details of the import statistics appear elsewhere in this issue with comparative figures for previous years.

* * *

EEC sugar prices for 1976/77

The Ministers of Agriculture for the EEC countries met in March and agreed, with some adjustments, the proposals of the Commission with respect to beet and sugar prices. The basic levels for 1976/77 will be: minimum beet price 24·57 units of account, white sugar intervention price 331·40 U.A. and white sugar target price 348·70 U.A. It was also decided to fix the maximum quota at 135% of the basic quota, as against 145% for 1975/76.

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[1] *I.S.J.*, 1975, 77, 64, 193, 353.
[2] C. Czarnikow Ltd., *Sugar Review*, 1976, (1275), 43.
[3] *Public Ledger*, 27th March 1976.
[4] C. Czarnikow Ltd., *Sugar Review*, 1976, (1270), 21–22, 25.

An investigation of condensates and their contribution to effluent disposal from sugar mills

Part 1. Studies on composition of condensates

By J. D. BLAKE

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Introduction

As in many other parts of the world, increasing pressure is being exerted by Queensland government authorities to ensure that pollution of the environment by factory wastes is brought within acceptable limits. Setting of realistic limits is a matter for considerable debate and the industry is actively engaged in research relating to the discharge of liquid effluents from mills.

For some sugar mills, effluent disposal presents no real problems, while for others it is acute. Plant for effluent treatment is expensive and the problems of treatment have been magnified by the observation that previously untreated sugar-free condensates frequently possess BOD_5 values of the order of 500 ppm and greater.

This paper describes the results of an investigation into the origin and nature of the compounds contributing to the observed BOD_5 levels existing in condensates obtained in sugar processing.

Experimental and Results

Collection and processing of samples

Condensates were collected from the calandrias of the first and second effects at Farleigh and Cattle Creek factories in the Mackay region in November and December 1973, respectively. They were frozen and stored prior to analysis.

Samples were analysed for total organic carbon (TOC) using a Beckman analyser model 915, chemical oxygen demand[1] (COD), and biological oxygen demand[2] for five days (BOD_5). Kjeldahl nitrogen and amine-ammonia contents were determined. The latter analysis simply involved the alkaline steam distillation step of the Kjeldahl procedure without the acid predigestion stage. Non-volatiles concentration was determined by vacuum distillation of three litres of sample on a rotary evaporator at 55°C.

Nitrogenous constituents were effectively removed by pumping condensate (6–8 litres) through Bio-Rad "Dowex 50 WX8 (H) (50 cm^3) in a 30-cm long column of 1·5 cm dia. at a flow rate of 2·5 $cm^3.min^{-1}$. Unretained components were washed from the column with five bed volumes of water and the retained fraction was recovered by elution with ten bed-volumes of 10% hydrochloric acid. A materials balance based on amine nitrogen indicated at least 98% recovery of applied nitrogen.

An acidic fraction was obtained from second effect Cattle Creek condensate by subsequent passage of the components unretained by cationic exchange through a 30 cm long × 0·9 cm dia. column of "Amberlite IRA 401" resin in carbonate form. Ten bed volumes of 1M Na_2CO_3 solution was used to elute the acidic fraction. Volatile constituents were then recovered from the eluate by acidification and steam distillation while non-volatiles were obtained by continuous

Table I. Original samples

Condensate analysis	*Farleigh No. 2 Effect*	*Cattle Creek No. 2 Effect*	*Farleigh No. 1 Effect*	*Cattle Creek No. 1 Effect*
pH	8·7	9·0	9·2	9·3
TOC*	577	509	—	225
COD	2487	2304	1024	672
BOD_5	1936	2271	450	813
Kjeldahl N	13·4	12·2	6·0	5·6
Amine N	13·4	10·3	5·4	3·9
Fractions unretained by cation exchange resins				
pH	4·5	5·9†	4·5	Not Analysed
TOC	545	427	490	
COD	1680	1530	880	
BOD_5	1949	1388	1150	
Fractions retained by cation exchange resins				
TOC	2·3	1·4	1·4	Not Analysed
COD	12·8	3·9	2·3	
BOD_5	29·2	39·8	31·1	
Kjeldahl	13·3	10·5	6·2	
Amine N	13·1	10·4	6·0	
N% isolated solids	24·4	25·0	23·5	

* TOC, COD, BOD_5, Kjeldahl N and Amine N are given as ppm.

† This fraction was also passed through an anion exchange resin.

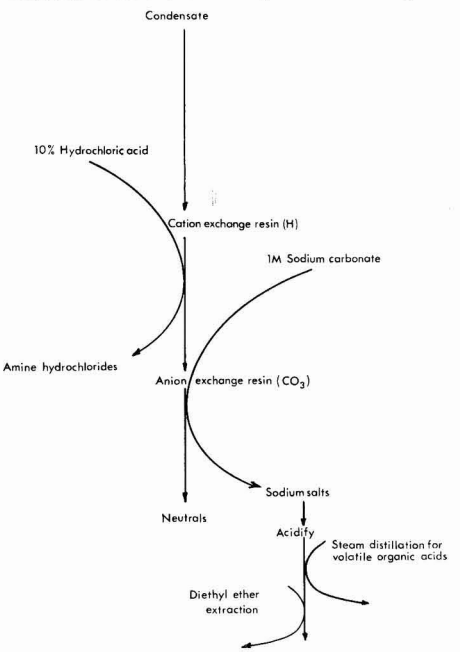


Fig. 1. Analytical scheme for investigation of condensate composition

[1] "Standard Methods for the Examination of Water and Wastewater", 13th Edn. (American Public Health Association, American Water Works Association, Water Pollution Control Federation), 1971, p. 495.

[2] *ibid.*, p. 489.

extraction with diethyl ether. They contributed 9 and 16 ppm, respectively, to the composition of the condensate.

The general properties of the condensates are outlined in Table I and the fractionation for second effect Cattle Creek condensate is outlined schematically in Fig. 1.

Carbohydrate composition was expressed quantitatively as sucrose equivalent using the phenol-sulphuric acid procedure[5], adapted to automated analysis. Results are reported in Table II.

Chromatographic analysis for α-amino-acids[6] failed to reveal any commonly occurring acids. First effect condensates possessed no ninhydrin-positive components while four unidentified positive spots were found in Farleigh second condensate. Concentrations were such that these components were of quite minor proportions.

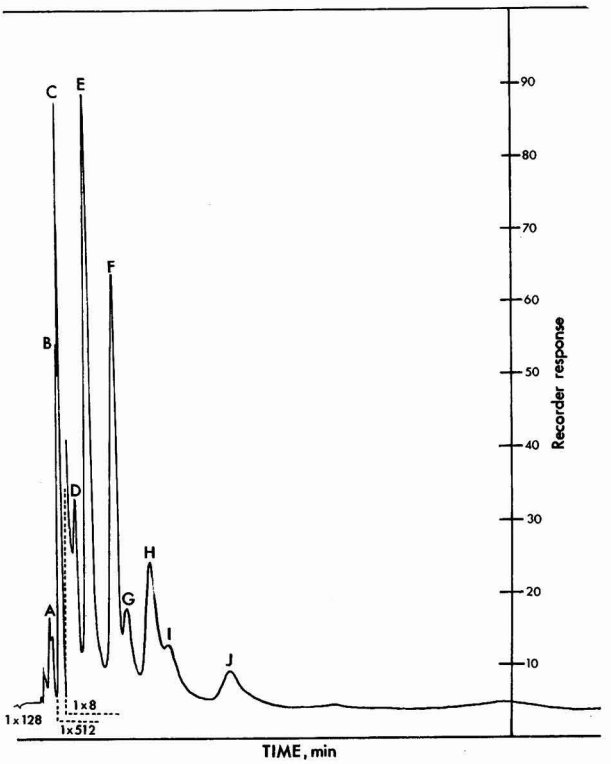


Fig. 2. 1 μl of volatiles obtained by partial distillation of condensate from the Cattle Creek No. 2 effect. They were chromatographed isothermally at 160° on "Chromosorb 101". Attenuation of recorder response is shown and peak assignments and retention times are: *A* Methanol 0 min 29 sec; *B* Acetaldehyde 0 min 52 sec; *C* Ethanol 1 min 0 sec; *D* Propanol 1 min 35 sec; *E* Acetic acid 1 min 58 sec; *F* Ethyl acetate 2 min 54 sec; *G iso*-Butanol 3 min 21 sec; *H* Propionic acid 4 min 9 sec; *I* Unknown 4 min 45 sec; *J* Butyric acid 6 min 51 sec.

Analysis of non-volatile constituents

Carbohydrate components were identified using paper chromatography. Ethyl acetate:pyridine:water (8:2:1, v:v:v) was used for development while alkaline silver nitrate[8] and *p*-anisidine[4] were used for detection. Sucrose proved to be the major constituent together with minor amounts of inversion products.

Table II. Sucrose concentrations (ppm) in condensate solutions

	Origin of condensate			
Sample	*Farleigh No. 2 effect*	*Cattle Creek No. 2 effect*	*Farleigh No. 1 effect*	*Cattle Creek No. 1 effect*
Non-Volatiles	2·7	2·1	—	0·8
Volatiles* ..	—	9·2		
Original sample	9·4	12·4	5·2	
Unretained by ion exchange	9·7	12·6	5·8	

* Obtained by incomplete distillation on a "Rotavapour" at 50°C.

Lactic and oxalic acids were tentatively identified among the non-volatile acidic components using paper chromatography developed with chloroform:ethanol:formic acid[7].

Analysis of volatile constituents

Gas-liquid chromatography was used extensively to investigate the composition of the volatile fractions.

[3] TREVELYAN *et al.*: *Nature*, 1950, **166**, 44.
[4] HOUGH *et al.*: *J. Chem. Soc.*, 1950, 1702.
[5] DUBOIS *et al.*: *Anal. Chem.*, 1956, **28**, 350.
[6] SMITH: "Chromatographic and Electrophoretic Techniques", 3rd Edn. (Heinemann, London), 1969, Vol. 1, p. 105.
[7] STARK *et al.*: *Anal. Chem.*, 1951, **23**, 413.

Acidic and neutral compounds were chromatographed on "Chromosorb 101" (100/120 mesh) in a 2 m long × 3 mm dia. glass column under conditions indicated on the chromatograms shown in Figs. 2, 3 and 4. A Perkin Elmer model 900 gas chromatograph fitted with flame ionization detectors was used. Tentative identifications were made by chromatography of authentic compounds and the comparison of retention times under similar conditions of analysis. Nitrogenous volatiles were analysed on "Chromosorb 103" (80/100 mesh) in a 2 m long × 3 mm dia. glass column using comparable conditions to those previously described. The nitrogenous hydrochlorides were analysed as 5% (w/v) solutions made alkaline by the addition of an appropriate amount of sodium hydroxide. Ammonia, which is not detectable using a flame ionization detector, was identified using a thermal conductivity detector on a separate gas chromatograph. It was noted that no other components were observed using this less sensitive detection mode.

Chromatograms are shown in Figs. 2, 3, 4 and 5.

The volatile acids from Cattle Creek second effect condensate, recovered by anion exchange chromatography, were analysed quantitatively using *iso*-valeric acid as internal standard. The small amount already present was compensated for by determining its percentage composition in the original mixture relative to butyric acid. The concentration of formic acid was determined by gravimetric analysis[8]. The measured distribution is shown in Table III.

Table III. Composition of volatile carboxylic acids recovered from No. 2 effect condensate from Cattle Creek factory by anion exchange chromatography

Relative percentage of total volatile acids

Formic	1·8	Butyric	23·3
Acetic	61·9	*iso*-Valeric ..	1·2
Propionic	12·0	Valeric	1·0
iso-Butyric	0·6		

A volatile fatty acid index was also established by steam distillation[8]. Volatile acidity was expressed as an acetic acid equivalent as shown in Table IV.

A standardized temperature programme was used to expedite the analysis of condensates and facilitate the quantification of the more volatile constituents.

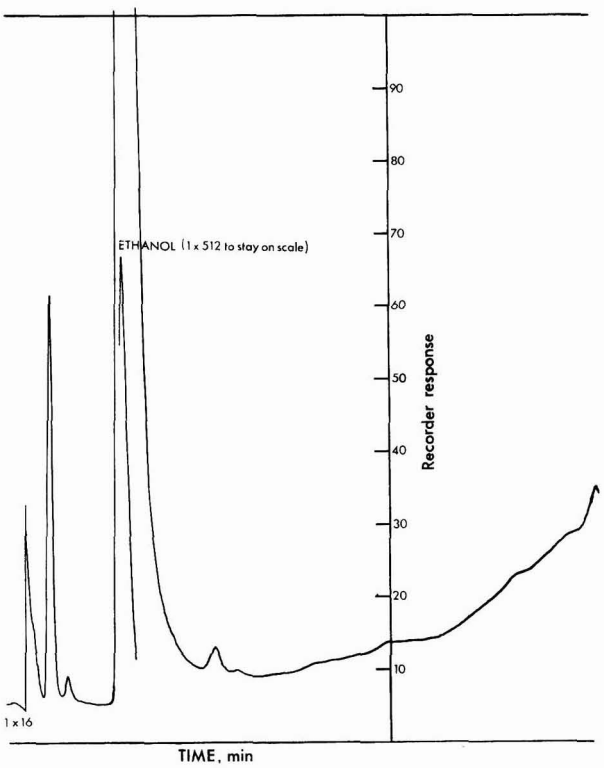


Fig. 3. 4 μl direct injection of condensate from the Cattle Creek No. 2 effect, chromatographed from 100° to 160° at 4°.min^{-1}, 4 minutes after injection on "Chromosorb 101". Attenuation at 1 × 16 throughout except for ethanol maintained on scale at 1 × 512 (sensitivity reduced by a factor of 32).

Table IV. Volatile acid index of condensates from No. 1 and No. 2 effects

Sample	*Acetic acid equivalent ppm*
No. 2 effect, Farleigh	4·9
No. 2 effect, Cattle Creek	12·8
No. 1 effect, Cattle Creek	2·1

[8] Horwitz: "Official Methods of Analysis of the Association of Analytical Chemists", 11th Edn. (A.O.A.C., Washington) 1970, p. 299.

Table V. Ethanol concentrations found in condensates together with theoretical and experimental values for TOC, COD amd BOD_5, all as ppm

Condensate	*Ethanol Conc.*	*Theoretical* TOC	*Theoretical* COD	*Theoretical* BOD_5	*Experimental* TOC	*Experimental* COD	*Experimental* BOD_5
No. 2 effect Farleigh	1164	605	2422	1920	577	2490	1940
No. 2 effect Cattle Creek	912	478	1910	1505	509	2300	2270
No. 1 effect Cattle Creek.....	312	166	661	515	225	670	810

Ethanol proved to be the major component though sometimes significant but variable amounts of acetaldehyde were noted. Other constituents tentatively identified included methanol, propanol, *iso*-butanol, ethyl acetate, and *n*-butanol.

From the chromatogram in Fig. 2, it may be seen that ethanol is present at concentration levels that

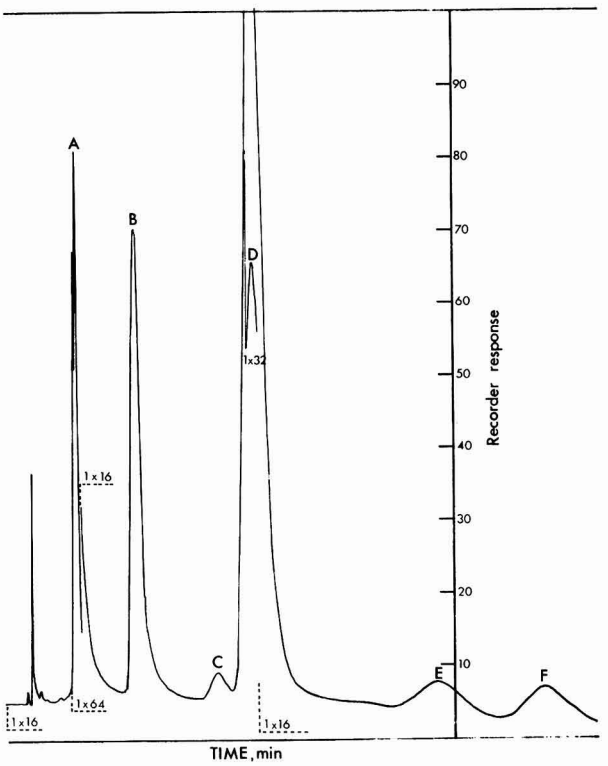


Fig. 4. 0·3 µl of volatile organic acids recovered from No. 2 effect condensate from Cattle Creek by anion exchange chromatography and subsequent steam distillation of the acidified element. Acids were chromatographed on "Chromosorb 101" isothermally at 160°C. Retention times and probable identifications are: *A* Acetic acid (1 min 59 sec); *B* Propionic acid (4 min 4 sec); *C iso*-Butyric acid (6 min 55 sec); *D* Butyric acid (8 min 15 sec); *E iso*-Valeric acid (14 min 20 sec); *F* Valeric (or possibly 2-methyl butyric acid) (18 min 12 sec).

reduce other components to insignificance. The liberty was therefore taken in the use of *n*-propanol as internal standard for its measurement and results are shown in Table V.

A number of solutions of accurately measured ethanol content were examined for their BOD_5 requirement. These results are shown graphically in Fig. 6 and established a working approximation that $BOD_5 = 1{\cdot}65 \times$ ethanol concentration. The theoretical COD for ethanol was also confirmed experimentally and comparative results are summarized in Table V.

Discussion

Honig[9] points out that most discussions in the technical literature consider evaporation as the concentration of the solids in sugar juices by the removal of pure water and without substantial changes in the composition or nature of the materials in solution. He indicates that condensates, depending on the temperature of the condensation, contain ammonia, organic acids, aldehydes and alcohols at pH levels which may vary from 5·5 to 9·0.

He suggests that the most characteristic feature of the organic impurities in condensates from cane sugar factories is their high reducing power[10]. More speci-

[9] "Principles of Sugar Technology", Vol. III (Elsevier, Amsterdam), 1963, p. 105.

[10] *ibid.*, 160.

fically, he refers to the presence of acetaldehyde and, to a lesser extent, its probable precursor, methyl glyoxal. STEINLE[11] reports the formation of lactic, acetic and formic acids together with methanol, acetaldehyde, and small quantities of metasaccharinic acid when invert sugar is limed at 85°C. He considers this to be a major mechanism for the origin of these components in condensates and pan vapours during the processing of sugar beets. He also recognizes that ethanol and acetaldehyde arise during anaerobic destruction of stored beets.

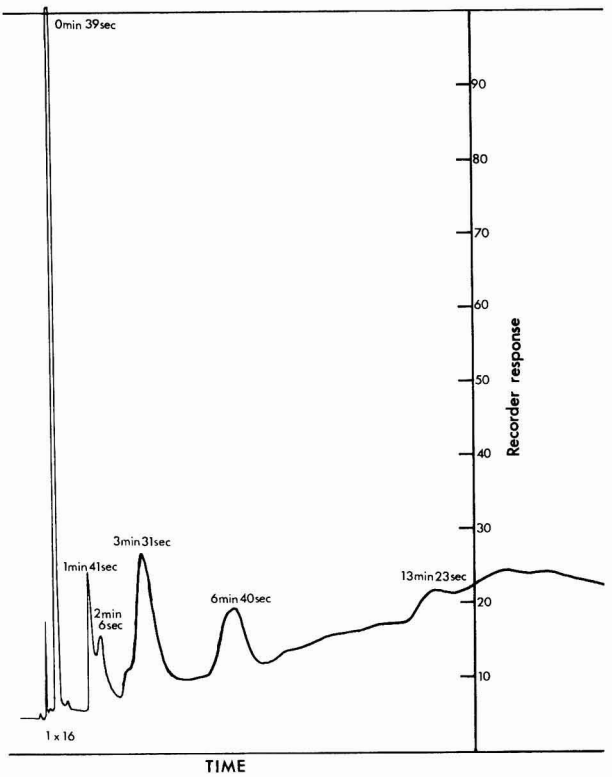


Fig. 5. 2 μl nitrogenous components from Farleigh No. 2 effect condensate, recovered by cation exchange and chromatographed on "Chromosorb 103" from 90 to 105° at 4°.min^{-1}. No peak identifications were made but retention times are as indicated. Throughout, nitrogen carrier gas flow was set at 32 cm^3.min^{-1} and hydrogen to the detector at 36 cm^3.min^{-1}. Injector and detector temperatures were 220°C and 270°C, respectively.

