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L'adsorption de matière colorante sur des résines décolorantes. F. SCHNEIDER, D. SCHLIEPHAKE et J. PALEOS. p. 67–69, 77

On a étudié le mécanisme de l'adsorption de matière colorante sur des échangeurs d'ions décolorants de structures différentes en employant des solutions de sucre brut et une fraction de l'acide fuscacinique. Les processus pendant le chargement et la régénération de la résine sont montrés à l'aide de particules coupées des résines; on peut voir comment les capacités d'adsorption de la matière colorante rapportées à la surface de la résine se rapprochent les unes des autres avec augmentation du nombre de cycles, ce qu'indique que la zone de l'absorption active consiste en une couche sphérique près de la surface de la particule de la résine.

* * *

Utilisation des ultra-sons pour le contrôle de la cristallisation. D. AHARI, J. GENOTELLE, F. HEITZ et J. M. VICAIGNE. p. 71–75

On a examiné la signification des mesures viscosimétriques ultra-sonores en fonction des paramètres fondamentaux de la cristallisation, en employant des solutions sucrées pures et impures. Les résultats, qui sont pratiquement indépendantes de la température de la cuite (70 à 90°C), montrent que l'addition de cristaux aux solutions influence la mesure, bien que dans le cas du viscosimètre ultra-sonore cette influence ne commence à se manifester qu'au-delà d'environ 25% de cristaux, et est d'autant plus faible que la dimension des cristaux est plus élevée. L'appareil a été utilisé pour le contrôle de la cristallisation industrielle en appareil à cuire.

* * *

Recherche aux Etats-Unis sur la diminution du rendement des variétés de canne. R. E. COLEMAN. p. 75–77

Des aspects variés du problème de la diminution du rendement des variétés de canne sont les sujets d'études aux Etats-Unis. L'auteur discute la nature de cettes recherches ainsi que quelques conclusions.

Farbstoffadsorption an Entfärbungsharzen. F. SCHNEIDER, D. SCHLIEPHAKE und J. PALEOS. S. 67–69, 77

Es wurde der Mechanismus von Farbstoffadsorption an Entfärbungsharzen unterschiedlicher Struktur mittels technischer Rohzuckerlösungen auch einer Fuscazinsäure-Fraktion studiert. Die Vorgänge bei Beladung und Regenerierung des Harzes werden an geschnittenen Harzkornern nachgewiesen, wobei man zeigt, wie sich die auf die Oberfläche bezogenen Farbstoffadsorptionskapazitäten mit zunehmender Zyklenzahl annähern; dies zeigt, dass der aktive Adsorptionsanteil aus einer spherischen Kugelschale dicht an der Oberfläche des Harzkorns besteht.

* * *

Anwendung von Ultraschallwellen für die Kontrolle der Kristallisation. D. AHARI, J. GENOTELLE, F. HEITZ und J. M. VICAIGNE. S. 71–75

Die Verfasser haben die Bedeutung von Ultraschallviskositätsmessungen in Verbindung mit den basischen Parametern der Kristallisation mittels reiner und unreiner Zuckerlösungen studiert. Die Ergebnisse, die praktische unabhängig von Kochtemperatur (70 bis 90°C) waren, zeigen, wie der Zusatz von Kristallen in die Lösungen die Messung abänderten, obgleich diese Einwirkung bei einer Kristallmenge von 25% oder weniger nur sehr klein war. Der Einfluss der Kristalle nimmt mit Zunahme ihrer Dimensionen ab. Der Apparat ist für die Kontrolle von industrieller Kristallisation in einem Kochapparat angewendet worden.

* * *

Forschungen in den Vereinigten Staaten über die Verminderung des Ertrags von Rohrsorten. R. E. COLEMAN. S. 75–77

In den Vereinigten Staaten werden verschiedene Faktoren des Problems von Verminderung des Ertrags von Rohrsorten studiert. In diesem Aufsatz bespricht man diese Forschungsarbeit wie auch einige Ergebnisse.

Adsorción de material colorante sobre resinas descolorizantes. F. SCHNEIDER, D. SCHLIEPHAKE y J. PALEOS. Pág. 67–69, 77

Los autores han estudiado el mecanismo de adsorción de material colorante sobre resinas descolorizantes de varias estructuras, empleando soluciones técnicas de azúcar crudo y de un fracción de ácido fuscazinico. Demuestran los procesos que ocurren mientras la carga y la regeneración de la resina con el ayuda de partículas seccionadas, de que es posible indicar que las capacidades para adsorción de los materiales colorantes, relativo al área superficial de la resina, convienen aproximativamente con aumento en el número de ciclos. Esto indica que la zona activa de adsorción es una capa esférica cerca de la superficie de la partícula de resina.

* * *

Empleo de equipo ultrasónico para el control de cristalización. D. AHARI, J. GENOTELLE, F. HEITZ y J. M. VICAIGNE. Pág. 71–75

El importancia de medidas de viscosidad, por técnicas ultrasónicas, como función de los parámetros básicos de cristalización, se ha estudiado con el uso de soluciones de azúcar puro e impuro. Los resultados, casi independiente de la temperatura de ebulición (70–90°C), demuestran que las medidas se cambian con el adición de cristales, aunque el contenido de cristales afecta el viscómetro ultrasónico solamente ligeramente a un contenido de 25% o menos. El efecto de los cristales se disminuye con aumento de su tamaño. El equipo se ha utilizado para el control de cocción en un tacho industrial.

* * *

Investigaciones en los E.U.A. sobre la disminución de rendimiento de variedades de caña. R. E. COLEMAN. Pág. 75–77

Un los E.U.A. se estudián varios aspectos de la problema de disminución de rendimiento de variedades de caña, y la naturaleza de esta obra y un número de descubrimientos se discutieron.

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Notes & Comments

World sugar balance.