The composition of condensates found in this survey suggests that fermentation in deteriorating cane is the major source of contamination found in condensates. The contribution of ethanol to the experimental results in Table V supports this contention.

This kind of deterioration is not novel. FORT[12] reported on the occurrence of an alcoholic fermentation in sugar cane damaged by frost in 1939. BRUIJN[13] measured ethanol levels in cane and observed that this form of deterioration appeared to occur mainly in burnt cane. No ethanol was detectable for as long as 25 days after harvesting green cane but 3000 ppm was measured in juice from cane stored for four days after burning. These observations have been confirmed in this laboratory although the levels recorded by BRUIJN were not attained.

YOKOTA & FAGERSON[14] identified 29 of the 35 compounds detectable in the volatile constituents of cane molasses. By using a combination of gas chromatography and mass spectrometry they found aliphatic and aromatic esters, aldehydes, alcohols and several furan derivatives. All identifications made in this study of condensates are listed in their report and it is probable that still unassigned peaks in the condensates are also listed there.

An example of some practical importance in this respect is the presence of furfural derivatives undetected by the gas chromatographic method used, but whose presence is established by the "sucrose" levels recorded in Table III. Partially distilled condensate contained 9·2 ppm "sucrose" in the distillate. This arises from the presence of hydroxymethyl furfural, the structural assignment being based on a maximum colour absorption at 488 nm which is

[11] *Zucker*, 1972, **25**, 81.
[12] *Sugar Bull.*, 1939, **17**, 4.
[13] *I.S.J.*, 1966, **68**, 331.
[14] *J. Food Sci.*, 1971, **36**, 1091.

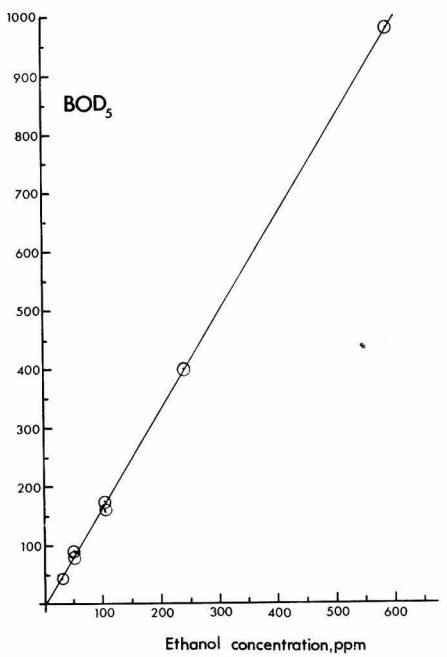


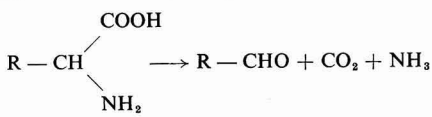
Fig. 6. The experimental relationship between ethanol concentration and BOD_5 using seed from an activated sludge plant operating on sugar factory effluent.

consistent with that obtained for hexoses[5]. Attention is thus drawn to the possible error in carbohydrate analysis of condensates using colorimetric methods based on strong acid dehydration of sugars to furfural derivatives as the preliminary mechanism to colour formation.

The results also indicate that, in general, entrainment of non-volatiles is not a serious problem in these condensates.

Some difficulty exists in accounting for the acidic fraction observed. At the pH at which juice is normally concentrated, the pKa values of carboxylic acids should ensure that they exist in their non-volatile anionic form. HONIG[15] mentioned the presence of weak organic acids in small concentrations in condensates and notes that a small quantity of acid can be determined in the distillate after evaporation of sugar juices to which sodium formate and acetate have been added at pH 6·5.

Another conceivable mechanism accounting for the presence of acids in condensates is via the Strecker degradation[16]. In this reaction, α-amino acids are degraded to aldehydes, carbon dioxide and ammonia by certain active carbonyl compounds:



The reaction occurs under relatively mild conditions, e.g. by heating a solution or suspension of the amino-acid and carbonyl compound for 15 minutes. Such

Table VI. Strecker degradation products of some α-amino-acids and their oxidation products

α-Amino-acid	*Strecker degradation product*	*Carboxylic acid*
Glycine	Formaldehyde ..	Formic acid
Alanine	Acetaldehyde ..	Acetic acid
Valine	2-Methyl propanal	*iso*-Butyric acid
Leucine	3-Methyl butanal	*iso*-Valeric acid
iso-Leucine	2-Methyl butanal	2-Methyl butyric acid
α-Amino-butyric acid	Propanal	Propionic acid

carbonyl compounds possessing an α-dicarbonyl structure are generally accepted components of the reductones produced in non-enzymic browning re actions[17]. These undoubtedly form during juice evaporation, and subsequent Strecker degradation of α-amino-acids would result in steam distillation of aldehydes into the vapour phase in condensates. Facile oxidation of these would then give rise to carboxylic acids. Table VI illustrates how some of these acids can be accounted for.

HONIG[18] reports that the oxygen composition relative to nitrogen in the non-condensable gases in cane sugar factories is always low in the vapour from the first vessel. This supports the hypothesis of its consumption during the evaporation process in oxidation of reducing compounds.

Ammonia is considered to result from the hydrolysis of the two amido-amino-acids, asparagine and glutamine. The concentration of these in fresh cane juice is such that 50 ppm ammonia is theoretically possible[19]. Deamination in the Strecker degradation of α-amino-acids is another source of ammonia. Together, these mechanisms easily account for the 4–16 ppm concentrations observed.

These studies suggest that aliphatic amines are only very minor constituents of condensates. Furthermore they have not been confidently identified. Volatile amines from beet molasses have been reported[20] and their presence is ascribed to "certain destructive reactions". α-Amino-acids undergo pyrolytic degradation in which decarboxylation to an amine is a major decomposition mode[21]. This, however, does not apply to aqueous solutions and was confirmed in these studies by extensive steam distillation of an alkaline solution of glycine. Nevertheless, on a plant production scale under the conditions employed for juice evaporation, it may be possible to produce small but detectable concentrations of amines by decarboxylation of α-amino-acids.

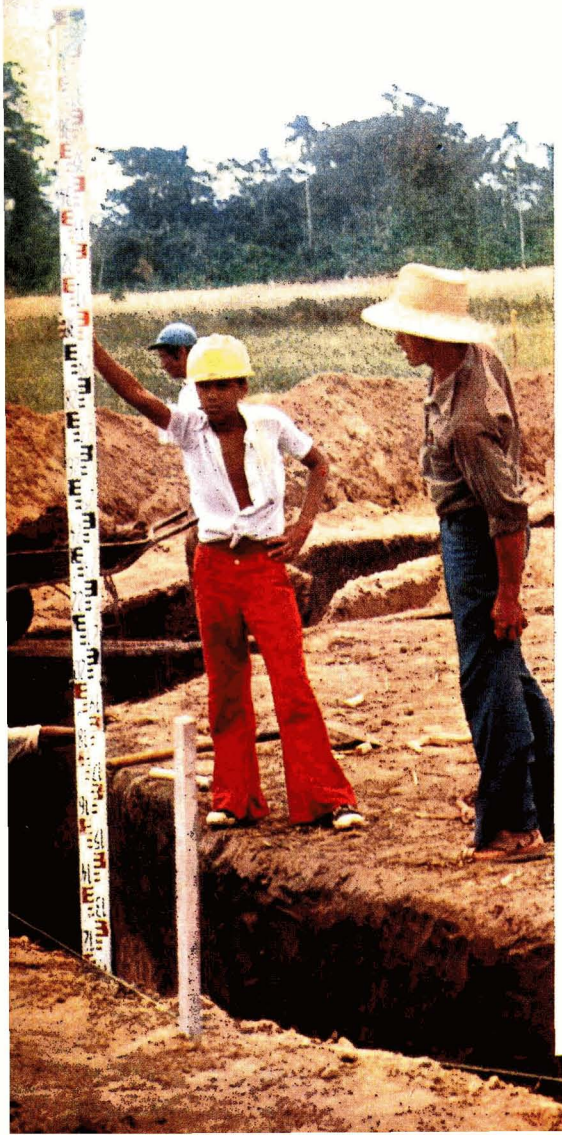
SUMMARY

The soluble constituents of condensates from calandrias of first and second effects of evaporators at Cattle Creek and Farleigh factories have been examined.

Small amounts of non-volatiles such as sucrose and organic acids were measured but, as expected, volatile materials proved to be major constituents. Ethanol was by far the major component in concentrations which largely accounted for the COD levels observed

[15] "Principles of Sugar Technology", Vol. III (Elsevier, Amsterdam), 1963, p. 164.
[16] SCHONBERG *et al.*: *J. Chem. Soc.*, 1948, 176.
[17] HODGE *et al*: *Cereal Sci. Today*, 1972, **17**, 34.
[18] "Principles of Sugar Technology", Vol. III (Elsevier, Amsterdam), 1963, p. 170.
[19] *ibid.*, 164.
[20] HRDLIČKA & JANÍČEK: *Sbornik. Vys. Skoly Chem.-Technol.* (Prague), 1966, **E9**, 117–120; *I.S.J.*, 1968, **70**, 217.
[21] SIMMONDS *et al.*: *Anal. Chem.*, 1972, **44**, 2060.

Why Bolivia chose Tate & Lyle Engineering.



Bolivia's Santa Cruz project, designed to employ 300 people and process between 600,000 and 800,000 tons of cane a year, is a major element in the systematic expansion of the country's sugar industry.

Tate & Lyle first visited Bolivia in 1971 for initial discussions. The following year the company carried out a detailed study of the Bolivian sugar industry. In 1973, the Union Agroindustrial de Cañeros S.A. invited Tate & Lyle to prepare a detailed feasibility study. In 1974, against international competition, Tate & Lyle was awarded the contract for a turnkey sugar mill, refining facility, distillery and can-making plant with a total value of £10.6m. Local contractors are participating in the civil engineering and construction work. Tate & Lyle's continuous involvement in the Bolivian sugar industry has proved invaluable. It is utilising the company's ability to plan and carry out everything from site clearance and manufacture of heavy machinery through to final commissioning and technical aid with the cane cultivation programme.

Probably no other single company has Tate & Lyle Engineering's wealth of experience, skill and know-how in this sphere – qualities which are invaluable wherever sugar is grown.

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in the condensates. Small amounts of other alcohols, volatile organic acids, aldehydes and ammonia were detected. The organic nitrogen component proved insignificant.

Attention is drawn to the error in the use of phenol-sulphuric acid colorimetry as a measure of carbohydrate content in condensates. This arises from the presence of furfural derivatives.

ACKNOWLEDGMENTS

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Reaction of sugar cane and other crops to mosaic virus

By NARAYAN RISHI*, K. S. BHARGAVA and R. D. JOSHI

(Department of Botany, University of Gorakhpur, India)

Introduction

IN an earlier study it was reported that all the thick sugar cane varieties were susceptible to mosaic virus but some of the Indian kinds appeared to be immune, and some hybrids very tolerant. An extensive study of the reaction of different cane varieties grown in Brazil to sugar cane mosaic virus has also been reported[1].

Susceptibility of a large number of maize varieties to sugar cane mosaic virus has been reported and it was suggested that inoculation of highly susceptible maize varieties might reveal divergencies permitting their use as differential hosts[2,3]. In a recent study it was reported that sweet corn varieties tested were susceptible to sugar cane mosaic virus and variations in reaction of 29 dent maize varieties indicated the availability of sources of resistance or immunity[4].

Marked variations were observed in a study of the reaction of 72 varieties of sorghum (*Sorghum vulgare* L.) to sugar cane mosaic virus. These variations were described as "mottle", "necrotic" and "resistant". Resistance was used where appearance of mottling was delayed by at least one week and was very mild[5]. Bajra (*Pennisetum typhoides*) has recently been reported a host of sugar cane mosaic virus[6].

Materials and Methods

In the present study, twelve commercially important cane varieties in Uttar Pradesh were selected to test their susceptibility and reaction to mosaic virus strains A and F (SCMV-A and SCMV-F). Nineteen varieties each of maize and bajra and eighteen varieties of jowar were also tested to see their susceptibility and reaction to SCMV-A and SCMV-F.

Vigorously growing four-week-old seedlings of the cane varieties were mechanically inoculated by a combination[7] of the methods of BAIN and MATZ. Seedlings of maize, jowar and bajra were mechanically inoculated using carborundum powder (400 mesh) as an abrasive. Five seedlings of each variety of cane, maize, jowar and bajra were maintained as controls. Inoculations were made to recover the virus from symptomless plants to confirm whether or not the virus was present in them. The degree of infection was calculated on the basis of number of infected plants out of the 25 under test.

Results

Sugar cane: A perusal of Table I shows that, of 12 cane varieties inoculated, BO 17 did not show any infection by either strain. Varieties Co 740 and Co 1148 showed infection only with SCMV-A. The remaining varieties showed infection with both SCMV-A and SCMV-F.

Table I. Susceptibility of different varieties of sugar cane to SCMV-A and SCMV-F

	Percentage of infection		*Incubation period in days*	
Cane variety	*SCMV-A*	*SCMV-F*	*SCMV-A*	*SCMV-F*
BO 10	28	20	18	18
BO 17	0	0	0	0
BO 32	40	20	17	18
BO 47	40	60	16	16
BO 48	44	40	17	17
Co 419	56	32	17	17
Co 740	56	0	16	0
Co 1148	48	0	16	0
Co 1158	40	36	16	18
Co 1347	60	32	16	17
CoS 245	80	44	16	18
CoS 416	48	40	18	18

In cane variety CoS 245 the SCMV-A symptoms were more prominent than with other varieties. The chlorotic stripes were broader and on some leaves they coalesced to form prominent chlorotic areas. The symptoms produced by SCMV-A and SCMV-F on other varieties were the usual mosaic pattern.

Infection varied from 20% to 80%, depending upon variety and strain used. The incubation period however remained the same.

Maize: Results given in Table II show that, of 19 maize varieties tested, 15 became infected by SCMV-A and SCMV-F while the remainder were not infected with either strain. Of the varieties infected, Deccan hybrid was most susceptible giving 100% infection,

* Indian Institute of Sugarcane Research, Lucknow, India.

[1] BETANCOURT: *Biologico*, 1940, **6**, 137–143.
[2] COSTA and PENTEADO: *Bragantia*, 1950, **10**, 93–94.
[3] *idem: Phytopath.*, 1951, **41**, 758–763.
[4] HALL, SHEPHERD and PENDERY: *Plant Disease Reporter*, 1966, **50**, 793–796.
[5] DEAN & COLEMAN: *Plant Disease Reporter*, 1959, **43**, 522–527.
[6] RISHI, BHARGAVA & JOSHI: *Annals Phytopath. Soc. Japan*, 1973, **39**, 361–363.
[7] BHARGAVA, JOSHI and RISHI: *Proc. 14th Congr. ISSCT*, 1971, 949–954.

followed by N.S.C.65 Deccan with 80% infection. Three varieties, viz. N.P.65K/3418, N.P.65K/3456 and N.S.C. 65 Hi-starch, showed infection below 50%. Infection in the rest of the varieties ranged from 52% to 68%. All the varieties gave nearly similar percentage infection with the two strains

Table II. Susceptibility and reaction of different varieties of maize to SCMV-A and SCMV-F

Maize variety	*Percentage of infection*		*Incubation period in days*		*Intensity of symptoms*	
	SCMV-A	*SCMV-F*	*SCMV-A*	*SCMV-F*	*SCMV-A*	*SCMV-F*
Deccan hybrid	100	100	7	7	S	S
N.P.65K 3334	0	0	0	0	—	—
N.P.65K 3394	0	0	0	0	—	—
N.P.65K 3404	56	56	7	8	S	S
N.P.65K 3418	48	44	8	8	M	M
N.P.65K 3447	0	0	0	0	—	—
N.P.65K 3456	40	40	8	8	S	S
N.P.65K 3457	0	0	0	0	—	—
N.P.65K 3505	60	60	7	7	M	M
N.P.65K 3764	64	60	7	7	S	S
N.P.65K 3779	60	44	7	9	M	M
N.S.C.65 Ganga safed	64	60	7	7	M	M
N.S.C. Ranjit	68	64	7	8	S	S
N.P.65K Exp. Hybrid 2385	56	48	8	9	M	M
N.S.C.65 Ganga 101	68	64	7	7	S	S
N.S.C.65 Deccan	80	80	7	7	S	S
N.S.C.65 Himalayan 123	64	60	7	7	S	S
N.S.C.65 Hi-Starch	48	40	8	9	M	M
N.S.C.65 Ganga-3	56	52	7	7	S	S

S = Severe, M = Mild, — = No infection.

Table III. Susceptibility and reaction of different varieties of jowar (*Sorghum*) to SCMV-A and SCMV-F

Variety	*Percentage of infection*		*Incubation period in days*		*Intensity of symptoms*	
	SCMV-A	*SCMV-F*	*SCMV-A*	*SCMV-F*	*SCMV-A*	*SCMV-F*
I.S.451	40	32	7	8	M	M
I.S.514	60	52	7	8	S	M
I.S.609	0	0	0	0	—	—
I.S.1149	64	56	7	7	S	S
I.S.1195	28	20	7	9	M	M
I.S.2405	0	0	0	0	—	—
I.S.2465	0	0	0	0	—	—
I.S.2497	0	0	0	0	—	—
I.S.2981	0	0	0	0	—	—
I.S.3228	0	0	0	0	—	—
I.S.3414	0	0	0	0	—	—
I.S.3495	52	48	9	10	M	M
I.S.4820	48	48	8	9	S	S
I.S.5151	20	8	7	9	S	M
I.S.5247	28	28	8	8	M	M
I.S.5623	32	28	9	10	S	M
I.S.5638	36	28	9	10	M	M
I.S.5653	40	32	9	11	M	M

S = Severe, M = Mild, — = No infection.

except N.P.65K/3779 where infectivity with SCMV-A was 60% while with SCMV-F it was only 44%. The incubation period, remained nearly the same in all susceptible varieties.

Intensity of symptoms also differed with the varieties. Nine of the susceptible varieties showed severe symptoms while six varieties gave only a mild reaction. The leaves of all susceptible varieties showed the usual mosaic pattern.

Jowar: Results in Table III show that, of 18 jowar varieties tested, varieties I.S.609, I.S.2405, I.S.2465, I.S.2497, I.S.2981, I.S.3228 and I.S.3414 were not infected. The remaining 11 varieties showed differential infection by both the strains. Varieties I.S.1149 and I.S.514 showed the highest percentage infection followed by I.S.3495. Infection in the remaining eight varieties was less than 50%.

Variety I.S.5151 showed the lowest infection, i.e. 20% with SCMV-A and 8% with SCMV-F. The incubation period was nearly the same in different varieties. The intensity of symptoms also depended on the variety and not the virus strain. Varieties I.S.514, I.S.5151 and I.S.5623 were, however, erratic showing severe symptoms with SCMV-A and mild symptoms with SCMV-F. The symptom pattern in all the infected varieties was typically mosaic.

Bajra: Table IV shows that, of 19 bajra varieties tested, varieties 89, 99, 135, 201, 262, 276 and 284 were not infected by either strain. Variety 367 was the only one to show infection by SCMV-A alone, the remaining varieties being infected by both strains. Varieties 117, 158, 304 and 376 showed high percentage infection, whereas varieties 260 and 345 showed the lowest percentage infection, viz., 12% and 8% respectively. Varieties 90 and 119, however, reacted differently with the two strains, showing higher percentage infection by SCMV-A.

Table IV. Susceptibility and reaction of different varieties of bajra (*Pennisetum*) to SCMV-A and SCMV-F

Variety	*Percentage of infection*		*Incubation period in days*		*Intensity of symptoms*	
	SCMV-A	*SCMV-F*	*SCMV-A*	*SCMV-F*	*SCMV-A*	*SCMV-F*
89	0	0	0	0	—	—
90	40	4	8	10	M	M
93	32	28	8	9	M	M
99	0	0	0	0	—	—
117	60	60	7	8	S	S
119	32	4	8	10	S	M
135	0	0	0	0	—	—
158	68	60	7	8	S	S
171	48	32	7	7	S	M
201	0	0	0	0	—	—
260	12	12	8	8	M	M
262	0	0	0	0	—	—
276	0	0	0	0	—	—
284	0	0	0	0	—	—
304	64	60	7	7	S	S
345	8	8	9	9	M	M
348	40	32	7	8	S	S
367	4	0	10	0	M	—
376	52	52	10	10	M	M

S = Severe, M = Mild, — = No infection.

As with maize and jowar, different varieties of bajra also differed in the intensity of symptoms. In nine varieties the symptoms were either severe or mild with both the strains. In variety 119 and 171 SCMV-A produced severe and SGMV-F produced mild symptoms.

Discussion

The present study reveals that cultivators in India should realize the risk of having a large number of susceptible varieties of maize, jowar, and bajra widely cultivated in the vicinity of sugar cane fields which aid in spreading mosaic disease of sugar cane. A large number of cane varieties are affected by mosaic disease while some show very severe symptoms. It is therefore advisable that only those varieties of sugar cane, maize, jowar and bajra which have been pretested for immunity to mosaic virus should be cultivated and thus greatly aid in the control of this disease.

Acknowledgments

We are grateful to the Head of the Division of Genetics, I.A.R.I., New Delhi, for providing seeds of the different varieties of maize, jowar and bajra. This investigation was partially supported by the funds provided by USDA under PL 480 grant.

Summary

Of the several varieties of sugar cane, maize (*Zea mays* L.), jowar (*Sorghum vulgare* L.) and bajra (*Pennisetum typhoides* Staff and C. E. Hubb) tested for their susceptibility and reaction to SCMV-A and SCMV-F only a few varieties were immune to both the strains. Cane variety BO 17 was not infected by any of the strains. One susceptible cane variety (CoS 245) showed very severe symptoms with SCMV-A. Two varieties (Co 740 and Co 1148) and one of bajra (367) were susceptible to SCMV-A while immune to SCMV-F. Maize varieties showed maximum percentage susceptibility.

Multiple elution with partial recycle

By JAN DOBRZYCKI

(Institute of Sugar and Food Technology, Technical University, Lodz, Poland)

SOME technological processes include cyclical elution of uniform porous beds by means of pure solvent. Examples of such elution are: sweetening-off of carbonatation mud, of bone char cisterns or of a column of ion exchange resin. The actual course of the batch elution exhibits behaviour between two extremes of:

—ideal displacement ("plug displacement") and

—complete mixing.

Perfect displacement (Fig. 1) gives a sharp drop of the effluent concentration curve. The borderline between wash liquor and displaced solution is as distinct as between two immiscible liquids. Theoretical usage is 1 m³ solvent per 1 m³ of the displaced interparticle solution. This ideal situation is actually interfered with by back-mixing. Through larger channels the wash liquor travels faster and dilutes the effluent. In smaller side-channels, some portions of the displaced solution lag behind, and the solute diffuses slowly into the main stream of solvent. This "tailing" effect renders the elution similar to the second condition above, i.e. complete mixing.

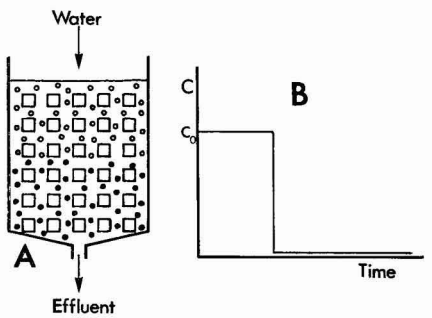


Fig. 1. Perfect displacement of interparticle liquid (A) and change of effluent concentration (B)

If the inflowing water could continuously and immediately mix with the whole solution filling the bed (as by the action of an impeller indicated in Fig. 2a), then the effluent concentration would decline exponentially (Fig. 2b).

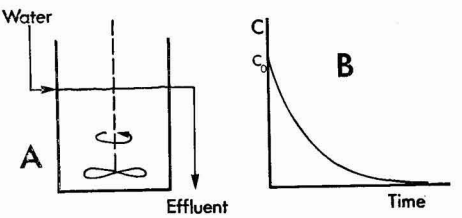


Fig. 2. Perfect mixing (A) and change of effluent concentration (B).

In practice, changes of effluent concentration follow a curve somewhere between the curves 1b and 2b. The shape of the curve depends on bed geometry, flow rate, viscosity, internal structure of the solid phase and other influencing factors. The result is that more than 1 m³ of wash liquor is required to expel totally 1 m³ of interparticle solution. In very difficult displacement conditions an exceedingly large amount of solvent must be used. The effects of this are: strong effluent dilution, losses to sewer, excessive fuel usage for water evaporation, etc.

Instead of total expulsion of the solution, some amount of the solute remains in the bed after the elution by a defined quantity of wash liquor. Let M kg be the amount of solute left in the bed from each kilogram of solute present in the original bed before the elution. M is the partition coefficient and $P (= 1 - M)$ kg is the amount of solute getting through to the effluent (eluate, washings, sweetwater etc.). We now make the simplifying assumption that the M kg are uniformly dispersed in the bed and thus the next elution will again split those M kg according

to the ratio $M:P$ between the bed and the effluent. After double elution the remainder is $M \cdot M = M^2$, after a third elution M^3, and so on.

Recycle elution

Larger or more numerous doses of washing water cause the dilution of effluent. Recycling of the effluent can be a remedy; the effluent is divided into several fractions and only the first fraction is separated; the other fractions are collected and recycled for the washing of the next batch of unwashed bed. Only the final washing fraction is performed with pure water.

Fig. 3 shows a plant for three-stage elution. Some additional equipment is necessary and the downtime of the plant is somewhat affected because of longer duration of the washing cycle. The economical counterbalance is more efficient extraction, or less dilution. It thus seems reasonable to develop general equations describing the recycle elution.

Several authors have proposed various "washing equations". A brief review of papers has been given by TOMIAK[1] who also presented theoretical equations and graphs for filter cake countercurrent washing. His rather complicated mathematics and simple graphs are based on the "wash" ratio of washings volume to the volume of cake liquid phase.

The following, more simplified, equations in this paper are based on the partition coefficient which is calculated from routine analyses of filter cake before and after the washing.

Each stage of model elution requires two steps:

(1) mixing of the interparticle solution of the bed with the eluting liquid,
(2) distribution of the solute between the remainder in the bed and the effluent according to a constant ratio $M:P$ (where $M + P = 1$).

The equations are developed for 1 part of solute, e.g. sugar, in each batch of solid phase—raw cake, precipitate, resin, active carbon, etc.—designated by capitals: A, B, C ... Small letters a, b, c ... denote the effluents. Once washed, bed A becomes A_0, twice A_1 etc. with corresponding effluents a_0, a_1 etc. (Fig. 4).

Mathematical model of 4-stage elution

The raw bed A washed with water gives effluent a_0

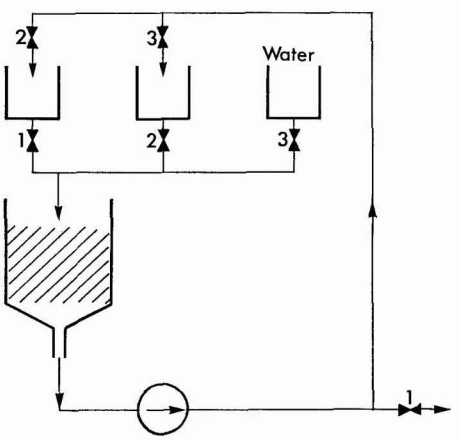


Fig. 3. Equipment for three-stage elution; 1—3 are valves to be opened during subsequent stages of elution

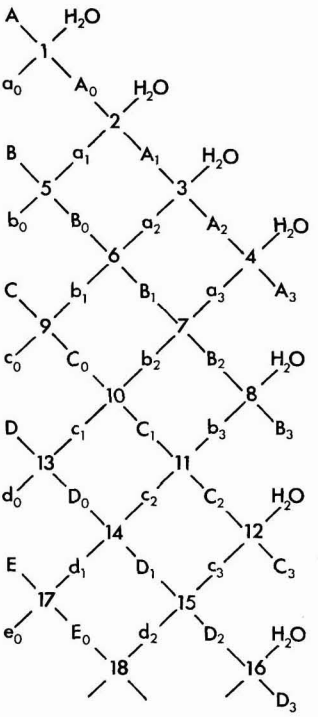


Fig. 4. Diagram of four-stage elution; A, B, C ... portions of bed (cake, resin column, etc.); a, b, c ... portions of effluent (sweetwater etc.)

containing P parts of the solute. The resulting bed A_0 contains M parts which after second elution with water is separated into

MP parts in the effluent a_1

and M^2 in the bed. The bed A_1 contains M^2 parts which after elution 3 with water is separated into

M^2P parts in the effluent a_2

and M^3 in the bed. The bed A_2 contains M^3 parts which after elution 4 with water is separated into

M^3P parts in the effluent a_3

and M^4 in the bed A_3.

The batch B contains again 1 part of the solute and it is mixed with the effluent a_1 containing MP parts, making together $1 + MP$; this is separated after elution 5 into

$P + MP^2$ parts in the effluent b_0

and $M + M^2P$ in the bed B_0. The bed B_0 is mixed with the effluent a_2 containing M^2P, to give $M + 2M^2P$ parts of solute, separated after elution 6 into

$MP + 2M^2P^2$ in the effluent b_1

and $M^2 + 2M^3P$ in the twice-washed bed B_1. This bed is mixed with the effluent a_3 containing M^3P, to give $M^2 + 3M^3P$ parts of solute separated after elution 7 into

$M^2P + 3M^3P^2$ in the effluent b_2

and $M^3 + 3M^4P$ in the thrice-washed bed B_2. This amount after elution 8 with water is separated into

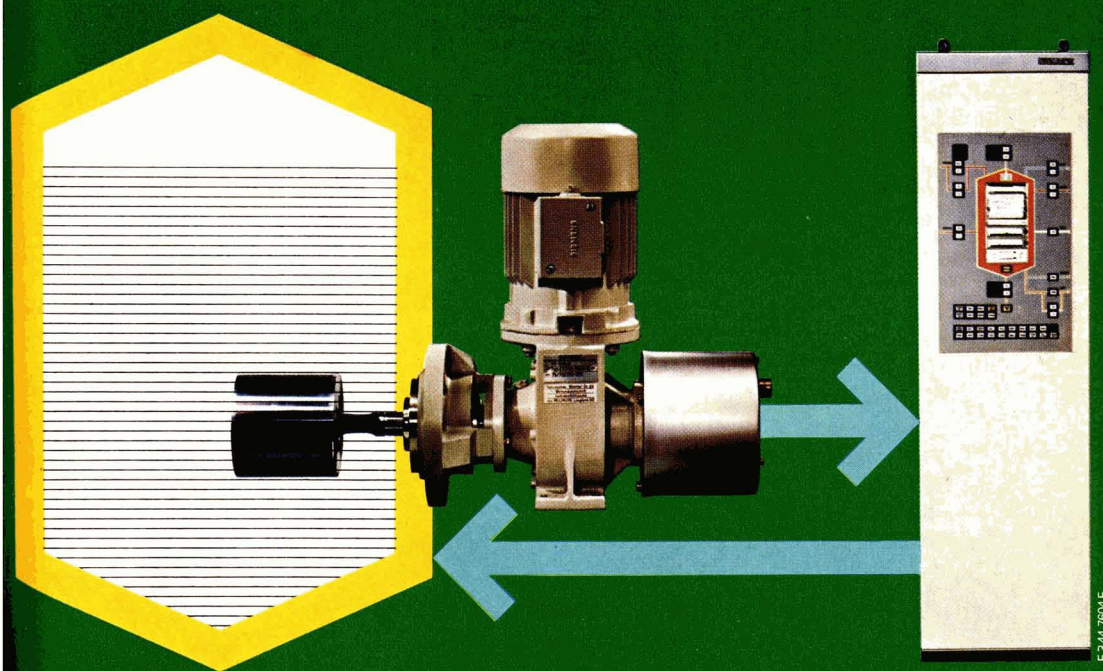
$M^3P + 3M^4P^2$ in the effluent b_3

and the four times-washed bed containing $M^4 + 3M^5P$.

[1] *Amer. Inst. Chem. Eng. J.*, 1973, **19**, 76.

SIEMENS

Better control of the sugar boiling process



In order to automate the sugar crystallization process, Siemens have developed an automatic boiling control system. Conductivity or viscosity/consistency are used as substitute variables for the degree of supersaturation and crystal content. The transmitter is flanged to the wall of the vacuum pan.
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- uniform crystals of definite size and high quality
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Similar calculations with the batch C give, after elution 9, the effluent c_0 with

$$P + MP^2 + 2M^2P^3 = P + MP^2(1 + 2MP)$$

and, after elutions 10, 11 and 12, the four times-washed bed C_3 with

$$M^4 + 3M^5P + 8M^6P^2 = M^4(1 + 3MP + 8M^2P^2)$$

The next batch D after four elutions 13, 14, 15 and 16 becomes D_3 containing $M^4(1 + 3MP + 8M^2P^2 + 21M^3P^3)$. The effluent d_0 contains:

$$P + MP^2(1 + 2MP + 5M^2P^2)$$

The stationary state, i.e. after many cycles, is characterized by the solute content:

$$X_4 = M^4(1 + 3MP + 8M^2P^2 + 21M^3P^3 + 55M^4P^4 + \ldots)$$

in the washed bed, and

$$Y_4 = P + MP^2(1 + 2MP + 5M^2P^2 + 13M^3P^3 + 34M^4P^4 + \ldots)$$

in the eliminated (not recycled) portions of effluent.

The coefficients of both equations are in conformity with the famous FIBONACCI sequence:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 . . . which begins with two units 1, 1—and each next term is the sum of two previous terms.

In order to find the sums X_4 and Y_4 we put $MP = Z^2$ and seek the "basic" sum

$$F = 1 + Z + 2Z^2 + 3Z^3 + 5Z^4 + 8Z^5 + 13Z^6 + \ldots$$

The simplest way to solve the problem is to rearrange the terms:

$$F = 1 + Z + Z^2(1 + Z + 2Z^2 + 3Z^3 + 5Z^4 + \ldots) + Z(Z + 2Z^2 + 3Z^3 + 5Z^4 + \ldots)$$

$$F = 1 + Z + Z^2F + Z(F - 1)$$

thus

$$F = \frac{1}{1 - Z - Z^2}$$

An auxiliary series is formed by the substitution of $-Z$ for $+Z$:

$$F' = 1 - Z + 2Z^2 - 3Z^3 + 5Z^4 - 8Z^5 + \ldots = \frac{1}{1 + Z - Z^2}$$

The sum of both series divided by 2 gives:

$$\frac{F + F'}{2} = 1 + 2Z^2 + 5Z^4 + 13Z^6 + \ldots = \frac{1 - Z^2}{1 - 3Z^2 + Z^4}$$

and, since $Z^2 = MP$

$$1 + 2MP + 5M^2P^2 + 13M^3P^3 + 34M^4P^4 + \ldots = \frac{1 - MP}{1 - 3MP + M^2P^2}$$

Thus

$$Y_4 = P + MP^2\left(\frac{1 - MP}{1 - 3MP + M^2P^2}\right) = \left(\frac{1 - 2MP}{1 - 3MP + M^2P^2}\right)P$$

In order to find the value of X_4 we must first calculate:

$$\frac{F - F'}{2Z} = 1 + 3Z^2 + 8Z^4 + 21Z^6 + 55Z^8 + \ldots = \frac{1}{1 - 3Z^2 + Z^4}$$

and, since $Z^2 = MP$,

$$1 + 3MP + 8M^2P^2 + 21M^3P^3 + 55M^4P^4 + \ldots = \frac{1}{1 - 3MP + M^2P^2}$$

Thus

$$X_4 = \frac{M^4}{1 - 3MP + M^2P^2}$$

(obviously $Y + X = 1$)

Three- and two-stage elution

Similar calculations in the case of elution in three or two stages with recycling of effluents give the following formulae:

$$X_3 = M^3(1 + 2MP + 4M^2P^2 + 8M^3P^3 + \ldots) = \frac{M^3}{1 - 2MP}$$

$$Y_3 = \frac{1 - MP}{1 - 2MP}P$$

$$X_2 = M^2(1 + MP + M^2P^2 + M^3P^3 + \ldots) = \frac{M^2}{1 - MP}$$

$$Y_2 = \frac{1}{1 - MP}P$$

The values of $X = f(M)$ are plotted in Fig. 5. The diagram permits a calculation as in the following example.

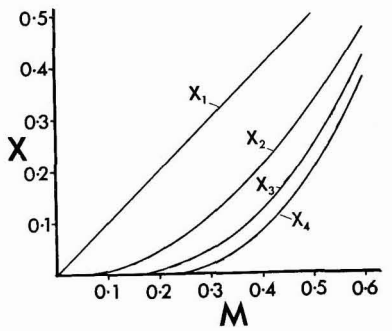

Fig. 5. Solute content in the washed bed (X) as ratio of solute content in unwashed bed, depending upon partition coefficient M and number of stages X_1—X_4

Let us assume that a bed of resin after the service cycle contains 5% sugar and that after simple sweetening-off with a given volume of water the sugar content of the bed is reduced to 1% sugar. Thus: $M = 0{\cdot}2$. The following values of X correspond to Fig. 5 for the value $M = 0{\cdot}2$:

$X_1 = 0{\cdot}2$ $X_2 = 0{\cdot}05$ $X_3 = 0{\cdot}01$.

Using the same volume of water but applying a two-stage recycle elution we can expect retention of only $\frac{0{\cdot}05}{0{\cdot}2} = 0{\cdot}25\%$ sugar, i.e. a quarter of the value for single-stage washing. Application of three-stage recycle elution gives $\frac{0{\cdot}01}{0{\cdot}20} = 0{\cdot}05\%$ sugar loss, i.e. only one-twentieth of that with single-stage washing. As the formulae are based on pure mixing without displacement within the bed, the real loss diminution can be less than these figures.

(continued on page 142)

Sugar cane agriculture

Nematodes and sugar cane. J. DICK and R. H. G. HARRIS. *S. African Sugar J.*, 1975, **59**, 397–410. Work on nematodes and their control is surveyed (with 45 references to the literature). The genera and species found in South African cane fields are listed. The most severe symptoms of injury by the pest occur in sandy soils, and it is only in these soils that treatment with nematicides has given spectacular improvement in cane growth. Of the various chemicals tested, fumigants have proved unable to eliminate plant parasitic nematodes completely, whereas "Temik" (described as a "nematistat" rather than a "nematicide") does not cause immediate reduction in the numbers of nematodes in the soil but is effective in preventing a subsequent build-up in populations. No consistent results have been obtained as regards effect of chemical control on cane sugar content, although comparison between treated and untreated plots has indicated an increase in cane weight sufficient to offset any reduction in sugar content. Recommended nematicide rates are given, and the effects of chemicals on ratoons and factors influencing their efficacy are discussed. Advantages of "Temik" are listed and mention made of trials with more recent chemicals. Other control measures are considered, but it is pointed out that biological control has been little investigated in South Africa because of fears that conditions are not suitable for introduction, propagation and dissemination of effective parasites. A number of aspects of which further investigation may be justified are briefly discussed, including movement and spread of nematodes, difficulty in predicting the effectiveness of a given nematicide, the apparent resistance of cane to nematodes in "better" soils, interaction between disease organisms and nematodes, and further studies on nematicides to determine economical rates of application, timing of treatment, spacing and placement of the chemicals, residual effects and the possible value of split dressings.