In January F. O. Licht KG published their first estimate of the world sugar balance for 1967/68[1]. The figures given below relate to the campaign year September-August and the conversion ratio for white sugar to raw value is 9:10.

	(*metric tons, raw value*)		
	1967/68	1966/67	1965/66
Production	66,116,847	65,564,625	62,850,468
Imports	21,509,000	20,842,267	20,717,739
Initial stocks	18,281,264	18,355,559	18,364,396
Total	105,907,111	104,762,451	101,932,603
Final stocks	16,821,686	18,281,264	18,355,559
Deliveries	89,085,425	86,481,187	83,577,044
Exports	21,621,500	21,251,078	20,559,870
Consumption	67,463,925	65,230,109	63,017,174
Production increase	552,222 (0·84%)	2,714,157 (4·32%)	
Consumption increase	2,233,816 (3·42%)	2,212,935 (3·51%)	

The 1967/68 data show a reduction in stocks which nevertheless are still expected to be nearly 17 million tons. There is therefore no need at present for a strong increase in world sugar production. It would be valuable to reduce stocks further to 15 million tons, and after this production should increase yearly by 2–2½ million tons. Any surplus above this would be unfavourable. In order to reach a stock reduction to 15 million tons it could be necessary to increase production in 1968/69, when the balance would be:

	1968/69
Production	67,925,000 tons
Imports	21,500,000 ,,
Initial stocks	16,800,000 ,,
Total	106,225,000 ,,
Final stocks	15,000,000 ,,
Deliveries	91,225,000 ,,
Exports	21,500,000 ,,
Consumption	69,725,000 ,,

A world production of 67,925,000 tons in 1968/69 would still involve an increase of 1,808,000 tons compared with 1967/68, and the final stocks of 15 million tons would represent 21·51% of annual consumption, compared with final stocks of 24·93% of consumption in 1967/68, 28·02% in 1966/67 and 29·12% in 1965/66.

* * *

International Sugar Conference.

The UNCTAD International Sugar Agreement Negotiating Conference is due to commence in April. Commenting on its significance, C. Czarnikow Ltd. write[2]: "It is of the greatest importance that efforts of the delegates should meet with success; a previous attempt to negotiate an Agreement in 1965 was a failure and should this year's endeavours also go unrewarded, the aims of all those who have for so long been striving for the re-establishment of more orderly marketing conditions are likely to receive a set-back from which it will take a long time to recover.

"On this occasion, however, delegates will go into the Conference far better briefed and with the various problems already having been discussed in detail. A great deal of work and study has been undertaken under the auspices of UNCTAD during the past year or so and many difficulties have already been overcome while others have been clearly delineated. Governments will therefore be in a position to decide upon their attitudes without further exploratory talks once the negotiations commence.

"If the negotiations are to succeed it is important that accurate statistics and forecasts upon which decisions can be made should be available. In the past there has been much criticism by the trade of the type of forecasts which international bodies have used. During a time when no effective International Agreement was in operation it was, perhaps of little moment that these seemed to be based more upon the aspirations of optimistic producers than upon more prudent calculations and, indeed, if they in any way served to dissuade some from expanding their capacities they may have served a useful purpose. When it comes to actual negotiations and decision making,

[1] *International Sugar Rpt.*, 1968, **100**, (2), 1–4.
[2] *Sugar Review*, 1968, (847), 9.

however, it is necessary for all available data to be as close to reality as possible."

Referring to price arrangements, Czarnikow adds: "The returns received by exporters for sugar delivered under the CSA Negotiated Price Quota, to the United States within the Sugar Act arrangements and to the Soviet Union against the trade agreement with Cuba are all roughly in line. These various arrangements illustrate the assistance which developed countries with substantial import requirements are able to offer. It must be the aim of delegates when they assemble later this year to ensure that measures are taken which will enable similar prices to be received by producers, whatever may be the destination of the sugar."

* * *

UK sugar imports and exports, 1967[1].

Elsewhere in this issue appear the figures of sugar imports and exports to and from the UK in 1967. Import figures show little change compared with the previous year but there was a small but significant improvement in the tonnage exported.

Imports of raw sugar from the Commonwealth, at 1,764,000 tons, were almost exactly the same as in the previous year, and represent more than 80% of the total sugar entering the country. Foreign countries supplied 345,000 tons of raw sugar in 1967 compared with 358,000 tons in 1966; despite the close comparison of these figures, however, there were considerable changes in sources. South Africa was the major supplier with 159,000 tons, or just over 100,000 tons more than in the previous year, followed by Cuba with 80,000 tons. On the other hand deliveries from Brazil, which in 1966 had reached 162,000 tons, fell to only 18,000 tons.

For the past four years imports of refined and white sugar have remained stable at around 50,000 tons. Presumably the system of open individual import licences, which has been in force in respect of sugar polarizing in excess of 98° since March 1966, will continue to apply all the time such imports remain at this low level.

Despite the improvement in the overall export figure, shipments to the Commonwealth fell for the first time in four years. The reduction of 24,000 tons was almost entirely accounted for, however, by the virtual loss of the Malaysian market, where domestic refineries are now in operation. Switzerland continued to be the most important outlet among foreign destinations, taking 57,000 tons out of a total of 233,000 tons dispatched in 1967. The Netherlands was the next largest market, with deliveries reaching 45,000 tons, or 20,000 tons more than in 1966. In total, exports amounted to 322,000 tons, compared with 298,000 tons in the previous year. The performance would probably have been even better had the Suez Canal not been closed throughout the second half of 1967.

Record USSR beet harvest[2].

The sugar beet harvest in the USSR this campaign was a record 86·8 million tons of beet, which compares with 73·8 million tons in the 1966 campaign. It is more than five million tons more than the previous record output in 1964. The bumper harvest was apparently the result of ideal growing conditions in the Western Ukraine and other key sugar areas which experienced a long wet autumn without frosts. There is no official indication of the average sugar content or of what the granulated sugar outturn is likely to be, but with the average content of 12·5% sugar the harvest would correspond to a sugar crop of 10·8 million tons.