* * *

Eldana **borer control and smut in Swaziland.** G. THOMPSON. *S. African Sugar J.*, 1975, **59**, 417. Attacks by the *Eldana* borer in South Africa and Swaziland have caused concern, and the possibility of importing parasites from Ghana has been suggested. The pest is apparently indigenous to Africa and has been observed across the full width of Central Africa and down the east coast as far as Natal. Hence, the recent outbreaks are probably due to conditions favouring the multiplication and spread of the borer rather than the result of a new introduction. The outbreak of smut in Swaziland has been assessed and a number of recommendations made regarding its control; among these is the eradication of N:Co 310 cane.

* * *

High-speed photographic analysis of sugar cane harvesting and cleaning mechanisms. J. E. CLAYTON. *Sugar News* (Philippines), 1975, **51**, 249–252.—See *I.S.J.*, 1975, **77**, 145, 209.

* * *

A forty-two year summary of United States Sugar Corporation sugar cane production, variety census, origin of Clewiston varieties. E. H. TODD. *Sugar J.*, 1975, **38**, (3), 36–38, (6), 26-27.—Details are given of cane and sugar yields obtained by the USSC in Florida during the period 1933–74 and the varieties grown and their relative importance. Mention is made of Cl (Clewiston) varieties bred by the USSC, and the parentages of these varieties are indicated.

* * *

Improved sugar cane quarantine facilities and procedures at Beltsville, Maryland. A. G. GILLASPIE and C. C. MCKNEW. *Sugar J.*, 1975, **38**, (3), 40–43.—See *I.S.J.*, 1975, **77**, 79.

* * *

Aspects of modelling sugar cane growth by computer simulation. T. A. BULL and D. A. TOVEY. *Sugar J.*, 1975, **38**, (3), 50–55.—See *I.S.J.*, 1975, **77**, 117.

* * *

Screening of sugar cane varieties for smut resistance. S. MUTHUSAMY and S. SITHANANTHAM. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 1–2.—Results are given of screening trials at Sirugamani sugar cane research station in India. Of 103 varieties tested, 20 were immune, 33 highly resistant, 13 resistant, 27 susceptible and 10 highly susceptible. Varieties Co 453 and Co 603 were parents associated with resistance in their progeny.

Continued from page 141

For evaluation of the economics of multistage-recycle elution we must also consider the disadvantages of this scheme. These are: additional piping, remote control valves and tanks, as well as the diminution of plant performance because the total cycle time is lengthened.

Summary

After the service cycle of a porous layer (e.g. after the filtration, active carbon decolorizing, ion exchange, resin regeneration, etc.), the immobile, insoluble bed (solid phase), soaked with the residue of the percolating solution, is usually washed with a solvent in order to eliminate the major part of the inter-particle solution.

The consumption of solvent and the accompanying dilution can be reduced if the effluent is split into fractions and the less concentrated fractions are re-used for the preliminary elution of the following unwashed portions of the porous layer. Mathematical equations of mass partition during such recycle elution are developed and discussed.

Pineapple disease on standing sugar cane in Nigeria. S. K. MANZO. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 3–4.—A severe outbreak of pineapple disease in northern Nigeria in 1974 is reported. Symptoms are described and mention made of difficulties in brown sugar manufacture, particularly in crystallization, when infected and healthy canes were processed together. The severity of the outbreak was attributed to drought.

* * *

Streak disease on sugar cane in the Sudan. I. A. NASR. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 5. Descriptions are given of symptoms of a disease, believed to be streak, on a 1st ratoon crop of N:Co 310 cane at Guneid. The outbreak is the first of its kind in the Sudan.

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Small coryneform bacteria in ratoon-stunted sugar cane. C. T. CHEN, S. M. LEE and M. J. CHEN. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 6–8.—Electron microscopy revealed the presence of small coryneform bacteria, similar to those found by TEAKLE *et al.*[1], in RSD-infected N:Co 310 and 64-836 cane. The bacteria, 0·12–0·30 μ wide and 1·20–3·00 μ long, were absent from healthy plants.

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Natural infection reaction to smut disease. S. L. LADD, D. J. HEINZ, G. W. STEINER, R. S. BYTHER, J. C. COMSTOCK and H. K. MEYER. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 9–10.—Results of trials are reported in which 117 clones were planted at random, after hot water and fungicide treatment, in three replicates and surrounded by artificially inoculated susceptible clones. It was found that the dip inoculation method used for smut resistance testing[2] correlated well with natural tolerance, and that propagation of only those clones with less than 20% infection (indicating greater than 5% natural infection) would exclude virtually all susceptible clones. On the other hand, it is admitted that artificial inoculation may eliminate some clones which are tolerant under natural conditions.

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Crow foot grass (*Dactyloctenium aegyptiacum* Wild.), another natural host of sugar cane mosaic virus from Gorakhpur, India. C. A. K. SINGH and K. S. BHARGAVA. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 12.—*D. aegyptiacum*, a common grass in localities around Gorakhpur which is used largely as a fodder, has been found to be a natural host of cane mosaic virus. Since the grass is a perennial plant, it can harbour virus inoculum for a long period and support multiplication of the virus, thus posing a serious threat to cane in the region.

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Effects of sub-freezing temperature on survival of the red rot fungus. R. J. STEIB. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 11.—*Physalospora tucumanensis*, the causal agent of red rot, was grown on oatmeal agar in Petri dishes and exposed to a temperature of —19°C for 10 days, after which incubation was carried out at room temperature (26°C). Growth commenced in 5 days as mycelial patches, with the greatest concentration on the periphery of the agar against the side of the dish. When growth covered the agar, the culture was re-exposed to —19°C for 1 month, after which survival was similar to that after 10 days at —19°. A third exposure period of 2½ months did not destroy the fungus but survival was somewhat diminished. The conclusion is that red rot fungus in the mycelial state in the soil or on cane residue is probably able to survive winter conditions in Louisiana and so provide a source of infection in the spring.

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Yellow wilt at Condong, New South Wales. A. G. HAYES. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 13–14.—Rapid yellowing of older leaves followed by general wilting of stools and finally by discoloration of young leaves was a condition found on cane in a region of NSW which had suffered from widespread flooding. The disorder was confined to areas where the soil had previously been disturbed, particularly where drain spoil had been spread and old creek beds filled; appearance of the symptoms coincided with the drainage of inundated land 5–10 days after the flood peak. Within 7 days of the initial yellowing, the affected tissue became necrotic, with considerable vascular reddening in the nodal region of affected stalks. Growing points became slightly discoloured, and the root system in both healthy and affected cane was somewhat retarded. However, within 2–3 weeks, affected plants showed signs of recovery and resumed growth; young re-growth had a normal green colour, although there was substantial reduction in yield. The root systems of plants in adjacent healthy areas showed more rapid and extensive re-growth after the flood than did roots of affected cane. Investigations of the soil condition and nutrient status of affected cane showed a considerable nutritional imbalance resulting from salt toxicity; considerable uptake of Mg and Ca was accompanied by an exclusion of N, whereas K uptake was normal. The normal mineral balance was restored once the salts water table had fallen. The situation was regarded as a transient problem which could easily be alleviated by adequate sub-soil drainage. More recent observations have shown that the problem has almost disappeared under normal local rainfall conditions.

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Diseases of sugar cane recorded in India. S. M. P. KHURANA and S. SINGH. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 17–22.—A list is presented of cane diseases encountered in India; causal agents are recorded, and 66 references are given to the literature.

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Bacterial sun spot, a new disease of sugar cane and sweet sorghum. N. ZUMMO and K. C. FREEMAN. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 15–16. Cultural and morphological studies of an organism associated with leaf spots on cane growing at Meridian, Mississippi, USA, revealed a small, rod-shaped bacterium of the *Pseudomonas* genus. The spots were generally elliptical and measured 4–20 mm; a halo formed around the lesions, and sometimes a runner similar to, but shorter than, runners of eye spot caused by *Bipolaris sacchari*. The bacterial "sun spot" was also found on sweet sorghum; there was abundant ooze on the underside of the spot, and the disease was easily transmitted by inoculation or by taping infected leaves to leaves of healthy cane. Although no visible loss was shown by cane as a result of the

[1] *I.S.J.*, 1975, 77, 174.
[2] *ibid.*, 77.

disease, none of several thousand varieties at Meridian remained completely free from it.

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A possible basis of resistance to ratoon stunting disease. D. S. TEAKLE, P. M. SMITH and D. R. L. STEINDL. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 22. A positive correlation has been established between cane resistance to RSD and resistance to movement of water and Indian ink, suggesting that vascular anatomy is involved. The causal agent could experience greater difficulty in moving through the nodes of immune and tolerant cane than in the case of susceptible cane; it is already known that one of the tolerant varieties used in the tests has mainly discontinuous vessels through the nodes, so that ready migration of conidia of the red rot fungus up or down the stalk is prevented. The average number of vascular bundles carrying Indian ink through double-node cuttings of two susceptible varieties was greater than for three tolerant or immune varieties; if the correlation is confirmed, the screening of varieties on the basis of the water flow rate through single-node cuttings may be possible.

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Leaf scald disease in Q 93 at Bundaberg, Australia. G. PERSLEY. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 23–25.—See *I.S.J.*, 1975, **77**, 333.

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Additives to the hot water-treatment tank. G. L. JAMES. *Sugarcane Pathologists' Newsletter*, 1975, (13/14), 27–28.—Tests showed that addition of urea, ammonium nitrate or ammonium sulphate (at 0·3% w/v) to hot water used to treat cane against ratoon stunting disease (2 hours' immersion at 50·5°C) had an effect on tiller populations which was governed by the nature of the additive and the variety treated; the effect varied from a lesser to a greater population than without additives, in some cases there being no difference at all.

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The effect of RTD on sugar accumulation in sugar cane. K. VENUGOPAL and T. P. PALANIAPPAN. *Sugar News* (India), 1975, **7**, (1), 39–41.—A high correlation was established between RTD (Relative Temperature Disparity) and cane sugar content whereby increase in RTD was accompanied by increase in cane sugar. RTD is given by $\frac{Mx - Mn}{Mx}$. 100 where Mx = mean monthly maximum temperature and Mn = mean monthly minimum temperature. For highest sugar accumulation the night temperature should be about 17°C.

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Problems in implementing mechanical sugar cane harvesting in Florida. J. E. CLAYTON and W. C. HEDICK. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 20–23.—Various aspects of mechanical cane harvesting in Florida in 1972–73, considered to be the first season in which harvesters were used commercially, are discussed.

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Mechanical harvesting of sugar cane and its effect on the factory at Talisman Sugar Corporation. J. CASTRO and J. J. BALERDI. *Proc.* 1973 *Meetings Amer. Soc Sugar Cane Tech.*, 24-25.—While the costs of mechanical harvesting were found to be less than half those of manual cutting, the trash volume increased in 1972–73 (the first mechanical harvesting season) compared with previous amounts, with the result that the cane fibre content and bagasse volume rose, while mill extraction fell. Increase in cane compaction (brought about because of the shorter stalks) led to cane conveyor problems, and various mechanical failures occurred at the milling end. The filter and clarifier stations had to handle greater quantities of mud, but boiling house operations were normal as were the size and shape of the sugar crystals.

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The A. Duda and Sons mechanical furrow stalk chopper. G. DODGEN. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 26.—The chopper was designed to cut cane lying in the furrow into lengths of 18–20 inches, to apply insecticide, cover cane and pack dirt on the top of covered cane. It was used on about 2000 acres in 1972–73.

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Evaluation of pre-harvest, foliar-applied chemicals for sucrose enhancement in Florida sugar cane. J. R. ORSENIGO and S. L. HOOKS. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 27.—Reference is made to trials with a number of cane ripeners, and criteria of ripener performance are mentioned.

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Testing chemical ripeners for sugar cane in Louisiana. B. L. LEGENDRE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 28–33.—Trials with "Polaris" and TD-692 are reported. It is stressed that chemical ripeners are less likely to succeed in Louisiana, where the night temperatures and the rainfall are low, than in tropical areas.

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Sucrose enhancement with "Polaris" in Louisiana sugar cane. K. R. FROST. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 34.—See *I.S.J.*, 1974, **76**, 174.

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Fallow flooding for control of Johnson grass in sugar cane: effect of bagasse application and time and depth of flooding. J. F. PARR, M. M. MAYEAUX, C. R. CAMP and B. R. CARROLL. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 35.—Three plots were flooded to depths of 5, 10 and 15 inches during 7, 5 and 3 months, respectively, after which the soil was drained and cane planted. Observations showed that there was a substantial fall in Johnson grass seed populations in all plots compared with controls, the effect increasing with duration of flooding, and being further enhanced by the incorporation of bagasse in the top 6 inches of soil at the rate of 10 tons per acre before the flooding. The overall effects with the greater depths of flooding were not as good as with the 5-inch depth, possibly because higher temperatures in the shallow-flooded plots contributed to a higher level of microbial activity, which in turn caused a greater fall in the reducing-oxidation potential.

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The use of chemical herbicides to control rhizome Johnson grass in Louisiana sugar cane. E. R. STAMPER. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 36–39.—Application of "Asulox" by ground or aerial spraying in trials conducted in 1972 gave good control of Johnson grass. The chemical has proved to be effective against most broad-leaved grasses but has

little or no effect on fine or narrow-leaved grasses; it is very slow in action and usually required 3–4 weeks to give visual effects with Johnson grass. Data are tabulated.

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Production of true seeds from basic lines of *Saccharum* and related genera in new crosses at Houma, Louisiana. P. H. DUNCKELMAN. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 40–41.—The first crosses between *Saccharum* spp. and related genera were made at Houma in 1972. Characteristics sought in the new breeding programme are mosaic resistance, borer resistance, cold tolerance, greater erectness for mechanical harvesting and greater yields in more ratoon crops. Information is given on the crossing programme and seed production.

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A new method of synchronization of flowering in sugar cane. E. D. PALIATSEAS. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 42–46.—See *I.S.J.*, 1975, 77, 13.

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Selection of high-sucrose experimental clones from single-stool Brix data. C. A. RICHARD and M. T. HENDERSON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 47–52.—In experiments, 100 single stools from each of four crosses, differing in rated sucrose content, were selected at random and the Brix determined by hand refractometer. Each stool, along with six replications of each parent, was then planted in 10-foot plots; in the following year the cane was harvested once, while in the subsequent year it was harvested twice, and the sucrose content determined for each harvest. Results indicated a moderate degree of correlation between the stool Brix and sucrose content of the clones, although not all clones were consistent as regards sucrose content determined at two harvests in one year, so that the stool Brix-cane sucrose association may be stronger than suggested.

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CP 65-357, a new sugar cane variety for Louisiana. H. P. FANGUY. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 53–55.—Trials conducted on this variety in 1972 are reported and its characteristics compared with those of other varieties in the L and CP series.

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Breeding for resistance to mosaic strain H in Louisiana. R. D. BREAUX and P. H. DUNCKELMAN. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 56–61.—The history of cane mosaic is briefly presented and screening of varieties for resistance to strain H of the disease described. The breeding work at Houma to produce high-yielding, resistant varieties is reported.

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Mixed infections of sugar cane with sugar cane mosaic virus and maize dwarf mosaic virus. H. KOIKE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 62–64. See GILLASPIE & KOIKE: *I.S.J.*, 1975, 77, 175.

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The recovery of sugar cane from infection with sugar cane mosaic virus: variety Co 285 and strain D. G. T. A. BENDA. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 65–73.—It has been known for some years that it is possible to obtain symptomless shoots from the buds of cane plants exhibiting mosaic symptoms, such shoots being described as "recovered". In tests, one-node cuttings from infected stalks of Co 285 cane grew recovered shoots, although the number of recovered plants was reduced by treating the cuttings with hot water. The results are discussed, and it is concluded that, on a fully-grown stalk, recovery is unrelated to age or position of the bud, that virus is present in some cuttings which, without heat treatment, would probably be considered as recovered, that virus may be restricted in the shoots before the plant develops symptoms, and that a sub-acute infection may persist in the cane population.

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(Effect of) Rate of planting on yield of sugar cane infected with mosaic. R. J. STEIB and S. J. P. CHILTON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 74. See *I.S.J.*, 1975, 77, 81.

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The effect of fungal isolates from sugar cane on seed piece germination. S. M. YANG. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 75–78.—In a long-term investigation of variety yield decline at Houma, where the same variety of cane has been grown since 1964, it was found that stands of plant cane were not as good in later crops as in the earlier growth cycles. Studies were undertaken to determine if pathogenic fungi found in ungerminated seed pieces were responsible for the yield decline through their action on bud viability under both controlled and field conditions. Tabulated results indicate that the three fungi (*Ceratocystis adiposa*, *C. paradoxa* and *Fusarium moniliforme*) injected into seed pieces, killed buds near the site of inoculation within six weeks, the first two fungi being more pathogenic than *F. moniliforme* and significantly reducing the shoot number of all seven varieties tested. Differences were found in the reactions of the varieties to the three fungi.

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Evaluation of sugar cane (*Saccharum* sp.) selections for eye spot resistance. J. D. MILLER. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 79–82.—Screening tests for resistance to eye spot are reported in which more than half of the crosses were found to be too susceptible for commercial production, while 10% were more resistant than commercial varieties and 35% were moderately resistant.

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Effects of inter-row spacing on sugar cane yields in Louisiana. R. J. MATHERNE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 114.—See *I.S.J.*, 1975, 77, 114.

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Maintaining maximum yields in Florida with skip planting. J. W. BEARDSLEY. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 115.—A system for increasing cane plant population without expanding the area is described in which seed pieces are planted in skips or gaps between established cane rows. Results are discussed.

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Yield and nutrient element content of roots and below-ground stubble as related to fertilization of sugar cane and soil variation. L. E. GOLDEN. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 116–119.—Investigations of cane root and underground stubble yields as a function of fertilization and soil type are reported. Wide differences were found in cane yield per acre with variation in soil, but no significant differences were found between root yields per acre, whereas there were wide differences between root yields per ton of millable cane with variation in soil type. A positive correlation was found between cane yield and underground stubble yield per acre, but since root yield was much greater than stubble yield, a highly significant negative correlation was established between cane yield on the one hand and root and stubble yield on the other. No

significant differences were found in root and stubble nutrient contents as a result of fertilization, but significant differences occurred in nutrient contents (N, P, K, Ca, Mg and S) of both roots and stubble per ton of millable cane as a function of soil type.

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Leaf sheaths and the germination of young axillary buds in sugar cane. G. T. A. BENDA. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 120.—Cane supplied only with distilled water has been grown in the dark as large cuttings or as tops with several mature nodes. Because of the stored food, the shoots, especially of certain varieties, can grow and live for many weeks without sufficient light to turn the developing leaves from yellow to green. The buds from large cuttings may develop into a tillering stool, consisting of a mother shoot with growing axillary shoots, before growth finally ceases. The tops of Co 205 cane, with leaf blades trimmed back, grow in length by the formation of new internodes and develop axillary shoots. These shoots tend to develop from the buds of older immature nodes when the sheaths from these nodes have been removed; when the sheaths are left intact, the axillary shoots tend to develop from mature nodes only. These results suggest that the sheaths may inhibit the germination of young buds where the nodes and internodes are roughly cylindrical (as near the top), but not where the nodes and internodes are very close together and like fulcrums of inverted cones (as at the base of the mother shoot).

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Estimating the total leaf area in sugar cane varieties. J. E. IRVINE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 121–123.—Leaf area estimates are of value in studies of pesticides, borer parasites and predators, and of production efficiency when the total leaf area is related to total land area. Details are given of a rapid method for determining total leaf areas in which the leaf area is related to leaf fresh weight. Differences between *Saccharum* species had the greatest effect on variation in area per unit weight, while differences caused by leaf age, between individual plants and between varieties of any one species were relatively unimportant. Values are tabulated for a number of varieties of *S. officinarum* and *S. spontaneum* as well as *Saccharum* hybrids and related genera.

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Florida sugar cane attacked by white grubs in 1972. T. E. SUMMERS. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 124.—Attacks by *Eothymus subtropicus* were reported in late August and early September, nearly mature plants being found dying as a result of root destruction by the grub. Affected areas ranged from a few square yards to entire 20-acre fields. Good control was obtained by field flooding continuously for 144 hours.

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Mass rearing the sugar cane borer. R. D. JACKSON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 125.—Details are given of the system used at Houma, Louisiana, for mass rearing of *Diatraea saccharalis*.

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L 60-14, a tropical sugar cane variety. M. GORONEL, F. CHU and S. J. P. CHILTON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 126.—Information is given on the performance of this cane in Nicaragua, where it was introduced in 1965 as an early to mid-season variety (November-February) for tropical areas.

Effect of frost on certain sugar cane varieties grown in the lower Rio Grande Valley of Texas. K. A. SUND and B. A. SMITH. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 127–131.—Damage to cane by frost on two successive days in January and February 1973 is described. Investigations showed a marked fall in average recoverable sugar per ton of cane as a result of the earlier frosts, while some varieties showed a deterioration in juice (as indicated by an apparent increase in ash % solids) as a result of the later frosts.

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Field losses and trash content of hand-cut and mechanically-harvested sugar cane in Florida. J. E. CLAYTON, G. A. ZEPP and W. C. HEDICK. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 146–148.—Comparison of trash contents and field losses was made between hand-cut and mechanically-harvested cane. While losses averaged 5·3% of total yield for hand-cut cane and 8·6% for mechanically-harvested cane, the difference was not considered so great as to justify rejection of mechanical harvesting but was regarded as more important in comparing costs of both systems. On the other hand, the difference in trash content between manual cutting (5·5%) and mechanical harvesting (8·3%) was considered more significant, particularly since most of the trash in the mechanically-harvested cane was green, while equal proportions of green and dry trash were found in the hand-cut cane. The problem is felt to be one of efficiently harvesting lodged cane.

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Costs for mechanically harvesting sugar cane in Florida. G. A. ZEPP and J. E. CLAYTON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 149–153.—The costs of manual cutting with continuous loading in 1972-73 were $3·69 per ton of cane compared with $3·83 for mechanical harvesting; the costs of the latter system were expected to fall in the future as outputs increased. The costs included the additional field losses with mechanical harvesting as well as reduced cane quality and lower cane payment.

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Trash sampling studies at Louisiana sugar cane mills. D. P. VIATOR. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 158–163.—Results are tabulated for 18 factories from which completed questionnaires were received, showing the trash content % cane for the period 1947-72. Factors suggested as causes of high values in 1971 and 1972 include: high rainfall during harvesting, use of mechanical grabs to obtain trash samples, changes in harvesting operations, e.g. adoption of push-pilers, placing of cane from six rows in one heap, and varietal differences. Of these, rainfall and trash sampling were subjected to further study. Sample sizes should be greater than 50 lb; while 150-lb samples are preferable, it is conceded that such a size is probably unpractical at many factories.

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Deterioration in whole and chopped sugar cane. J. E. IRVINE and B. L. LEGENDRE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 174–181.—The deterioration rates were measured as changes in Brix, sucrose, purity, acidity and gum content under the action of stalk size, bacterial strain, burning, freezing, variety and type of cut. The rates were found to be greatest in small pieces of cane and were accelerated by burning or freezing. No differences were found as a result of strains of *Leuconostoc mesenteroides* in the four locations involved. The gum content was little affected

by the use of rotary *vs.* counter-rotating, circular blades. Varietal differences were found between the rates for chopped cane. Unburnt or unfrozen cane harvested by chopper-harvesters should be crushed 1–2 days after harvesting, depending on the size of the stalk pieces, the smaller pieces requiring the shorter delay.

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What causes trash? F. N. BOLTON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 164–166.—Reasons for high trash contents in cane supplied by certain growers to the author's sugar factory are investigated, including land preparation, particularly row width and height; varietal selection; mechanical harvesting efficiency; burning and loading.

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Mechanical harvesting in Louisiana: the effect on cane quality and processing response—1972 studies. J. J. SEIP and J. A. SALAZAR. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 182–191.—Studies of cane harvesting by a J & L chopper-harvester are reported in some detail. The investigations are described as the initial phase of a continuing programme and only tentative conclusions are drawn. A single run in December yielded cane from which soil, loose stubble and tops were essentially absent, while milling performance was excellent; even a 4-day delay between cutting and grinding (at low ambient temperatures) did not adversely affect quality. Threshold values for gums % Brix and dextran % Brix are suggested.

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Some results of herbicide trials conducted in the Rhodesian sugar cane industry. J. E. LONSDALE. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 115–121.—Pre- and post-emergence herbicide trials are reported in which "Atrazine" proved the most suitable pre-emergence chemical against broad-leaved weeds but was weak against grasses; "Ametryne" + "Alachlor" proved successful against grasses but requires further investigation. The most successful pre-emergence herbicide was "Sencor" ("Metribuzin"), but this was also the most expensive chemical. "Ametryne" was the best post-emergence herbicide against broad-leaved weeds and against grasses provided they were not too advanced at the time of spraying. No advantage was found in the use of wetting agents with "Ametryne", and in fact there were indications that they may increase phytotoxicity. Phytotoxicity of 2,4-D is discussed, as are other aspects of herbicide application, including measurement of residual effects.

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Results of screening pre-emergence herbicides for sugar cane. G. A. IGGO. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 122–125.—Three pre-emergence herbicide trials and one trial to evaluate the phytotoxic effect of certain herbicides on cane are reported. In the tests, the activities of 11 coded compounds, used alone or in combination with other herbicides, were compared with those of herbicides currently recommended by the SASTA Experiment Station at Mount Edgecombe. Results, which are tabulated, showed that the currently recommended pre-emergence herbicides "Alachlor" + "Atrazine", "Metribuzin", 2,4-D and MDPA gave consistent results. However, "Destun" (MBR 8251) was the only chemical evaluated to give commercially acceptable control of *Cyperus esculentus* and *C. rotundus* as well as controlling grasses, although a number of broad-leaved weeds were tolerant to it. Other combinations gave control of *C. esculentus* or *C. rotundus* and of grasses and broad-leaved weeds.

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The containerization of herbicide mixtures as developed at Illovo. M. R. BOAST. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 126–128.—Information is given on the system used at Illovo in which herbicide application errors are reduced by mixing the chemicals into a concentrated slurry which is then packed into plastic bags; these are stored in sealed containers until use, the contents of one bag being added to each knapsack. A pacemaker is also briefly described which is of value in correcting the walking speed of men spraying from knapsacks.

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Advances in the interpretation of foliar analysis of sugar cane in the South African sugar industry. J. H. MEYER. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 129–136.—Since foliar diagnosis based on the principle of minimum values has not always been found satisfactory for interpretation of the P status of sugar cane, investigations were conducted on evaluation of the approach using ratios between N, P and K in the top visible dewlap leaf. Results, which are discussed in some detail, indicated that an interpretation based on the N:P, N:K and K:P ratios can greatly improve the chances of a correct diagnosis, particularly for P, provided sampling conditions are standardized. Moreover, ratios are of value in studying nutrient interactions, which helps in the understanding of how soil and cane react to different fertilizer treatments.

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Diagnosis of the N-P-K requirements of sugar cane irrespective of plant age and season using Beaufils' system (DRIS)—preliminary observations. M. E. SUMNER and E. R. BEAUFILS. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 137–141.—The DRIS (Diagnosis and Recommendation Integrated System) developed by BEAUFILS was originally intended for rubber in Vietnam but has subsequently been the subject of investigations in other crops including sugar cane in South Africa. The system is based on establishment of a chart comprising two concentric circles divided into equal segments by straight lines passing through the centre; three successive lines are assigned to the K:P, N:P and N:K ratios, respectively, while any three adjacent areas formed by four lines are assigned to N, P and K, respectively. Any one area comprises the segment of the inner circle, a section of the outer circle and the space beyond the circumference of the outer circle but still bounded by the extended straight lines. A system of horizontal, vertical and sloping arrows is used for qualitative designation of the N, P and K values, which are also entered numerically. These are allotted for six reaction intermediates, viz. soil properties, climatic conditions, farming practices, soil treatment + properties, soil response + climatic conditions + farming practices, and plant response. An index value basically represents the distance by which any particular characteristic deviates from its optimum position in relation to its balance with other characteristics. [Full details of the method used to construct the chart and obtain diagnostic indices are given in *Soil Science Bulletin*, 1973, (1), a publication of the University of Natal.] Preliminary investigations have indicated that an improved sensitivity in the diagnosis of N, P and K requirements can be reasonably expected by use of the method at any stage of cane growth regardless of moisture status, season and variety.

Sugar beet agriculture

Effect of powdery mildew on sugar beet production. F. J. HILLS, D. H. HALL and D. G. KONTAXIS. *Plant Disease Reporter*, 1975, **59**, 513–515.—In field trials at Davis, California, powdery mildew reduced beet sugar yield by 27%. However, applications of about 10 lb wettable sulphur per acre increased the yield compared with the untreated control, although delay in spraying caused a higher loss than did prompt treatment. "Benomyl", applied at 1 lb per acre 1 month before the appearance of mildew and three times subsequently, was as effective as the sulphur treatment. Three other fungicides improved the sugar yields but were not as effective as the sulphur. The number of applications of wettable sulphur varied between 1 and 5, and the dilution could be 9·6 lb per 44 gal or 8·6 gal per 205 gal. The first application was responsible for 92% of the total yield increase resulting from three or more applications.

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Fungicides and timing for control of sugar beet powdery mildew. A. O. PAULUS, O. A. HARVEY, J. NELSON and V. MEEK. *Plant Disease Reporter*, 1975, **59**, 516–517. When "Benomyl 50W" and wettable sulphur were applied, separately, to powdery mildew-infected beet after half of the plants in a test plot had become diseased, the resultant yield was lower than where no fungicide was applied. The sugar content was also lower than in the control. On the other hand, the same amount of sulphur applied immediately on appearance of the disease symptoms gave a very much higher yield than the control. In the case of BAY MEB 6447 25W and "Triarimol 7·2%", results (higher yield and sugar content than the control) were approximately the same irrespective of when they were applied. Triphenyltin hydroxide and MBC 50W were also successful in increasing sugar yield compared with the control.

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Trials on weed control in sugar beet with "Isocarbomide" and its combination with "Lenacil": results of four years of experimentation. J. M. BELIEN, L. DETROUX, J. F. SALEMBIER and M. GOMAND. *Publ. Trimest. Inst. Belge Amél. Betterave*, 1975, **43**, 63–89. See *I.S.J.*, 1975, **77**, 339.

* * *

Sugar beet yield and nutrient uptake. U. BEISS and C. WINNER. *Zucker*, 1975, **28**, 461–471.—Investigations during the period 1957–69 are reported in which the total ash, K, Na, Ca, Mg, P and N contents in beet root, leaves and crown were determined during the growth period and the uptakes of the various nutrients calculated for a given average beet yield. The results, given in the form of tables and graphs, are discussed, particularly the increase in the nutrient contents with time and the effect of deviation in the amount of fertilizer applied from the optimum for yield. While the experiments indicated no relationship between yield and leaf growth, considerable leaf development during the second half of the growth period was found to be indicative of a probable nutrient uptake which was in excess of the requirements for maximum sugar yield and which would lead to a reduction in beet quality.

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The effect of irrigation on various processing quality factors in sugar beet in 1972-1974. I. AL-WINDI and L. SCHMIDT. *Listy Cukr.*, 1975, **91**, 145–152.—The effect of irrigation on beet properties was investigated in the case of two varieties. Results for the three years 1972–74 showed that application of varying amounts of water during the April-October period (the amounts being governed by the rainfall in the month in question) increased beet and sugar yield, leaf growth and white sugar recovery per ha while somewhat reducing the beet sugar content. The effect on ash content varied, but the average for the 3-year period was lower with irrigation than in the unirrigated control. Dobrovická A proved superior to Slovmona in all parameters investigated.

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Trials with lightweight sugar beet toppers. J. A. WAYMAN, M. J. O'DOGHERTY and F. W. JOYCE. *British Sugar Beet Rev.*, 1975, **43**, 123–125.—Comparative trials with a conventional heavy beet topper and an experimental lightweight topper (weighing 48% less than the former), each operated at five vertical knife settings, showed that at speeds up to 6 mph the experimental machine generally proved superior to the commercial machine in terms of over- and undercropping.

* * *

Better ploughing and cultivation for sugar beet. J. D. BURNE. *British Sugar Beet Rev.*, 1975, **43**, 128–130. An expert ploughman, the author describes how it is possible to obtain a well-cultivated, level seed bed which is nevertheless firm and well-drained.

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Autumn application of fertilizer. A. P. DRAYCOTT. *British Sugar Beet Rev.*, 1975, **43**, 141–144.—While nitrogen cannot be applied in autumn because of rapid leaching under normal winter climatic conditions in the UK, all other fertilizers can be successfully used in autumn rather than spring, particularly in the form of blends. The advantages of autumn fertilization and of blends are discussed. Tests so far have indicated no consistent differences in yields between autumn and spring fertilization.

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Covering beet clamps with dyke reeds. D. CHARLESWORTH. *British Sugar Beet Rev.*, 1975, **43**, 150. Mention is made of the practice on a farm in Lincolnshire, where the beet clamps are covered with dyke reeds, which allow the beet to dry out but not to sweat as they do when completely covered in a conventional way. The beet are protected from rain and frost, and dirt tare is minimal.

Nitrogen—why waste money? D. R. BRISBOURNE. *British Sugar Beet Rev.*, 1975, **43**, 152.—The excessive use of nitrogen in beet fields is discussed. Not only is the practice uneconomical (because of the price of the fertilizer as well as the reduction in beet sugar content and juice purity which results), but excessive N may also mask various deficiency symptoms. The author recommends greater attention to soil analysis and selection of a compound fertilizer having an analysis which is suitable for beet rather than a general one suitable for a variety of crops.

* * *

Some pre-harvest advice. A. VIGOUREUX. *Le Betteravier*, 1975, **9**, (90), 9.—The advice briefly given concerns eradication of bolted beet and weeds of the *Chenopodium* family, correct topping, harvesting of leaves for use as animal fodder, and loading of beet transport from beet clamps.

* * *

Excessive application of N-P-K to soils treated with liquid manure. R. VANSTALLEN. *Le Betteravier*, 1975, **9**, (90), 10.—Values tabulated for soils in Belgian beet fields at various levels down to 80 cm indicate the N, P and K contents introduced in the form of liquid and solid farmyard manure. It is shown how repeated applications of liquid manure over the years eventually lead to considerable quantities of the nutrients in the soil, especially since the liquid can easily penetrate to lower levels; sufficient stocks are finally created for only very limited specific fertilizer application to be needed.

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Phospho-potassium fertilization of sugar beet. N. ROUSSEL. *Le Betteravier*, 1975, **9**, (90), 11–12.—Advice is given on P and K application in beet fields, including optimum quantities, time and mode of application and pretreatment of soil for optimum utilization of the fertilizers. The forms in which the fertilizers are available are listed, including filter cake and various types of organic manure. The author warns against excessive doses, and recommends a formula which will give a P_2O_5:K_2O ratio of about 1:4.

* * *

Fertilization and increase in the price of fertilizers. R. DE CLIPPEL. *Le Betteravier*, 1975, **9**, (90), 14–17. The optimum quantities and proportions of N, P and K to apply to various crops, including sugar beet, are discussed on the basis of uptake by the crop and losses by lixiviation and fixation. The difficulty of assessing the amounts incorporated in the form of farmyard manure is examined, wherein it is pointed out that some of the N goes to make up humus as well as being lost by lixiviation, while the "effective" activity of the nutrient is usually spread over two years. Balances are drawn up for each of the three nutrients.

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Beet yellows. ANON. *Le Betteravier*, 1975, **9**, (90), 16, 18–19.—The situation as regards beet virus yellows in Belgium in 1975 is surveyed. Treatment with "Temik" has proved generally successful in controlling the disease; reasons for any failure include factors not directly associated with the chemical, e.g. poor seedbed structure, prevention of assimilation by heavy soil, excessive quantities of humus which inhibit "Temik" adsorption in the root zone, inadequate dosage, etc. Mention is also made of a disease termed "whites" which occurred on beet in most regions towards the end of August and was caused by a mould of the *Erysiphe* type. The symptoms were a white mycelium giving a floury aspect. The incidence of the disease was associated with the absence of rain, with warm, sunny days following misty (or even foggy) nights and heavy dews. No adverse effect on yield was observed, and the use of fungicide was considered uneconomical.

* * *

What is grown must reach the factory. Look out for harvest losses. W. C. VON KESSEL. *Die Zuckerrübe*, 1975, **24**, (5), 7–10.—Sources of losses in beet are discussed, including incorrect topping, poor lifting, inadequate windrowing and physical damage to the beet at various stages between harvesting and storage in the factory beet yard. Advice is given on ways of minimizing the losses.

* * *

KS 6—a six-row self-propelled beet harvester from East Europe. ANON. *Die Zuckerrübe*, 1975, **24**, (5), 11–12.—Details and illustrations are given of a new beet harvester which is assembled in the USSR from parts supplied by Bulgaria, East Germany, Hungary and the Soviet Union.

* * *

Again and again: serious injuries and deaths in beet harvesting. ANON. *Die Zuckerrübe*, 1975, **24**, (5), 14. To minimize the occurrence of serious accidents in beet harvesting, a list is presented of things which should or should not be done. These extend to precautions involving other users of the public highway.

* * *

Agriculture and sugar beet growing in Finland. W. C VON KESSEL. *Die Zuckerrübe*, 1975, **24**, (5), 16.—A brief survey is presented of the Finnish beet sugar industry, with particular emphasis on agricultural aspects and beet research.

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Sugar beet in Rumania. ANON. *Die Zuckerrübe*, 1975, **24**, (5), 16.—A very brief glimpse is given of Rumanian beet agriculture.

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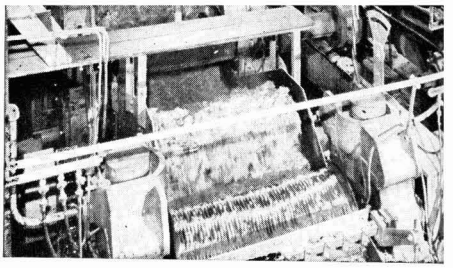
Selective use of "Phenmedipham" and EP-475 in Michigan for weed control in sugar beets. L. W. HENDRICK, W. F. MEGGITT and D. PENNER. *J. Amer. Soc. Sugar Beet Tech.*, 1974, **18**, 97–107.—Tests are reported with various pre- and post-emergence herbicides at two sites in 1971 and 1972; these were aimed at evaluating the effectiveness of "Phenmedipham" and EP-475 (ethyl *m*-hydroxycarbanilate carbanilate)—the former will not control redroot pigweed (*Amaranthus retroflexus*) as large plants while the latter will. Results demonstrated the effectiveness of both against *A. retroflexus* and *Chenopodium album* (lambsquarters) after pre-emergence treatment with "Pyrazon" + TCA. Best results were achieved with two separate doses of the post-emergence herbicides. EP-475 generally gave better control than "Pyrazon" + "Phenmedipham" + oil; good results were also obtained with SN 503, a 1:1 mixture of "Phenmedipham" and EP-475. Crop injury was minimal and did not affect beet yields. White sugar yield per ton of beets is indicated. The amounts of herbicide applied varied in the tests, and the economics are not discussed.