Unfortunately, without adequate information on the sugar content, such an estimate can only be a guess and with such a large tonnage of beets a small error in the supposed sugar content can result in a relatively small but absolutely large error in the sugar outturn estimate.

* * *

Brazil—Morocco sugar negotiations.

Brazil is the fourth largest sugar producer in the world and it is a measure of her importance that the sugar market has been subject to numerous rumours concerning negotiations with Morocco. C. Czarnikow Ltd. reported[3] that they originated from two separate bids, each for 100,000 tons of raw sugar for 1969 shipment made to the Instituto do Açúcar e do Alcool on pricing terms which were unacceptable. Morocco bought 160.000 tons of Brazilian sugar in May 1967 of which 60,000 tons was for 1967 delivery and the remainder for 1968 delivery. Morocco also bought 295,000 tons from Cuba in 1967 but no mention has been made of any extension of this contract and Morocco might be a market for sugar of other origin in consequence, especially as observers believe likely Cuban production to be much reduced below the official target of 5·7 million tons as a result of bad weather.

The Export Director of the Institute confirmed that Brazil was negotiating with Morocco for a sale of 200,000 tons and later that the President of his country had authorised negotiations for a long-term agreement for up to one million tons of sugar during the years 1968–71[4]. No conclusions to the negotiations had been reached at the time of writing.

* * *

French sugar production targets[5].—According to an announcement in the French official journal of 12th December 1967, the production target for refined sugar in the sugar economic year 1967/68 has been fixed at 2,300,000 metric tons, of which 1,852,964 tons (1,500,000 in 1966/67) has been set for Metropolitan France, 213,626 (192,336 tons) for Réunion, 164,559 tons (131,075 tons) for Guadeloupe and 68,851 tons (93,131 tons) for Martinique.

[1] C. Czarnikow Ltd., *Sugar Review*, 1968, (851), 29–31.
[2] *Public Ledger*, 27th January 1968.
[3] *Sugar Review*, 1968, (850), 25.
[4] *Public Ledger*, 3rd February 1968.
[5] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (35), 10.

Adsorption of Colouring Matter on Decolorizing Resins

By F. SCHNEIDER, D. SCHLIEPHAKE and J. PALEOS
(Institut für landwirtschaftliche Technologie und Zuckerindustrie an der TH Braunschweig)

Paper presented at the 13th Congress of the Commission Internationale Technique de Sucrerie (C.I.T.S.), 1967

A decolorizing exchange resin loaded with colouring matter cannot be regenerated until the adsorbed colouring matter has been completely removed. If a colour balance is carried out, residual colour still remains on the exchanger. This residual colour is referred to hereafter as "irreversible adsorbed colouring matter". It contains that proportion that cannot be eluted with 10% NaCl solution. The following tests concerned the kinetics of adsorption, particularly irreversible adsorption.

Investigations have been made on resins of four different structures. The resins differ either in their degree of cross-linkage (4 and 6% divinylbenzene content) and in their porosity or macropore content (high-porosity S-types, and low-porosity G-types). The resins used were 4S, 6S, 4G and 6G*, the number indicating the divinylbenzene content.

First the relationship was determined between the measured capacity and the number of cycles when decolorizing 6·5°St raw sugar liquors (Fig. 1).

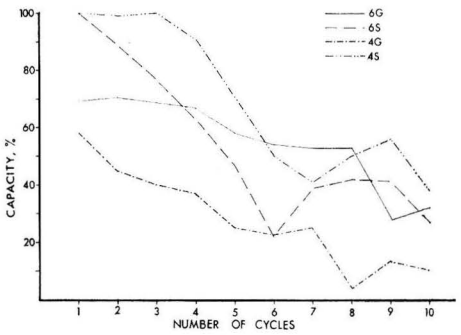

Fig. 1

The graph shows the drop in capacity with increasing number of cycles. Those resins with macroporous structure (4S and 6S) have the highest initial capacity. After 10 cycles, however, the differences are not so marked; also, if we consider the scatter, the differences on the whole are not very specific. This is principally due to the presence of both large and small colouring matter molecules with their different behaviour. Similar tests were therefore carried out with a homogeneous colouring matter fraction (so-called fuscazinic acid) obtained from molasses (Fig. 2).

Again the initial capacities are widely different for the S and G types, while at the same time the

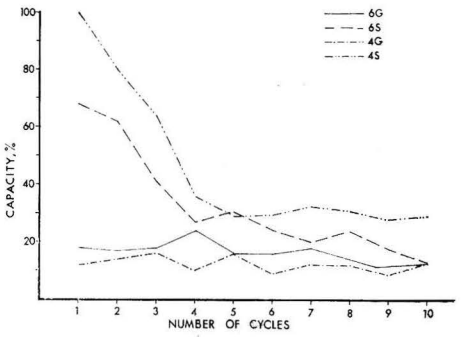

Fig. 2

curves follow a smoother path. The convergence of the adsorption capacities with increasing number of cycles is more marked than in the previous test.

The path of the curves in Fig. 1 is not so clear because of the heterogeneity of the adsorbed colouring matter, while adsorption of the fuscazinic acid fraction involves a highly homogeneous fraction of relatively large molecules (15,000–17,000 M.W.). This resulted in more clearly defined relationships. The absorption capacity of the G resins is also very small because of the large colouring matter molecules.

The test results indicate that with increasing number of cycles in the case of the porous resins, the interiors of the particles become saturated, with the result that after a large number of cycles adsorption and desorption occur only in the layers near the surface. In the case of the G-type resins, this phenomenon is found from the start because of their low macroporosity relative to the larger colouring matter molecules, i.e. the G resins adsorb in only a very thin surface layer.