Cane sugar manufacture



Boiler stack emissions: Clewiston sugar house. B. F. SANFORD. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 127–132.—See *I.S.J.*, 1974, **76**, 247.

* * *

Air and water environmental control in the cane sugar industry. F. A. GRILLOT. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 133–142.—The problems confronting the Florida and Louisiana cane sugar industries with regard to boiler stack emission and waste water are discussed. (See also HENDRICKSON & GRILLOT: *I.S.J.*, 1972, **74**, 341.)

* * *

Viscosity. G. ALEMAN. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 160–164.—Causes of increased viscosity in the cane sugar factory are examined and the problems created in clarification and pan boiling are discussed.

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Second report on the experimental cush-cush screw press operation at Bryant sugar house. E. DEL VALLE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 165–166. A brief assessment of the French Oil Mill Machinery Co. screw press performance is presented.

* * *

Sugar cane deterioration during storage as affected by chopping, delay in milling and burning. G. J. GASCHO, J. E. CLAYTON and J. P. GENTRY. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 168–173.—Raw juice pH and theoretical sugar recovery from manually-cut cane decreased significantly with increase in the interval between harvesting and milling. Rapid deterioration occurred in short pieces stored for a long period. Although the dextran content in raw juice was the most sensitive measure of deterioration, it was closely related to pH which was easier to measure. Chopped cane stored in cane carts deteriorated faster than did whole-stalk cane. Burning had little effect on the deterioration rate.

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Cane juice acidity *vs.* sugar recovery. J. C. P. CHEN and R. W. PICOU. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 186–189.—See *I.S.J.*, 1974, **76**, 84.

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Why? F. A. GRAUGNARD. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 190–192.—See *I.S.J.*, 1973, **75**, 116.

* * *

The 1971 crop Audubon sugar factory studies. J. J. SEIP and F. L. GAYLE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1972, 194–203.—See *I.S.J.*, 1974, **76**, 84.

* * *

ICINAZ produces white sugar direct on the industrial scale. S. ORTEGA. *ATAC*, 1975, **34**, (May/June), 28–31.—At the Pablo Noriega sugar factory, the experimental unit of the Cuban Institute for Sugar Research (ICINAZ), 3200 metric tons of white sugar has been made directly from cane using the sulphitation process and the latter shown to give a quality as required for the Cuban economy. The process is to be extended to five other factories and further study made of factors influencing steam consumption, equipment required, labour needed, total sugar losses and volume of auxiliary products to be utilized.

* * *

Continuous weighing of bagasse using a nuclear weigher. B. D. RAVNÖ, P. C. SCULLY, M. E. PHILLIPS and W. KRAUSE. *Sugar y Azúcar*, 1975, **70**, (9), 30–34. See *I.S.J.*, 1975, **77**, 54.

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Use of phosphate in the double carbonatation process for improvement of colour of sugar. ANON. *N.S.I. News* (India), 1975, **11**, (1), 6–7.—Addition of superphosphate to 2nd carbonatation juice has been found, in laboratory and factory-scale trials, to increase juice quality, reduce the CaO content and improve the resultant sugar. The optimum clear juice phosphate content was 80 mg.litre^{-1}.

* * *

Control of starch level in cane juice during sugar processing. G. EL-K. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Tech. Bull. Egyptian Sugar and Distillation Co. Sugar Cane Dept.*, 1972, (42), 25 pp; through *S.I.A.*, 1975, **37**, Abs. 75-1114.—Tests on starch removal are reported and discussed with reference to previous studies (19 references covering 1953–1972). Heating raw juice to 75–80°C in 5–6 min should remove about half of the starch present, thus eliminating all factory difficulties due to starch; inversion would be negligible. Centrifuging at 2000 rpm for 5 min, or 4000 rpm without holding at this speed, removed all starch from screened raw juice; the power consumed and abrasion caused may be uneconomical.

* * *

Solid-state controls for sugar centrifugals at Glades sugar house. A. L. BALLARD, L. GANDIA and R. R. BURNS. *Proc.* 1973 *Meeting Amer. Soc. Sugar Cane Tech.*, 92.—Information is given on the solid state controllers which replaced relay controllers on two Western States *A*-sugar centrifugals and operated so successfully in their first season that their installation on other centrifugals was recommended. Their advantages over relay controllers are listed.

* * *

Solid-state centrifugals battery sequencer at Glades sugar house. A. L. BALLARD and L. GANDIA. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 93–94. A solid-state battery sequencer was installed on a *C*-centrifugal battery at Glades to replace an electromechanical sequencer and is briefly described. Two of the solid state units have performed successfully; advantages of the system are indicated.

Automation. G. ALEMAN, A. ARVESU and C. REYNALDOS. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 95–103.—See *I.S.J.*, 1975, **77**, 20.

* * *

Particulate sampling in a Louisiana cane mill. C. C. WATSON. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 107–108.—Methods are described for sampling and analysing particulate emission from a cane sugar factory chimney. Results indicated that about 97% of the particles smaller than 150 μ consisted of mineral solids (defined as those not consumed after being heated for 45 minutes at 600°C), of which principal sources are unburnt bagasse and field soil mixed with bagasse. (The tests were conducted during extremely muddy field conditions.) Particles greater than 150 μ were efficiently separated by a fly-ash arrestor.

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Aspects which affect clarification and the remedies Greenwood factory uses to combat such aspects. G. J. LABAT. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 109–111.—Measures adopted at Greenwood which have contributed to efficient clarification are discussed. They include processing cane in as fresh a state as possible (a yard storage time of less than 48 hours is the aim) and washing it thoroughly to eliminate extraneous matter, maintenance of the mills in a hygienic state by washing with hot water every 8 hours and adding chlorine to the cush-cush, control of limed juice pH and adjustment of juice temperature to 216–220°F. Details are given of the continuous liming process used, and juice Brix, sucrose, purity and acidity are tabulated for 1972–73. It is stressed that, if acidity rises, the amount of lime added should not also be increased but should be adequate to adjust the clarified juice pH to 6·4–6·6.

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Pneumatic conveying of bulk bagasse in Louisiana. A. I. GUIDRY. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 112–113.—See *I.S.J.*, 1974, **76**, 371.

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Multiple-effect evaporation: a simplified method of calculation. E. DEL VALLE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 134–136.—A simple and flexible method of calculating multiple-effect evaporation for use in determing optimum juice heater and evaporator effect arrangement is described and illustrated by means of a diagram of a quadruple-effect evaporator.

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Conditions affecting the low-grade work in a cane sugar factory. G. F. FUNDORA. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 137–142.—As guides to molasses exhaustion, the author presents graphs relating apparent purity to the (i) reducing sugars:ash ratio, and (ii) impurity:water ratio. If the drop in purity from syrup to final molasses is less than 50, ratio (i) will indicate whether further exhaustion could have been accomplished; if it could have been achieved, ratio (ii) will have a low value, indicating poor pan work or inadequate crystallizer performance. The bases of a well-run low-grade station are listed.

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Sugar exhaustion by massecuite cooling. G. ALEMAN. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 143–144.—The advantages of high-grade massecuite cooling as regards sugar purity is demonstrated by tabulated data comparing 1st and 2nd massecuite purities and sugar purity at three factories, one using cooling and the others not.

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Operation of an anti-fouling evaporation process pilot plant at the Raceland factory of the South Coast Corporation. J. DORNIER. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 193–194.—See *I.S.J.*, 1974, **76**, 115.

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Cane washing at Lula factory. C. J. DAIGLE. *Proc.* 1973 *Meetings Amer. Soc. Sugar Cane Tech.*, 210–212. See *I.S.J.*, 1974, **76**, 115.

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Treatment of sugar factory effluent in biological trickling filters. J. BRUIJN. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 22–28.—Studies were made on treatment of a synthetic effluent (containing molasses, sucrose and water of specified concentrations) by pilot-scale biological trickling filters. A two-stage system was used, the first stage being designed to remove 50–60% of the oxygen demand and the second stage being intended to give an effluent conforming to South African disposal regulations (COD < 75 μg.cm^{-3}). Urea and superphosphate were added to give a set COD:N:P ratio (100:4:0·8 was found to be the most suitable). Results showed that the system provided adequate treatment and that a plastic filter medium was highly suitable as first stage. At no stage was any filter blockage observed. Large quantities of BOD were removed under anaerobic conditions and gave no operating difficulties at very high loadings, although odours were produced. From examination of the costs of effluent treatment at three factories it is concluded that biological filtration is more expensive than the activated sludge process, while a Pasveer ditch is probably the easiest to construct while giving adequate results.

* * *

How cane delay times are affected by various operational conditions. R. G. HOEKSTRA. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 29–40.—Causes of delays between cane harvesting and crushing were examined by application of shift-by-shift simulation of cane movements based on an idealized steady-state week of operation at Amatikulu factory, for which a variety of transportation methods are used. The simulation technique is described and results are compared with actual values. It is concluded that the chief cause of a wide scatter in delay times in the system harvest-transport-crush which occur in practice is non-adherence to the principle of "first in, first out", rather than irregular crushing or deliveries.

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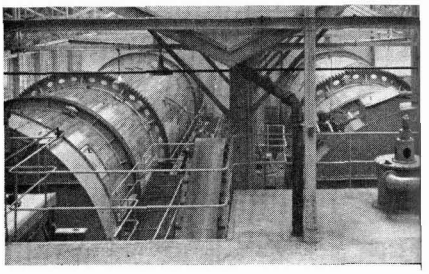
Centrifugal dewatering of filter cake. A. B. RAVNÖ and G. R. E. LIONNET. *Proc.* 49*th Congr. S. African Sugar Tech. Assoc.*, 1975, 59–62.—Tests on filter cake dewatering in a *C*-massecuite batch centrifugal showed that at a speed of 1000 rpm and a duration of 9 minutes, the mass was reduced by 32% and about half of the filter cake pol recovered in the separated liquid, the purity of which averaged 70. The initial moisture content of the cake was about 76% and its pol content 1·1%. High correlation was found between Brix of the separated liquid and the original filter cake pol content. Increasing the centrifugal speed to 1500 rpm did not produce any significant increase in moisture removal.

Beet sugar manufacture



Effect of the diffusion water acidification method on the effectiveness of formalin. F. HOLLAUS. *Zeitsch. Zuckerind.*, 1975, **100,** 457–460.—Investigations are reported in which the effect of diffusion water treatment with Na_2SO_3, H_2SO_4 or SO_2 on the disinfecting properties of formalin was determined. Results showed that the sulphite ion stimulated growth of certain anaerobes such as *Clostridium thermosaccharolyticum* and *C. thermohydrosulfuricum* in the upper sections of a tower diffuser, while aerobic bacteria were found in the lower sections and in the circulation juice. Apart from its bacteria-stimulating effect, SO_3^{--} also reacted with formalin to reduce its disinfecting properties, particularly in the upper sections where the juice sulphite content is high. Hence, it is not recommended to use SO_2 to acidify diffusion water.

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Heat exchange during boiling of highly viscous solutions and massecuites on a sloping plane heating surface. V. T. GARYAZHA and B. G. DIDUSHKO. *Izv. Vuzov, Pishch. Tekh.*, 1975, (3), 107–111.—Boiling tests were conducted in a special arrangement in which the heating element was a stainless steel plate 2·8 m long and 0·6 m wide which could be adjusted from horizontal to a 30° angle of slope. The massecuite overflowed from a mixer onto the plate element, from which it passed to a measuring tank and thence to a second mixer; it was then recycled to the first mixer. Measurements were made of a number of variables; these showed that the heat transfer coefficient as a function of heat flow, Brix and crystal content was much greater at a 3° slope of the heating surface than in conventional boiling.

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Sugar, Iran. J. E. MAUDRU. *Sugar y Azúcar*, 1975, **70,** (9), 19–22.—A brief survey is presented of the Iranian beet sugar industry, with particular reference to the Shahdsaz Company which operates five factories, each slicing 1000 tons of beet a day and constructed in 1966–68. Information is given on the equipment and processes used at these factories.

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Introduction of the KTIPP juice purification scheme at Gorodishche sugar factory. K. D. ZHURA and S. P. OLYANSKAYA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6,** 3–4.—The scheme developed at the Kiev Technological Institute for the Food Industry (KTIPP) and introduced in 1970/71 at Gorodishche is described. It includes recycling 1st carbonatation juice (100–120% on raw juice) to preliming together with 10% juice from main liming; the preliming pH is maintained at 10·8–11·0. The prelimed juice is then transferred to a settling tank for mud removal. Results indicated a lower lime consumption than with conventional juice purification (without preliming mud removal), a higher raw juice purification efficiency, a higher evaporator thick juice purity and lower lime salts content, and a lower 2nd carbonatation juice and thick juice colour content.

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Remelt liquor decolorization by defeco-saturation and defeco-sulphitation in beet sugar manufacture. L. D. BOBROVNIK and L. P. KOTEL'NIKOVA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6,** 4–5.—Simultaneous liming and gassing with CO_2 of remelt liquor was found to be less efficient as regards decolorization than was simultaneous liming and gassing with SO_2; identical quantities of lime were added in both cases. However, since defeco-sulphitation is a more complex process and SO_2 is dearer than CO_2, it is recommended to use the lime-CO_2 process at a lime consumption of 0·8–1·0% by weight and a pH of 8·5–9·0, under which conditions the decolorization efficiency will be satisfactory from the standpoint of the final white sugar colour.

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Determination of the degree of sugar decomposition in an evaporator. I. M. FEDOTKIN, A. S. DYCHENKO and E. M. BRUSILOVSKAYA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6,** 17–18.—The behaviour of products in evaporators such as used in the sugar industry is discussed, and equations developed for a mathematical model of an evaporator are used to postulate the theory of product degradation as a function of temperature and residence time. As regards sugar solution, the initial period, characterized by a low rate of decomposition, is of particular importance, and an empirical equation has been derived in which the percentage of sucrose decomposed is calculated as a function of time and temperature. A theoretical equation is also given for calculation of the amount of sugar decomposed as a function of the total feed rate, solution Brix, temperature and a time function.

* * *

Effect of purified juice alkalinity on its behaviour during evaporation. M. KH. LIKHITSKII and L. P. REVA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6,** 18–19. Three methods were compared for determination of optimum 2nd carbonatation juice alkalinity (at which juice soluble lime salts and coloration are minimum in evaporation), pH and CaO content. Investigations showed that considerable soluble lime salts removal from 2nd carbonatation juice was obtained by contacting the juice for about 10 minutes with $CaCO_3$ mud at 1% on juice weight; this is regarded as complementary to 2nd carbonatation where the latter process lasts an insufficient period for supersaturation

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of the juice to be reduced. Optimum thin and thick juice pH (at which the soluble lime salts content is minimum in evaporation) was found to be 9·0–9·5.

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The optimum relative initial charge in vacuum pans. V. P. TROINO, E. L. ZARECHANSKII, A. V. OMEL'CHENKO, M. L. VAISMAN and V. N. GLADKII. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 20–21.—The optimum relative initial charge (the proportion of footing volume to final massecuite volume) is that at which all the boiling tube is wetted by the time the massecuite is brought together; in the case of a footing covering 75–80% of the tube height, complete wetting is achieved (without syrup drinks) by boiling to 60–65% tube height. Effects on boiling parameters of deviation in massecuite volume from the optimum are discussed. Experiments showed that maximum heat surface utilization in a 1st product pan was achieved at approx. 35% relative initial charge and a final massecuite level no greater than 180–190% tube height. For optimum boiling, it is recommended to reduce tube height to no greater than 1 m and increase the pan diameter.

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Optimum ratio of cross-section area of ascending and descending channels in vacuum pans. V. P. TROINO, E. L. ZARECHANSKII, A. V. OMEL'CHENKO, M. L. VAISMAN and V. N. GLADKII. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 21–22.—Investigations of 1st product and 1st refined massecuite boiling showed that while boiling tube diameter in the range normally used had practically no effect on heat transfer, the circulation ratio (that between the cross-section areas of ascending and descending tubes) influenced heat transfer, pan throughput, heat surface loading in terms of water evaporated, massecuite colour, crystal size and crystal size uniformity. The effects are demonstrated by curves plotted for 20, 25 and 30% relative initial charge. Optimum circulation ratio as regards boiling parameters is shown to be 0·72–0·76.

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Model of a continuous direct-flow pan. I. S. GULYI, V. D. POPOV, S. I. SIRENKO, A. M. SIROTENKO and I. V. BIRYUKOV. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 22–23.—Reference is made to investigations on 1-, 2- and multi-section models of a continuous vacuum pan, from which an industrial-scale 2nd product pan was built and installed at Gnivan' in 1970.

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Investigation of a model of a continuous columnar vacuum pan. I. S. GULYI, V. D. POPOV and S. I. SIRENKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 23–24. A description is given of a vacuum pan model which was used in tests with a 67·1°Bx syrup at a temperature of 23°C to determine the residence time pattern. A semi-industrial model with a capacity of 3 metric tons of massecuite has given good results.

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A structural model of section *i* of a continuous vacuum pan. V. P. ZUBCHENKO, I. S. GULYI and V. D. POPOV. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 24–25.—A mathematical model is presented of section *i* of the 2nd product continuous vacuum pan installed at Gnivan'. Calculated values given by an analogue computer for mass transfer, heat transfer and temperature components agreed closely with experimental results.

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Simulation of the processes in the crystal growth chamber of a continuous vacuum pan. I. S. GULYI, V. D. POPOV and S. I. SIRENKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 25–27.—A 1:10 scale model of the crystal growth chamber in the Gnivan' continuous vacuum pan is described which could be operated as a 1-, 2- or multi-section system. Apertures in the partitions separating the sections were adjustable to permit changes in the working conditions. Variation in compressed air flow altered the circulation of the massecuite. A diagram is presented of the unit and details are given of the mode of operation. Residence time curves are plotted, showing massecuite colour as a function of time and feed rate.

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Unit for investigation of the effect of temperature fluctuation frequency on crystallization rate. I. S. GULYI, V. D. POPOV, S. I. SIRENKO, A. M. SIROTENKO and I. V. BIRYUKOV. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 27–28.—An experimental unit is described which was used to determine the crystallization rates of sucrose and alum as a function of temperature change frequency. Tests were conducted at various dry solids contents and a pre-determined crystal size distribution function; at constant heat flow the circulation rate of the dispersed system was varied over a wide range of values, or the heat flow was varied at constant circulation rate. Conditions under which an increase in crystallization rate is possible were determined.

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Sugar crystallization in a fluidized bed. E. E. SHUMSKAYA and V. D. POPOV. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 28–29.—An experimental fluidized bed unit is described in which an ascending supersaturated sugar solution stream passed through the distribution screen on which lay pre-formed crystals. The crystals were finally separated from the solution by washing with sugar-saturated alcohol, dried and weighed; the crystallization rate was determined from the increase in weight. A number of conclusions have been drawn from the tests and are discussed.

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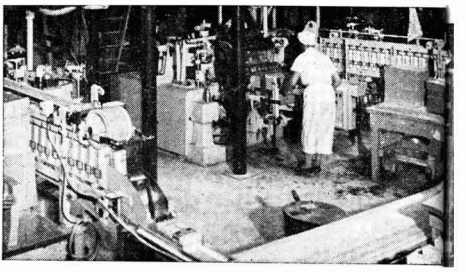
Hydroabrasive erosion of centrifugal pumps in sugar factories. A. I. SLYN'KO, G. A. PREIS and N. A. SOLOGUB. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 30.—Laboratory and factory tests were conducted with various juices and solutions to which quartz sand had been added. Results obtained with the jet-impact unit used showed that in alkaline media metal erosion is caused by multiple plastic deformation, so that durability of the metals is the governing factor; the corrosive action of acid media was considerably greater than the abrasive effect. Hence, for handling alkaline media it is recommended to use e.g. high-carbon steels, chromized cast iron (containing 1·15–1·35% C, 1–2% Si and 15–17% Cr), copper and titanium alloys; for acid media, chromized cast iron, stainless steels and titanium alloys are recommended, while copper and aluminium alloys have shown promise where the concentration of abrasive components is low.