Hence, without regard to the kinetics, we can say that the total "irreversible" capacity is several times the reversible capacity, because it results from the slow saturation of the interior of the particles.

This is illustrated by Fig. 3, in which the total irreversibly adsorbed colouring matter considerably exceeds the values for the actual adsorption per cycle at any given time.

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* Produced especially for the tests by Farbenfabriken Bayer A.G., Leverkusen. We are grateful to this company, and particularly to the late Professor HAGGE, for this.

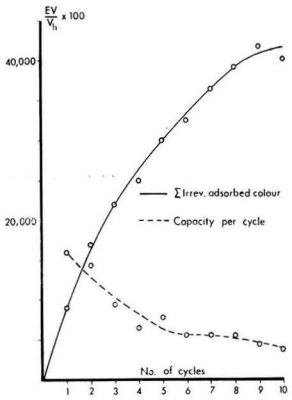

Fig. 3

Fig. 4. shows the irreversible adsorption as a function of the number of cycles for the resins tested, and demonstrates how the values tend towards saturation with increasing number of cycles. As expected the irreversible adsorption with the G-type resins is very small as, from the start, the inside of the particles is not very accessible.

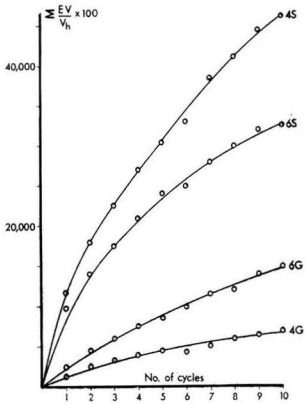

Fig. 4

The order of the resins does not alter if the specific load is changed.

The mechanism or kinetics of reversible or irreversible adsorption is easily studied and may be determined from the cross-sections of the loaded or regenerated particles. We managed to take very good photographs of exchange resin particles using a microtome especially manufactured for this purpose.

The following photographs (Fig. 5) show the cross-sections of loaded and NaCl-regenerated particles of an S-type resin after 1 and 7 cycles. It is clearly seen how the loading is distinguished by a sharply defined front which becomes blurred by regeneration. The active boundary zone expands only very slowly as the interior becomes filled.

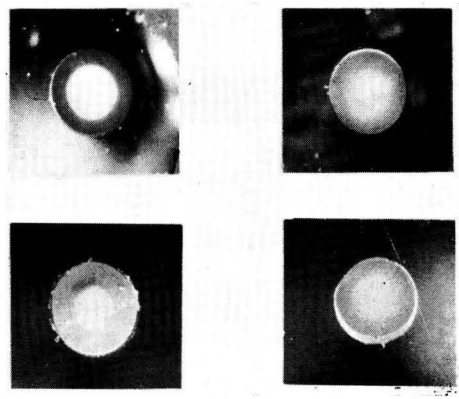

Fig. 5

The process is schematically represented in Fig. 6. Regeneration leads to a change in the swelling conditions in the particle. In these circumstances, the molecules adsorbed inside the outer spherical shell can diffuse further into the particle as well as to the outside. Thus, the inner front becomes indefinite. Hence, the "irreversible" portion consists of the firmly bound colouring matter which is diffused to the inside of the particle, while diffusion to the inside (see Fig. 6) leads to a concentration which is the same as inside the particle, i.e. resulting in saturation.

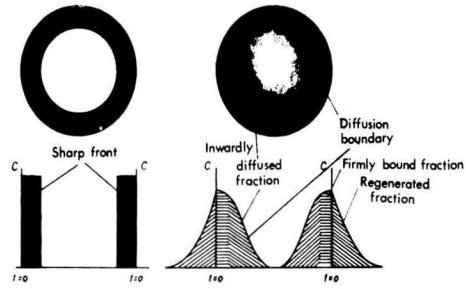

Fig. 6

By this means we have confirmed the qualitative assumptions made above on the basis of the capacity curves. The different behaviour of the G-type resins, i.e. adsorption much more restricted to the surface, is clearly seen in Fig. 7.

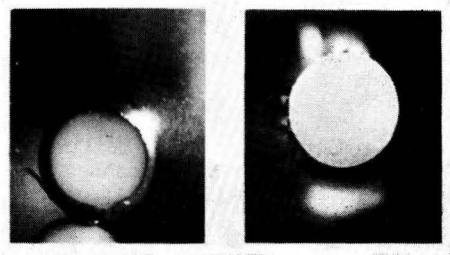

Fig. 7

Apart from these conclusions on irreversible adsorption, we have carried out further tests to explain the definition of the front in the photographs and hence the kinetics of adsorption. With the aid of photographs it is possible with static load tests to make a direct observation of the saturation process in the particle in relation to time. If we apply a colour solution to exchange resin particles and examine the progress of the colour front in the particle, expressed in terms of the ratio between the thickness of the coloured layer δ and the radius R of the particle, we can determine the progress of the front from the diffusion rate, while the adsorption is responsible for the sharpness of the inner boundary (Fig. 8).

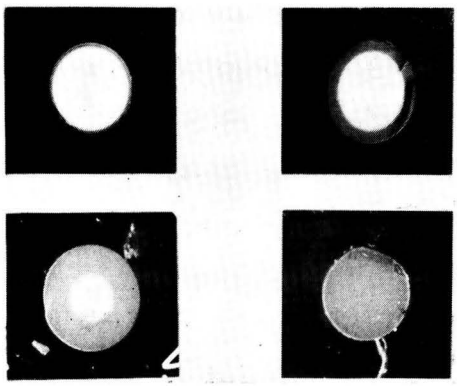

Fig. 8

For an analogous process, viz. the progress of frost in the ground, a mathematical model exists. If this is applied to the sphere and colouring matter adsorption, then at constant outer concentration we have:

$$\dot{m} = D\frac{\Delta C}{\delta} \text{ for small values of } \delta.$$

The increase $\frac{d\delta}{dt}$ is found from the mass balance, if we assume a saturation concentration for adsorption C_s:

$$\frac{dQ}{dt} = 4\pi D \frac{Rr}{\delta} \Delta C \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The equation is derived from the diffusion formula $\frac{d}{dr}\left(r^2 \frac{dC}{dr}\right) = 0$ for the stationary case.

But

$$\frac{dQ}{dt} = C_s 4\pi r^2 \frac{d\delta}{dt} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Hence

$$C_s 4\pi r^2 \frac{d\delta}{dt} = 4\pi D \frac{Rr}{R-r} \Delta c \quad \ldots\ldots\ldots\ldots (3)$$

or

$$\frac{D\,\Delta\,c}{R^2 C_s}\, t = \int_{\frac{\delta}{R}=0}^{\frac{\delta}{R}} \frac{(R-\delta)}{R^2} \frac{\delta}{R} d\left(\frac{\delta}{R}\right) \quad \ldots\ldots\ldots\ldots (4)$$

This gives

$$\frac{D\,\Delta\,C}{R^2\,C_s}\, t = \left(\frac{\delta}{R}\right)^2 \left(\frac{1}{2} - \frac{1}{3}\,\frac{\delta}{R}\right) \quad \ldots\ldots\ldots\ldots (5)$$

This "ice model" permits $\frac{\delta}{R}$ to be expressed as a function of $\frac{D}{R^2 C_s}\, t$ (Fig. 9).

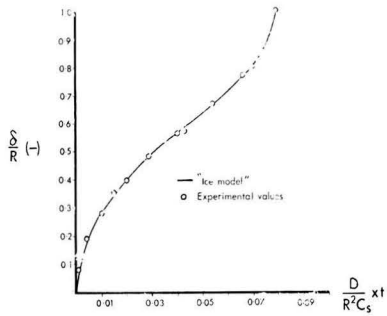

Fig. 9

That the model represents the conditions very well is shown by the fact that the value of $\frac{D}{C_s}$ is in fact practically constant with astonishingly small amount of scatter, as Fig. 10 shows.

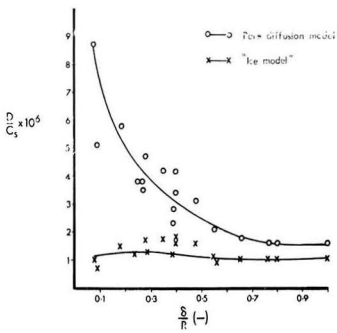

Fig. 10

Hence with this relatively simple model we are in a position to explain the migration mechanisms of colouring matter in a particle and to demonstrate the need for sharpness (definition) of the front. The diffusion coefficients calculated from (5) for colouring matter molecules lie in the approximate range 1·0–1·5 × 10^{-6} sq.cm./sec and hence in the order of size of similarly large albumin molecules (15,000–17,000 M.W.).

We can draw a further interesting conclusion from the behaviour of decolorizing resins in relation to the number of cycles.

The decrease in capacity with increasing number of cycles with simultaneous saturation of the irreversible adsorption points to the fact that the process is

(continued on page 77)

Correspondence

The Editor,

The International Sugar Journal Ltd.

Sir,

CANE SUGAR EXTRACTION

In recent years the cane sugar industry has once again become interested in the possibilities of diffusion and lixiviation processes as alternatives to straight milling for the extraction of sugar from cane. It is proving extremely difficult, however, for sugar producers to evaluate the performance and economics of the various systems which are now offered. I believe that a further attempt should be made to establish a basis for evaluating the economics of the various methods of extracting sugar from cane.

Rightly or wrongly, a large number of people have reservations about one or other of the new "washing" processes. It is certainly true that cases have been reported in which an increase in extraction appears to have been accompanied by an extremely disconcerting drop in Boiling House performance.

According to some reports, difficulties in maintaining efficiency in the recovery of sugar in the Process House, have apparently resulted in reducing to a minimum any increase in overall recovery, after the installation of a diffusion or lixiviation system. In some cases it appears to have resulted in a drop in overall recovery. As the profitability of any factory project or rehabilitation programme must be dependent upon the overall recovery, it is extremely difficult for those responsible for the economics of the industry to decide how best to use and interpret that technological information, about the new processes, which is available at present.

In order to assist the industry to evaluate the overall performance that may be associated with diffusion and lixiviation processes, I would like to propose the collection and correlation of information about the overall performance of cane sugar factories in which the extraction is achieved by milling plants. This would form a base from which to judge the performance of the newer systems. I believe it should be possible, from an examination of a large number of world-wide performance reports, to predict standard overall recoveries obtainable from canes of different technical qualities. The world-wide basis of such an exercise should even out any of the difficulties associated with variations in the millability of the cane, whilst, at the same time, giving full weight to the Boiling House performance.

To obtain such a basis, I would be willing to carry out a statistical appreciation of the relevant data with a view to publishing, for the benefit of the industry in general, a series of graphs or tables based upon the conclusions, copies of which would also be made available to anyone interested.

The purpose of this letter, therefore, is to ask you to allow an appeal through your Journal to sugar producers in all parts of the world to supply me with the necessary information to undertake this survey. However, in order not to distort the figures, the request must really be restricted to those factories working within reasonable proximity of efficient design capacity, excluding those factories which are consciously accepting a loss in recovery, by sacrificing process efficiency to throughput, albeit for valid, sound commercial reasons. Once such a survey can be completed, all producers will have a basis for evaluating the true overall benefits that may be expected from any process, including any of the new diffusion or lixiviation methods of extraction, when compared with what may be considered rational standard results from the more traditional factories.

I attach a table which I hope will make clear the information for which I would be grateful and the form in which I would appreciate it being supplied.