Sugar refining



On the decolorization of regeneration waste of ion exchange resin. F. ONDA, H. ITO and T. MIKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 53–60.—Tests on decolorization of resin regeneration waste water with various commercial coagulants, bleaching powder and sodium hypochlorite are reported. Results showed that none of the coagulants removed colouring matter, whereas 1% bleaching powder (containing 60% available chlorine) and 3% of a 10% sodium hypochlorite solution (containing 8% available chlorine) achieved 90% decolorization. The decolorization level at 20–30°C increased with time of treatment up to 50 minutes, after which no further decolorization was obtained. Increase in the temperature reduced the time taken to reach maximum decolorization, although the level was reduced. Heating of the waste water at 20–30°C caused redevelopment of colour, especially when sodium hypochlorite had been added. The colouring matter in the treated waste was highly sensitive to change in pH; when bleaching powder was used, the colour of the waste was minimum at pH 7 and increased when the pH became either acid or alkaline. When sodium hypochlorite was used, the colour fell with reduction in pH. The cost of treatment with bleaching powder was lower than with sodium hypochlorite, but during treatment with bleaching powder a calcium precipitate formed which caused a rise in pH and made the waste difficult to handle.

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On the re-use of lime cake in a sugar refinery. S. OMORI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 61–64.—Studies on calcination of lime cake in a rotary kiln showed that CaO recovery increased with temperature rise up to 1000°C (the furnace outlet temperature) after which it decreased, the optimum being 950–1000°C. A white clinker resulted which was soft and porous and contained particles of 3–40 mm. The colour of the treated cake increased with calcination temperature but the colouring matter did not enter sugar solution with which it was in contact. No difference was found in purification efficiency and liquor filtrability between use of a 1:1 fresh lime:regenerated lime mixture and use of all fresh lime. Further study is suggested to determine working conditions for increasing the available lime content in the refinery, to control impurities accumulated in the regenerated lime by recycling and to utilize the excess calcined cake.

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Treatment of waste water by the activated sludge process. K. KASHIMURA and Y. YOSHIDA. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 65–70.—Details are given of the activated sludge process used at the Okayama refinery of Mitsui Sugar Co. Ltd. to meet local regulations. The system is designed to reduce the COD from 1500 ppm to a maximum of 100 ppm and to reduce the solids content from 100–200 ppm to 50–100 ppm. The daily capacity is 1000 m^3. Observations of the plant's performance showed that the micro-organisms developed spontaneously without any inoculation and that the COD fell below 100 ppm after 3 weeks' operation. After six months, COD removal was greater than 95%. A dehydrator handles 6 tons of excess sludge (of 85% moisture content) a day. The quality of the treated waste water is unaffected by pH fluctuations in the untreated water.

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Studies on the treatment of sugar refinery waste water by the biodisc process. S. TANIGAKI, Y. SAKA and N. SUZUKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 77–86.—Details are given of trials on refinery effluent treatment by a two-stage rotating disc, made of polystyrene, and a conical clarifier. The BOD was reduced by about 95% at a load of 20 $g.m^{-2}$ per day and by about 90% at 40 $g.m^{-2}$ per day, while the reduction in COD was of the order of 60–75% at a load of 20 $g.m^{-2}$ per day; COD removal was affected by colouring matter in the waste water. The BOD load of the initial waste could be increased if the disc speed were raised to a maximum of 20 rpm; beyond this speed, the biomass floc disintegrated and the effluent clarity fell. An overall BOD load of 30 $g.m^{-2}$ per day is recommended for the initial waste. The ratio of sludge production to BOD was 20–30:100.

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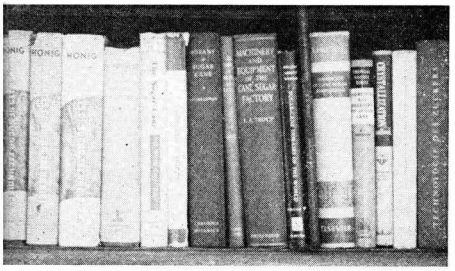
Refined sugar in Malaysia. Two different methods of sugar refining. T. YAMANE and H. ASAI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 88–90.—Information is given on the method used up to 1973 for melt liquor treatment at the refinery of the Malayan Sugar Manufacturing Co. which involved carbonatation, decolorization with active carbon and a polish decolorization using "Amberlite IRA 401" anion exchange resin in Cl^- form. This has been replaced by a simpler process, in which active carbon treatment has been abolished and a new anion exchange resin, "Amberlite IRA 458", used in Cl^- form; this resin has proved more efficient than "Amberlite IRA 401" and less susceptible to fouling by colouring matter. (The earlier resin has a styrene-divinyl benzene structure, while the newer one is an acrylic-based resin.) However, the colour of the final sugar is not as low as that obtained by the earlier process, although it is lower than that of Taiwan plantation white sugar, which is popular in south-east Asia. Mention is also made of the refining techniques used in the refinery section of a cane sugar factory built by Hitachi Zosen Co. in 1973 at Kangar in north-west Malaysia.



New books

Composition, properties and uses of molasses and related products. B. P. BAKER. 80 pp; 25 × 32 cm. (United Molasses Trading Co. Ltd., Bowater House East, 68 Knightsbridge, London, England SW1X 7LP.) 1975.

In 1971, United Molasses produced "The analysis of molasses"[1], one of the finest works on the subject ever produced. Now, the same organization has published a complementary volume concerned with molasses properties and uses, and the two works combine to make an excellent contribution to knowledge of the subject. As before, use has been made of the loose-leaf ring-binder. There are 10 sections: the sugar in molasses; the composition of cane molasses; the composition of beet molasses; properties of molasses; energy value of molasses; cane molasses in animal feeding; distribution, metering and proportion of molasses; molasses mixing; use of molasses in fermentation; and condensed molasses solubles. A table is appended for conversion of Brix to s.g. as well as temperature and viscosity conversion tables.

The printing is highly legible and the layout excellent. The language used is straightforward, and no attempt is made to go into excessive detail—obviously, it is felt better to leave the reader to obtain details of specific processes from sources such as articles abstracted in this journal; but for a general background, this work surely could not be bettered. For readers interested in molasses utilization, this is an excellent acquisition.

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Comptes rendus de la 15e Assemblée Générale de la Commission Internationale Technique de Sucrerie. 615 pp; 21 × 30 cm. (Secrétariat Général, CITS, Aandorenstraat 1, B-3300 Tienen, Belgium.) 1976. Price: Fr.B. 1250.

The Proceedings of the 15th General Assembly of the CITS, held in Vienna 12th–16th May 1975, contains the text of 44 papers in the language in which they were presented, with summaries in English, French and German. The papers are primarily concerned with beet diffusion and the behaviour of non-sucrose substances during sugar manufacture, and provide some of the most up-to-date work on these topics. The papers are preceded by details of sponsoring companies, members of the Administrative Committee and of the Scientific Committee, a photograph of the participants (with a key), an extract from the opening and closing speeches of the Chairman of the Scientific Committee, F. SCHNEIDER, a foreword by the Secretary-General and Treasurer of the CITS, J. HENRY, obituaries of four leading members, and a list of the participants. An author index is given at the back of the book. The text is clearly printed on a matt paper. Copies can be obtained by applying to the address above, payment being made to C.C.P. 000-0018180-41 de la Caisse Tirlemontoise de Dépôts, compte CITS No. 681-0001652-58.

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Instability of world centrifugal sugar production. G. B. HAGELBERG. 61 pp; 41·5 × 21 cm. (Institut für Zuckerindustrie, Amrumer Strasse 32, 1 Berlin 65, Germany.) 1975.

Research Report No. 2 of the Berlin Institute Test Unit is a statistical exercise aimed at determining the extent and major causes of swings in world beet and cane centrifugal sugar production. It is divided into two parts, the first being devoted to the world situation, while the second concerns six selected beet and cane sugar-producing countries (West Germany and the US for beet, and Australia, Hawaii, Mauritius and South Africa for cane).

The pattern of trends in production of beet sugar, cane sugar and world sugar are shown by graphs and tabulated data covering some 20 years. While instability in the beet sector has been greater than with cane sugar, in only a few cases have the deviations from the mean been statistically significant. World sugar production has shown greater stability than beet and cane sugar production, respectively, since the deviations in beet and cane sugar have tended to be counteracting. While geographical distribution has had a stabilizing effect on sugar production, this factor is limited because of the large proportion of world sugar which is produced in just a few countries. Fluctuations in sugar yield per unit area were found to have greater effect on total production swing than fluctuations in beet or cane yields.

The work, available in English, is interesting as background material for the establishment of regulatory policies for sugar production and stocks.

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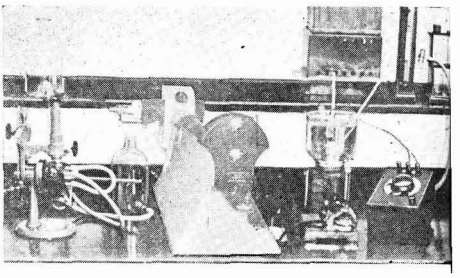
The Gilmore Louisiana-Florida-Texas-Hawaii-Puerto Rico sugar manual 1975. Ed. C. M. MCKAY. 222 pp; 21·5 × 28 cm. (Sugar Publications, Gilmore Sugar Manual Division, 503 Broadway, Fargo, North Dakota, 58102 USA.) 1975. Price: $30.00.

For the first time, all five cane areas mentioned in the title appear in the one volume; previously Puerto Rico had been covered by a single edition, while Texas had received no mention (the W. R. Cowley factory having started operations only comparatively recently), and a single edition had been devoted to the other three areas.

The work is a guide to the sugar factories and their chief personnel, with details of equipment and performance data for 1973 and 1974 as well as general information about each factory. There is much that would be of value to readers interested in the particular industries, and the contents are well set out and very legible.

[1] *I.S.J.*, 1972, **74**, 250.

Laboratory methods & Chemical reports



Effect of campaign length on the viscosity of and diffusion in beet sugar syrups. M. N. DADENKOVA *et al. Izv. Vuzov, Pishch. Tekh.*, 1975, (3), 177–178.—The diffusion coefficient for sucrose and kinematic viscosity were determined for thick juice during two campaigns at three Soviet sugar factories. The mean values obtained at temperatures in the range 25–80°C for purities of 88·8–9·38 showed that the colloids content rose sharply, the viscosity increased and the sucrose diffusion coefficient fell as the campaign was extended beyond January, The values of the two factors for a given Brix were very similar between factories and campaigns. The Stokes-Einstein law was found to be invalid for the diffusion-viscosity relationship.

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A laboratory constant-temperature device for determining the sugar content in raw material. I. A. PRIKHOD'KO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 4–7.—Details are given of a device for sugar determination in beet brei which has earlier been described in connexion with dry solids determination[1].

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Quantitative determination of organic acids in sugar factory products by means of a densitometer. G. P. VOLOSHANENKO and A. M. SHEVCHENKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 7–8.—Organic acids in molasses, including oxalic, tartaric, citric, malic and malonic acids, were concentrated by electrodialysis and treatment with cation exchange resin in H^+ form; they were then separated by paper chromatography using 7:1:2 *n*-butanol:formic acid:water as solvent. The spots were developed with a 0·04% solution of bromophenol blue in acetone-alcohol mixture and the amounts present determined quantitatively from the optical densities. The R_f values of twelve acids are given as well as details of the technique used to prepare calibration curves. The method is applicable to organic acids in juices and other factory products.

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Determination of soluble calcium salts by a flame photometric method. L. G. KALINENKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 8–10.—K, Na and Ca were determined in 2nd carbonatation juice, thick juice and syrup by flame photometry and the results converted to alkaline ash. Soluble lime salts were determined from the alkaline ash (% 100°Bx) and from the known non-ammonia alkalinity of the product. The flame photometric results (for which considerable dilution of the test sample was necessary) were compared with those obtained by a method of BARABANOV in which a 15-ml sample is charred over an open flame, a pre-determined quantity of H_2O_2 added and the precipitate ashed in a muffle furnace at a temperature not exceeding 600°C. The ash was dissolved in 0·2N HCl solution and titrated with 0·1N NaOH to give the alkaline ash % 100°Bx. Differences between the two sets of values were slight (maximum of ± 5%).

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The dependence on temperature of the pH of beet sugar factory products. L. P. REVA and N. L. IZBINSKAYA. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 10–11.—For each beet sugar factory product the pH falls to a minimum with rise in temperature in the range 25–85°C. Investigations conducted to establish the effect of acid or alkaline constituents on the change in pH are reported and a mathematical expression given for calculation of the pH of hot products at the process temperature based on knowledge of the pH at room temperature and the mean temperature coefficients. A table is also given showing the pH range for products from press juice to molasses, the changes in pH brought about by temperature change and the values of the temperature coefficients.

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PCB and organochlorine pesticides residue in sugars. T. MIKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 32–38.—Gas-liquid chromatography was used to determine polychlorinated biphenyls (PCB) in refined, liquid and raw sugar as well as refinery molasses, and BHC, DDT, DDE and "Dieldrin" in raw sugar. Results, given in the form of chromatograms, showed that no PCB was present in refined and liquid sugar and was present, at less than 0·03 ppm, in only 3 out of 20 raw sugar samples and 3 out of 5 refinery molasses samples. Two of the 18 raw sugar samples analysed for BHC showed a relatively high γ-BHC peak, but the total BHC content was still less than 0·0063 ppm; only a few samples revealed DDT and DDE, but the components were only just detectable.

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A continuous determination of sugars in condensed water. Y. TAKATORI, R. TOYAMA and T. TAKEZAKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1975, **25**, 47–52.—A system for continuous detection of sugar in condensate is described which is based on the fact that heating of condensate to a high temperature (265°C) at high pressure (20 $kg.cm^{-2}$) causes a considerable increase in the electrical conductivity of sucrose compared with water. Tests in which 0–50 ppm sucrose was added to condensate showed that a 5-minute retention in the heating tube incorporated in the system gave higher conductivities than did a 2½-minute retention and that in the former case there was linearity between conductivity and sucrose up to 10 ppm. The system detected as little as 1 ppm sucrose and can also be used to detect glucose, fructose, formalin and starch.

[1] PRIKHOD'KO: *I.S.J.*, 1972, **74**, 348.

Thin-layer chromatographic method for the identification of mono-, di- and trisaccharides. S. A. HANSEN. *J. Chromatogr.*, 1975, **107**, (1), 224–226.—A method is described in which plates were precoated with silica gel and impregnated with sodium phosphate; 4:4:2 acetone:*iso*-propanol:0·1M lactic acid was used as solvent, and the spots were revealed with aniline-diphenylamine:acetone:80% phosphoric acid. R_f values and the colour reactions are given for 28 sugars.

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Gas chromatographic investigations of the behaviour of non-sugars in the technical process of sugar recovery. E. REINEFELD, K. M. BLIESENER, A. REINEFELD and L. REXILIUS. *Zucker*, 1975, **28**, 472–481.—See *I.S.J.*, 1976, **78**, 28.

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An optical method for determining the granulometric composition of sugars and massecuites. D. TONINGEROVÁ and K. HAMPLOVÁ. *Listy Cukr.*, 1975, **91**, 152–157.—Details are given of a method for determining crystal size distribution by means of a special device which comprises a microscope and a semi-automatic analyser for measuring and counting. Sugar-saturated glycerine (4 ml) is added to 1 g of sugar or massecuite sample and placed on the slide carrier for photographing at a magnification of 20×. The photograph is divided into a matrix of mm squares and the crystals measured and grouped into sieve sizes. Comparison of results for normal sieve analysis and the optical method shows insignificant differences for the size range 0·2–2·0 mm.

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Simplified procedures for precipitation and separation of starch for its determination in sugar cane juice and its products. G. EL-K. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Tech. Bull. Egyptian Sugar and Distillation Co. Sugar Cane Dept.*, 1972, (35), 16 pp; through *S.I.A.*, 1975, **37**, Abs. 75-1269.—The development of a rapid, accurate method of starch extraction for iodine colorimetry is described with tabulated results. Filtration always gave lower recovery than centrifuging. For raw juice, screen off the coarse particles, add filter aid, centrifuge for 5 min at 5000 rpm and discard the supernatant (which includes floating cane wax); wash the precipitate with 80% ethanol to remove pigments and centrifuge as before; dissolve the starch in $CaCl_2$ solution of 1·3 s.g. at 100°C and centrifuge off the filter aid at 3000 rpm. Modifications to this method are indicated for clarified juices, syrups, and sugar end products or intermediates. Results at Kom-Ombo factory ranged from about 0·2 g.litre^{-1} for pre-evaporated juice to about 1 g.litre^{-1} for molasses; raw sugar contained about 400 ppm.

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Quality of cane juice. III. Changes between cutting and milling of sugar cane. G. EL-K. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Tech. Bull. Egyptian Sugar and Distillation Co. Sugar Cane Dept.*, 1972, (38), 15 pp; through *S.I.A.*, 1975, **37**, Abs. 75-1119. Samples of the plant, 1st and 2nd ratoon crops from three cane varieties were crushed 0, 24, 48 and 72 hours after harvesting and the juices analysed for purity, ppm starch on Brix, reducing sugars % sucrose and fructose % sucrose; results are graphed and briefly discussed. Starch content decreased at a reducing rate; fall in purity and deterioration in the fructose ratio and glucose ratio was usually slight after 24 hours, but became progressively more rapid. Fructose % sucrose is considered to be a reliable index of cane quality.

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Cane juice alpha-amylase. G. EL-K. SAYED, A. A. EL-BADAWI and M. S. MOHAMED. *Tech. Bull. Egyptian Sugar and Distillation Co. Sugar Cane Dept.*, 1972, (40), 23 pp; through *S.I.A.*, 1975, **37**, Abs. 75-1239. Alpha-amylase in Egyptian cane juice showed maximum activity at about pH 5·5; after partial purification with chilled acetone, the optimum pH was about 6. Its optimum temperature was 60°C, but prolonged exposure to this temperature caused inactivation. Activity increased with increasing substrate and enzyme concentrations up to constant levels, other conditions being constant. As cane matured, there was negligible increase in amylase activity as starch concentration increased manyfold, and varieties with higher starch contents had lower amylase activities. In post-harvest deterioration, the enzyme activity increased as the starch concentration decreased. The amylase activity increased from the bottom of a cane stalk to the top.

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Fluorimetric determination of reducing sugars with ethylene diamine sulphate. S. HONDA, K. KAKIMOTO, K. SUDO *et al. Anal. Chim. Acta*, 1974, **70**, (1), 133–139; through *S.I.A.*, 1975, **37**, Abs. 75-1260.—Reducing sugars were reacted with a 10-fold molar amount of ethylene diamine sulphate in phosphate buffer solution at pH 8·0. The fluorescence spectra obtained after 3 hours heating had excitation and emission maxima at 460 and 465 nm, respectively; relative intensities are tabulated. Sucrose, raffinose and other non-reducing sugars did not produce fluorescence under the conditions used. The method is suitable for the determination of 0·004–0·4 μmol reducing sugars in the presence of glycosides or neutral polysaccharides.