Finally, I would like to make the point that whilst my associates and I have a considerable amount of information, nevertheless the results reported are not reported in exactly the same manner. In addition, certain areas and certain organizations do not publish their achievements. Appealing to those particularly who do not, at present, publish their results for general information, I would like to give a sincere undertaking that any individual performance results sent to me will be treatest in strict confidence and will not, under any circumstances, be disclosed to any third party without full authorization from the supplier of the information. It is hoped that this undertaking will result in a very large number of factories and companies submitting the results necessary to carry out this survey, since it is only if individuals are prepared to assist that reliable information can be extracted from the exercise.

It would be appreciated if the information could be sent to arrive in Derby not later than the end of June; this would ensure that the survey would not be greatly delayed.

Yours truly,

F. A. SEAFORD
Fletcher and Stewart Ltd.
Derby, England.

* * *

INFORMATION REQUIRED FOR CORRELATION

1. In order that the basic data will be comparable, it is necessary that both the mill and boiling house controls should be based on the I.S.S.C.T. weight method for one or more complete crops.
2. The mill equipment data should include number of knife sets, other preparatory devices, number of mills and of mill rollers with the size and peripheral speeds, so that a "theoretical" capacity can be average calculated on a common basis.
3. Any deficiencies in sugar boiling or purging equipment should be mentioned.
4. The analyses should include pol % cane, fibre % cane, Brix and purity of 1st and last expressed and mixed juices, % pol and % moisture in bagasse, RS/Ash ratio and gravity purity of final molasses and polarization of sugar.
5. The control figures should include tons cane per hour, imbibition % cane, mill extraction, boiling house recovery, overall recovery and pol or sucrose balance.

Use of Ultrasonics for the Control of Crystallization

By D. AHARI, J. GENOTELLE, F. HEITZ and J. M. VICAIGNE
(Laboratoire Central du Groupement Technique de Sucreries, Paris, France)

Paper presented to the 13th General Assembly of the Commission Internationale Technique de Sucrerie (C.I.T.S.), 1967

Introduction

THE control of crystallization by measurement of the tightness of the massecuite is not new. The use of an ultrasonic viscometer seemed to us to be an elegant and more precise solution than those methods used up to now in the sugar industry.

The object of the present study was to attempt to determine the significance of viscometric measurements made in this way as a function of the fundamental parameters such as the degree of supersaturation of the mother-liquor and the weight of crystals present in the massecuite.

Value of viscosity measurements for the control of crystallization

The viscosity η of a solution may be represented by the following equation[1]:

$$\eta = ae^{\frac{bN}{T}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where a and b are constants, N is the molecular concentration of the solute, and T is the absolute temperature.

For a solution of sucrose in water, N may be expressed as a function of the Brix B:

$$N = \frac{B}{1900 - 18B}$$

Equation (2) gives an approximate value for sugar solutions:

$$\log \eta = -2 + \frac{1460}{40 + t} \times \frac{B}{1900 - 18B} \quad \ldots\ldots\ldots\ldots (2)$$

where η is given in poises, t is the temperature in °C, and B is the Brix of the solution (or dry matter % by weight).

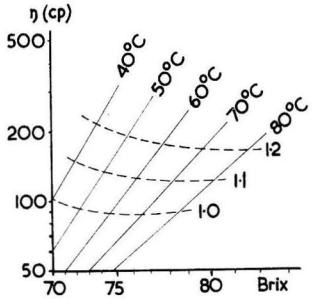

Fig. 1. Viscosity of a sugar solution as a function of its Brix, temperature and degree of supersaturation

In Fig. 1, which expresses this equation in graph form, the lines of equal supersaturation being drawn according to GRUT's table, it is seen that for the same degree of supersaturation, the viscosity is relatively slightly affected by a change of temperature.

Within the limits of temperature used in vacuum pans, this effect may be considered as negligible; the viscosity may thus, for the practical technologist, represent the degree of supersaturation with adequate precision.

The case of impure solutions

In this case equation (1) can only express supersaturation if N is considered as an average molecular concentration. For a given weight of dry matter dissolved, the value of N will depend not only on the purity but also on the composition of the non-sugars. Since this non-sugars composition appreciably influences the Brix measurement, it is evident that the method of measuring Brix must be specified if one wishes to speak of the viscosity of a sugar factory run-off. In the present article, all the Brix measurements have been made direct by refractometer, i.e. with undiluted solutions.

It is important to emphasize this for the case of products having an abnormal non-sugars composition. This is the case, for example, with run-offs from the Quentin process in which the average molecular weight of the dissolved solids is appreciably affected.

Knowing the specific viscosity of an impure product, i.e. relative to a given Brix and temperature, it is easy to derive a graph analogous to that of Fig. 1. The curves of equal supersaturation in this, as with pure solutions, are little affected by variation from the initial temperature to 70°, as we have verified.

Application of an ultra-sonic viscometer to sugar solutions

The apparatus we have used is the "Ultra-Viscoson" viscometer made by Bendix and put at our disposal by the firm of Jobin & Yvon who have assisted us in carrying out our tests.

Principle of the apparatus[2]

The measuring probe is a metallic strip, of which half is a magneto-strictive alloy and the other, which is in contact with the liquid, is of stainless steel. This strip is fixed to a diaphragm which constitutes

[1] KAGANOV: *Sakhar. Prom.*, 1949, **23**, (3).
[2] ROTH and RICH: *J. Applied Phys.*, 1953, **24**, 940.

the end of the body of the probe. Under the influence of electromagnetic impulses, it is excited in longitudinal vibrations which induce half-wave oscillation of the strip at its resonance frequency. The length of each half-strip being 50 mm. the frequency obtained is 28 kHz. The amplifier then transforms the alternating voltage from these oscillations into a measurable electric current. The indicator of the apparatus transforms these values in proportion to the product of the viscosity times the density of the liquid measured. The precision of the determinations is of the order of 2%.

Experimental equipment

The viscometric probe was placed in a small laboratory vacuum pan provided with equipment for controlling the Brix and temperature of the solution as well as with mechanical circulation using a helical device. It was thus possible to vary the principal parameters simply. Products of different purities were prepared by addition of molasses to a syrup of pure sucrose in water.

Difficulties encountered in measurement of sugar solution viscosity

The determinations carried out showed good reproducibility of the results, at least for concentrations less than or equal to those corresponding to the state of saturation. On the other hand, for supersaturated solutions we came up against a difficulty during the first part of our experiments which disturbed the results profoundly; for a solution maintained at constant supersaturation and Brix the figure at first read normal, then increased progressively as a function of time, a phenomenon not arising with under-saturated systems.

We noticed that the cause of the anomaly lay in the formation of a more or less thick layer of fine crystals on the measuring strip, which modified its vibration more and more.

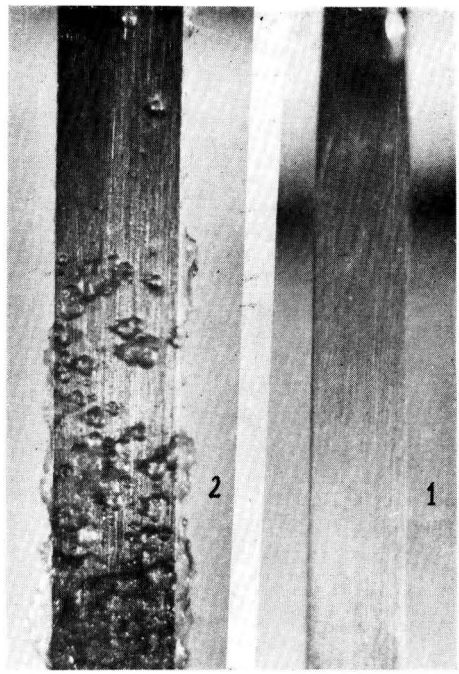

Fig. 3. Enlarged view of the ultrasonic measuring strip showing the heavy incrustation obtained after 15–20 minutes in a supersaturated system

After cleaning the strip, the measurement returned to its normal value. On the other hand a control metallic strip, identical with that of the probe but not subject to vibratory movements, was not incrusted under the same conditions.

To remedy this inconvenience, the viscometer was modified as follows: by means of a time-switch the impulses were sent to the probe only for a fraction of a second per minute, the measurement recorder naturally being modified in consequence.

Results obtained

In Fig. 4 the viscosity is represented as a function of Brix, for different purities and at the same temperature (80°C). The ordinate axis is graduated in terms of log ($\eta \times d$). We see that the influence of syrup purity, between 80 and 100, is of the order of magnitude of experimental error and can, as a first approximation, be neglected.

The results have been assembled, however, as a function of purities and degrees of supersaturation (Fig. 5), a form which may be utilized in practice.

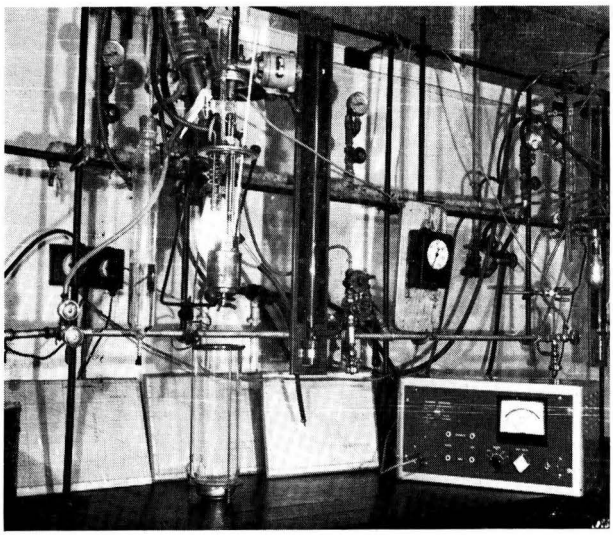

Fig. 2

The interest of these curves, on the other hand, is that they are not affected by a variation in temperature, as is shown by Fig. 6; there is, for temperatures

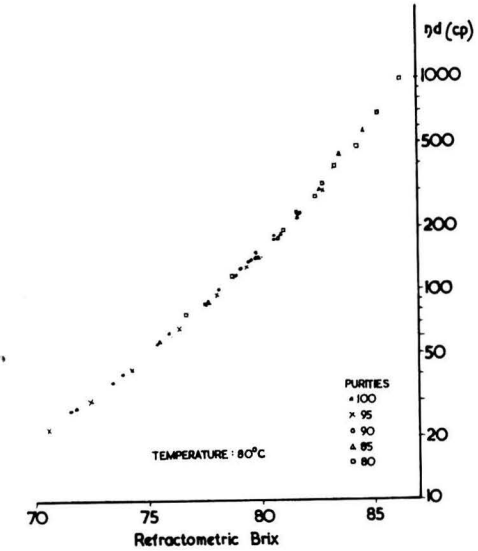

Fig. 4

of the order of 70–90°C, a good enough compensation for the same supersaturation between Brix and temperature, a property very interesting for the control

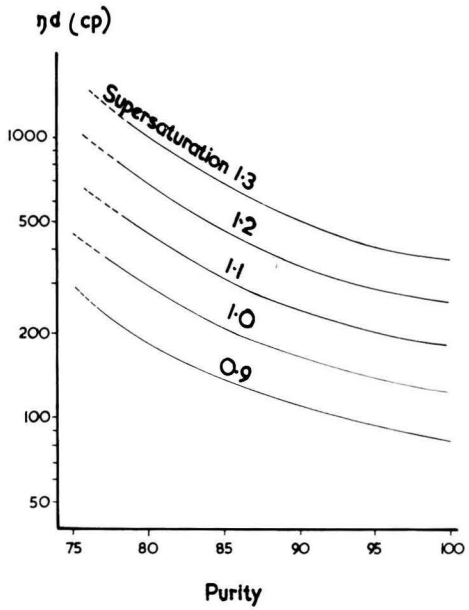

Fig. 5

of crystallization in pans. During the building-up of a strike it would suffice to know approximately the purity of the mother liquor when the viscosity of the latter would give the degree of supersaturation if there were no disturbing influence due to the crystals in the massecuite.