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Method for simultaneous determination of carbohydrates in molasses by gas chromatography. A. BORYS and S. J. KUBACKI. *Prace Inst. Lab. Badaw. Przem. Spozyw.*, 1974, **24**, (3), 381–394; through *S.I.A.*, 1975, **37**, Abs. 75-1268.—Two versions of the method are described: one permits simultaneous determination of mono-, di- and trisaccharides, while the other is suitable for only mono- and trisaccharides. Molasses was clarified with lead acetate and the sugars were converted to their silyl derivatives before separation; *meso*-inositol was used as internal standard. For sucrose and raffinose, the methods showed high precision. In glucose determinations, the error depended on the content in the molasses. The highest errors, about 20%, occurred in fructose determinations. Losses of sugars occurred during clarification of the samples, and for raffinose could reach 24%.

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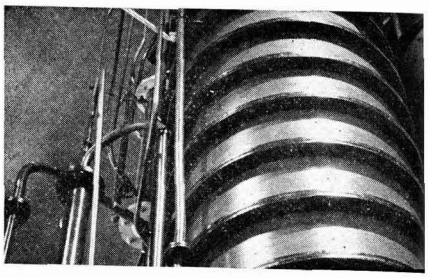
Effect of concentration and temperature on the thermophysical properties of sugar solutions. D. E. SINAT-RADCHENKO and V. D. POPOV. *Sakhar. Prom.*, 1975, (8), 26–28. A graph is presented for calculation of sugar solution viscosity (both dynamic and kinematic), molecular diffusivity, temperature and heat conduction, heat capacity and density as functions of Brix tion, heat capacity and density as functions of Brix in the range 0–90° and temperature in the range 0–140°C.

By-products



Furfural and levulinic acid prepared concomitantly from bagasse pith. C. I. NEE and W. F. YSE. *Taiwan Sugar*, 1975, **22**, 49–53.—Since 30–40% of bagasse takes the form of pith, disposal of which is difficult after its separation in the paper mill, experiments were conducted on the preparation of furfural and levulinic acid by distillation. Maximum yield of levulinic acid (52·8% of the original content in pith) was obtained by distilling for 20 minutes at 170°C and 10 minutes at 170–190°C, while maximum furfural yield (54% of the original content) was also obtained under these conditions. No clear difference was found in % yields between fibre and pith, although the furfural and levulinic acid contents in fibre were slightly higher than in the pith.

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An experiment on bagasse bulk storage by wet piling. ANON. *Taiwan Sugar*, 1975, **22**, 54–55.—Preliminary tests are reported in which fresh bagasse was mixed with fresh water or with an acidic biological liquor to give a suspension of 3–5% consistency and pumped to a storage area having an aerated floor. After the pile was stacked to a desired height, liquid was applied continuously by recirculation every day for 11 months in the case of the water suspension and 9 months where the biological liquor was used. To ensure that the pile density does not increase sufficiently to prevent molasses penetration, the rate of liquid recirculation and the quantity of molasses should be increased. Continuous application of liquid prevented aerobic fermentation and hence temperature rise in the pile, thus inhibiting deterioration of the fibres.

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An experiment on bagasse fermentation for beef cattle feeding. C. H. LIU. *Taiwan Sugar*, 1975, **22**, 56–57. Fermentation of a bagasse-molasses-urea-chlorinated water mixture with a *Monilia* sp. culture at 30°C for 18 hours gave a product which was almost as good as cane tops in terms of feed efficiency (weight of feed used/body weight gain) and was much better, after 3 months, than unfermented bagasse-molasses mixture. The fermented bagasse had a crude protein content of 4·14% (compared with 1·4% in the untreated bagasse), while the fibre content was reduced from 34·45% to 31·88%.

* * *

Composition and yield of sugar cane at different ages in relation to its utilization as an energy source for livestock. J. DEVILLE and Y. WONG YOU CHEONG. *Rev. Agric. Sucr. Maurice*, 1974, **53**, 132–137.—The changes in yield and composition of cane stalks, derinded stalks and tops were determined at 5, 7 and 10 months in the case of S 17, M 93/48 and M 377/56 varieties. Tabulated data for two locations indicate that, although the dry matter content increased with age, the protein content of the stalks was very low; crude fibre content decreased, while there was little change in the lignin content. The total available carbohydrates (TAC) content in the stalks increased steadily, particularly from 5 to 7 months, whereas it fell consistently in the tops of all varieties during this time, increasing again at 10 months. Ether extract was very low in the stalks. Yields of total carbohydrate, of importance for the feeding of cattle, were much greater at one site than at the other, while varietal differences were also found. Comparison between the results and values obtained in Barbados show discrepancies in terms of age for maximum yield.

* * *

Deferred grazing of sorghum by beef steers, supplemented by molasses and urea. A. R. FRONTERA, J. L. REBOLA and E. L. VALY. *Rev. Agron. Noroeste Argentino*, 1974, **11**, 227–239.—Fattening steers were grazed on sorghum, some being provided with supplementary 10:1 molasses:urea mixture. No metabolic disorders were observed in the latter and body weight gains were greater at 1·187 kg per day against 0·950 kg per day for the former animals.

* * *

The effect of various factors on energy consumption and dust emission from pulp dryers with reference to the residence time behaviour of the pulp during drying. T. CRONEWITZ, G. MÜLLER, B. BISSINGER and F. STADLER. *Zucker*, 1975, **28**, 401–410.—See *I.S.J.*, 1976, **78**, 126.

* * *

Increasing the economic efficiency of dried pulp production in beet sugar factories. N. M. TKACHENKO. *Referativ. Inform. Zakonch. Nauch.-Issled. Rabot. Vuz. UkSSR, Pishch. Prom.*, 1972, **6**, 32–33.—The author state that about 60% of all the beet pulp from Soviet sugar factories is transferred to open pits and used in an acid form. He recommends a number of measures for improving dried pulp production, including replacement of obsolescent and worn-out presses and pressing to 20–25% dry solids, establishment of mechanized pulp silos and synchronizing pulp production with juice extraction.

* * *

Content of higher alcohols in molasses wort as a function of the yeast strains used. V. F. SUKHODOL, A. M. KUTS, P. M. MAL'TSEV, I. D. MOVCHAN and A. M. SHEVCHENKO. *Izv. Vuzov, Pishch. Tekh.*, 1975, (3), 64–68.—The composition of three molasses samples from different alcohol distilleries was determined and distillate obtained from them analysed for ethyl and higher alcohols. Results are presented in the form of tables and gas chromatograms. The strain of yeast was found to have a considerable effect on the distillate higher alcohol content, strain B of the *Saccharomyces* sp. used tending to give a greater proportion of *iso*-amyl alcohol than did hybrid yeasts, which tended to increase the accumulation of *n*-propanol.

Brazil sugar exports[1]

	1975	1974	1973
	metric tons, raw value		
Afghanistan	13,422	—	10,317
Algeria	173,267	279,476	78,706
Bangladesh	—	—	48,290
Chile	38,874	51,880	54,818
China	71,942	—	367,598
Cyprus	—	1,065	2,129
Egypt	2,170	62,962	—
EEC	226,442	212,452	116,315
Finland	11,735	—	47,081
Ghana	5,424	—	—
Greece	—	10,663	7,312
Hungary	—	19,324	—
India	—	—	12,095
Indonesia	—	—	68,462
Iran	38,973	62,298	190,099
Iraq	277,171	247,310	221,566
Israel	34,418	21,005	2,405
Ivory Coast	7,322	—	1,073
Japan	346,593	234,994	129,015
Jordan	—	—	11,480
Korea, South	—	—	10,250
Kuwait	18,593	—	—
Lebanon	9,774	32,064	42,598
Libya	—	11,148	—
Malaysia	—	—	7,650
Malta	2,224	—	—
Morocco	12,802	61,078	105,430
Pakistan	11,185	—	21,960
Portugal	40,066	11,000	58,250
Qatar	—	5,933	—
Saudi Arabia	11,933	—	—
Senegal	6,861	40,088	—
Singapore	—	—	16,152
Spain	23,378	79,864	—
Sri Lanka	—	—	111,591
Sudan	—	—	104,280
Surinam	—	—	1,597
Syria	61,048	70,217	53,628
Tunisia	12,215	47,830	28,160
Turkey	—	11,037	—
Uruguay	—	12,740	11,545
USA	154,673	699,028	445,584
USSR	95,494	—	438,154
Venezuela	—	12,153	36,900
Vietnam, South	—	—	73,382
Yemen	—	5,047	—
Yemen, South	5,966	—	—
Yugoslavia	15,946	—	39,434
	1,729,911	2,302,656	2,975,306

* * *

Thailand sugar exports[2]

	1975	1974	1973
		(metric tons, tel quel)	
Indonesia	0	0	32,351
Iran	34,756	71,624	11,990
Iraq	0	34,087	10,581
Japan	214,737	221,966	0
Lebanon	0	12,272	0
Malaysia	67,841	33,924	101,263
Morocco	11,159	0	0
Singapore	0	10,999	0
Sri Lanka	29,216	11,974	23,571
Syria	13,195	0	0
USA	67,040	23,394	17,180
Vietnam, South	0	0	61,358
	437,944	420,240	258,294

M & B sugar cane herbicide exports.—May & Baker Ltd. recently despatched one of their largest single shipments ever in response to an order from Quimimport in Cuba for "Asulox" 40, worth approximately £750,000. "Asulox" 40 is a translocated herbicide developed by May & Baker for the control of grass weeds in sugar cane. In 1974, M & B received a Queen's Award to Industry for technological innovation in respect of "Asulam", the active constituent of "Asulox" 40. "Asulox" 40 is considered very important in the Cuban sugar industry, and its usage has more than doubled each year for the past three years, largely in respect of its great value in controlling the problem sugar cane weeds Johnson grass (*Sorghum halepense*) and corn grass (*Rottboellia exaltata*).

Brevities

£5m. order for sugar centrifugals.—Against fierce competition from Federal Germany and the USA, a British and Mexican joint-venture company has won an order worth £5,000,000 to supply plant for six new sugar factories being built in various parts of Mexico. The deal was agreed between the Comisión Nacional de la Industria Azucarera, a Government Agency, and Centrifugas Broadbent Inter-Americana, an associate company of Thomas Broadbent & Sons Ltd., of Huddersfield, England. It involves the supply of 150 centrifugals; up to 40% of the components will be made in England while the remainder is to be produced at a new plant being erected near Toluca, close to Mexico City. The Mexican Government has taken a 40% interest in the associate company, through which the Huddersfield firm, one of the larger producers of centrifugals in the world, hopes to increase involvement in an industry which currently produces about 2·6m. tons of sugar annually.

* * *

International Sugar Organization booklet.—In 1963 the International Sugar Council published in two volumes, "The World Sugar Economy, Structure and Policies", covering national sugar economies and policies, and the world sugar situation in general. Those who found in these volumes a valuable source of reference have long urged that they should be updated. This has now been taken up. As the studies on individual countries are completed and agreed, they will be issued in booklets covering two or three countries. The first of these booklets covers three African countries, the Malagasy Republic, Mauritius and South Africa, and is available from the International Sugar Organization, 28 Haymarket, London, SW1Y 4SP England, price: 75p, plus postage. This cross-section of African countries illustrates the diversity of developments in sugar policies during the 'sixties. Malagasy, which became an independent country within the French Community in 1960, widened its exports market and concentrated on shipments to other African countries and to the United States. Mauritius, which became independent in 1968, remained one of the largest exporters under the Commonwealth Sugar Agreement. Cane cultivation in Mauritius had almost reached the limit of productive land and production was expanded by raising yields per acre. South Africa ceased to be a member of the Commonwealth Sugar Agreement in 1962 and developed its exports to world markets, particularly to Japan. The expansion of production, however, was cautious and limited until the potentialities of the export market became clear. This first booklet is available in English. Translations into French, Russian and Spanish are in preparation.

* * *

Sugar cane consultants in Barbados.—Sugar Cane Consultants is a newly-formed group in Barbados, comprising Bruce Inniss, Keith Laurie and Gerald Proverbs who call on great experience in agronomy, sugar technology and animal production and offer professional advice in these fields. Based on a unique experience in the use of derinded and chopped whole cane for animal feeding (the "Comfith" process), the group can provide expertise in development of animal feeds, livestock management, etc., as well as the more usual fields of agricultural and process technology, the latter including a new patented process for amorphous sugar production. The group's address is "Glenaire", Reservoir Road, Brittons Hill, St. Michael, Barbados.

* * *

Mexican sugar commission[3].—The Mexican Government has set up the Comisión Nacional de la Industria Azucarera to develop the sugar industry, and has established a 1,000,000,000-peso fund for the purchase of machinery and equipment to improve sugar milling facilities.

* * *

Deferment of Australian exports to Japan[4].—It is reported that agreement has been reached for deferment of part of the sugar purchased by Japan from Australia. Originally 450,000 tons were to be shipped during the period July/December 1976 but it is now agreed that 150,000 tons of this is to be shipped during January/June 1977.

[1] C. Czarnikow Ltd., *Sugar Review*, 1976, (1270), 25.
[2] *ibid., Sugar Review*, (1269), 19.
[3] *Bank of London & S. America Rev.*, 1976, **10**, 156.
[4] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (6), 11.

Brevities

US sugar exports[1].—Before 1974 US crystal sugar exports seldom exceeded 8000 short tons, raw value, annually. But in 1974, owing in large part to tight world supplies and very high prices, US exports exceeded 70,000 tons. In calendar year 1975 refined sugar exports reached 223,900 tons, according to Bureau of Census data. Canada received more than one-third of US crystal sugar exports and more than 90% of liquid sugar exports, totalling 82,622 tons. One reason for increased Canadian imports may have been work stoppages in Canadian refineries. The EEC received about a quarter of 1975 US sugar exports (49,733 tons), and Japan imported 49,503 tons of US sugar from Hawaii. The level of exports for 1976 is not expected to return to pre-1974 levels and will probably be comparable with more recent exports.

* * *

West German campaign results, 1975/76[2].—A total of 18,898,646 metric tons of beets were processed during the 1975/76 campaign, against 16,757,601 tons in the previous campaign. The substantial increase was the consequence of an enlarged beet area (435,573 ha *vs.* 377,472 ha[3]) since the beet yield per hectare was lower at 43·1 tons than the 44·5 tons of the previous year. In spite of the 12·88% increase in the beet slice, sugar production was only 3·94% higher, owing to the unusually low extraction obtained during the 1975/76 campaign, amounting to only 13·58% as against 14·73% in 1974/75 and 15·13% in 1973/74. The low beet yield and sugar extraction gave a sugar per hectare figure of only 5·89 tons, compared with an average of 6·89 for the previous 5-year period. Sugar produced amounted to 1,994,463 tons of white sugar and 314,934 tons, white value, in the form of raws and intermediate products, i.e. a total of 2,309,397 tons, against 2,221,940 tons in 1974/75. Corresponding figures expressed in metric tons, raw value, are 2,565,996 for 1975/76 and 2,468,822 for 1974/75.

* * *

Nigeria sugar factory plans[4].—It is reported that the Government of Nigeria and the Indian Mehta Group have made a contract for the erection of a new sugar factory at Lafiagi, 300 kilometres north-east of Lagos. The factory is to come on stream in 1978 and is to have an annual production capacity of 60,000 tons of sugar.

* * *

Denmark campaign results, 1975/76[5].—The six beet sugar factories in Denmark sliced a total of 2,967,003 metric tons of beet in 1975/76 as against 2,811,300 tons in the previous campaign. Sugar production was 389,800 tons, white value, compared with 381,000 tons in 1974/75.

* * *

Hong Kong sugar imports and exports[6].—Imports of sugar by Hong Kong during 1975 totalled 76,909 long tons, tel quel, as compared with 80,640 tons in 1974. The major suppliers were China with 21,968 tons (23,988 tons in 1974), Japan with 13,573 tons (14,267), Malaysia and Brunei with 13,359 tons (10,663), South Korea with 8767 tons (18,067), North Vietnam with 6710 tons (6506) and Singapore with 6269 tons (1314). Exports and re-exports totalled 13,958 tons, a considerable increase on the 2805 tons of 1974, the principal destinations being China (5300 tons), Sri Lanka (3195 tons), Afghanistan (1968 tons) and Malaysia & Brunei (1600 tons).

* * *

Venezuela sugar purchases[7].—Venezuela is to purchase sugar for future delivery, to take advantage of current low terminal prices, and to safeguard against a possible shortfall in domestic output. The volume to be purchased has not yet been decided. It is expected that these will be Venezuela's last sugar purchases abroad because expansion of existing sugar factories and the building of new ones is to start this year. Sugar purchased abroad in 1974 and held in reserve as domestic demand increased is now virtually used up.

* * *

Paraguay sugar production 1975[8].—Production of sugar in 1975 amounted to 51,876 tons, compared with 71,876 tons in 1974. Private sources report that sugar exports in 1975 amounted to 25,000 tons, an increase of 1000 tons over the 1974 total.

European sugar beet areas, 1976[9]

	1976 *Estimate*	1975	1974
		(*hectares*)	
Belgium/Luxembourg	100,000	119,600	104,426
Denmark	80,000	86,000	68,000
France	560,000	560,000	508,000
Germany, West	435,000	435,573	377,472
Holland	143,000	136,515	115,648
Ireland	34,000	33,000	25,680
Italy	280,000	260,000	189,227
United Kingdom	206,400	193,336	182,432
Total EEC	*1,838,400*	*1,824,024*	*1,570,858*
Austria	59,000	59,864	53,666
Finland	26,000	23,230	21,306
Greece	43,200	44,500	26,973
Spain	210,000	190,500	127,918
Sweden	52,500	52,600	46,500
Switzerland	12,500	11,500	9,919
Turkey	220,000	213,250	153,204
Yugoslavia	126,000	108,000	100,443
Total West Europe	2,587,600	2,527,468	2,110,814
Albania	6,000	6,000	6,000
Bulgaria	65,000	62,700	58,000
Czechoslovakia	205,000	200,000	190,000
Germany, East	275,000	268,000	235,367
Hungary	130,000	123,180	92,762
Poland	530,000	500,000	445,000
Rumania	283,000	275,000	250,000
USSR	3,760,000	3,690,000	3,610,000
Total East Europe	5,254,000	5,124,880	4,887,129
Total Europe	7,841,600	7,652,348	6,997,943

* * *

Argentina sugar statistics[10]

	1975		1974	
		(*metric tons, raw value*)		
Initial stocks		505,841		736,254
Production		1,367,180		1,513,625
		1,873,021		2,249,879
Consumption		1,086,317		1,100,269
Exports—Algeria	0		45,279	
Chile	0		65,454	
Egypt	14,056		34,365	
Finland	0		4,241	
France	2,000		31,248	
Greece	0		984	
Holland	0		894	
Iran	0		63,652	
Iraq	0		21,742	
Japan	10,893		0	
Libya	54,344		32,609	
Morocco	4,500		27,406	
Senegal	3,883		0	
Spain	9,458		49,878	
Sri Lanka	0		10,760	
Syria	0		16,538	
Tunisia	0		17,939	
UK	5,534		79,333	
Uruguay	0		8,000	
USA	92,472		100,018	
Venezuela	0		12,119	
Yugoslavia	0		11,154	
Zaire	0		10,156	
		197,140		643,769
Final stocks		589,564		505,841

[1] *U.S.D.A. Sugar & Sweetener Rpt.*, 1976, **1**, (1), 16; (2), 7.
[2] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (5), 6–7.
[3] C. Czarnikow Ltd., *Sugar Review*, 1976, (1272), 33.
[4] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (4), 9.
[5] *Zeitsch. Zuckerind.*, 1976, **101**, 164.
[6] C. Czarnikow Ltd., *Sugar Review*, 1976, (1271), 28.
[7] *Public Ledger*, 14th February 1976.
[8] *Bank of London & S. America Review*, 1976, **10**, 99.
[9] F. O. Licht, *Daily Sugar Information Service*, 1976, **19**, (40), 153.
[10] F. O. Licht, *International Sugar Rpt.*, 1976, **108**, (7), xii.

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