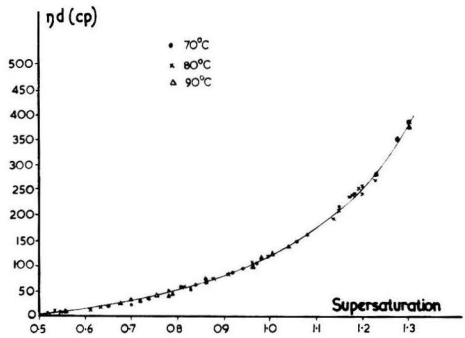

Fig. 6. Viscosity *vs.* supersaturation at 100 purity.

We note in passing that the fact that the viscometer indicates not the viscosity but the product of the latter multiplied by the density does not present any inconvenience. In fact, the density of the mother liquor varies very little under the conditions of industrial crystallization; the maximum variation in density observed in the purity range 80–100 and for supersaturations of 1·0–1·1 is such that the error in supersaturation, if one considers the density constant, is of the order of 0·01, which is negligible.

Influence of the presence of crystals on viscosity measurement

It is well known that the measurement of the viscosity of a solution is modified by the addition of crystals, the effect being greater the higher the amount in relation to the solution. SILIN[3], as well as KAGANOV, has calculated the size of the factor by which it is necessary to multiply the viscosity of the mother-liquor to obtain that of the massecuite, in terms of th ‹ weight of crystals % massecuite.

It appears that the measurements made with the aid of the ultrasonic viscometer give results notably different from those of the usual viscometers (of the Couette type, for example), the measurement being much less affected by the presence of crystals as is shown by the following table, giving the ratio η_{MC}/η_{ML} (tightness of the massecuite/mother liquor viscosity) as a function of the weight of crystals % massecuite.

For solutions of 100 purity, the measured viscosity is hardly altered up to 20% of crystals. For 45% of crystals the measurement is modified to one-seventh of the extent found with the usual type of viscometer.

[3] *Sakhar. Prom.*, 1953, **27**, (8), 10–14; *I.S.J.*, 1954, **56**, 297.

Table I

Ratio $k = \eta_{MC}/\eta_{ML}$ where P is the mother liquor purity

Crystal % *Massecuite*	*According to Silina*	*With the ultrasonic viscometer* $P = 100$	$P = 90$	$P = 75$
0	$k = 1{\cdot}0$	$k = 1{\cdot}0$	$k = 1{\cdot}0$	$k = 1{\cdot}0$
10	1·6	1·02	1·05	1·15
20	2·9	1·07	1·15	1·4
30	5·5	1·17	1·45	1·7
40	12·0	2·06	2·1	3·5
45	20	2·8	2·9	—

The figures indicated in the three right-hand columns of Table I correspond to an average size of about 0·35 mm. Our experiments have shown that the measurement is appreciably influenced by the average size of the crystals, the coefficient falling, for example, to 1·5 instead of 2·8 when the average size is increased from 0·35 mm to 1 mm, which happily reduces the disturbing effect of the crystals in proportion to their growth within the massecuite.

Application to the control of a pan

Let us suppose that a syrup of e.g. 94 purity is progressively concentrated. Having arrived at the graining concentration, the crystallization is seeded and the supersaturation brought to about 1·05 and allowed to crystallize while maintaining the supersaturation at this value by evaporation; the purity of the mother-liquor is progressively reduced, while the weight of crystals formed % massecuite increases (see Table II).

Table II

Mother liquor purity	94	93·2	92·0	[90·5	88·8	86·4
Crystals % massecuite	0	10	20	30	40	50

Fig. 5 above permits us to represent conveniently the development of the viscosity during the course of this crystallization (see Fig. 7 below). The concentration is depicted by the vertical section from A to B; graining is carried out at B, after which the supersaturation is reduced from B to C by dilution until it reaches the value of 1·05. There follows the period of crystallization where the supersaturation is maintained at about 1·05 and where the viscosity measured is influenced in turn by the fall in purity and by the growth of the crystals (D — D'). Beyond 25% of crystals the viscosity rises progressively up to the end of the boiling at E where one can see the effect E — E' of the presence of crystals (it is assumed here that the average size is about 0·35 mm).

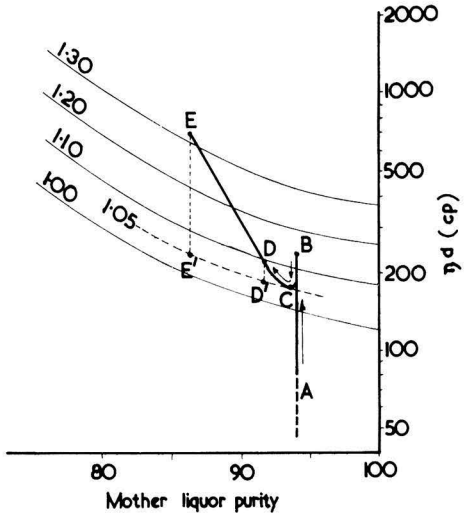

Fig. 7

We could represent similarly the variation of viscosity for different purities corresponding to those of strikes of different stages in the process.

The curves thus traced could serve as programmes of viscosity if they were related to time. Certainly, the variations recorded as a function of time would serve in such a way as to carry out the boiling; after graining, for example, the strike could be held at a constant viscosity by suitable feeding of syrup.

The probe of the "Ultra-Viscoson" apparatus, suitably protected, was installed within the downtake of an industrial pan. In Fig. 8 the course of the

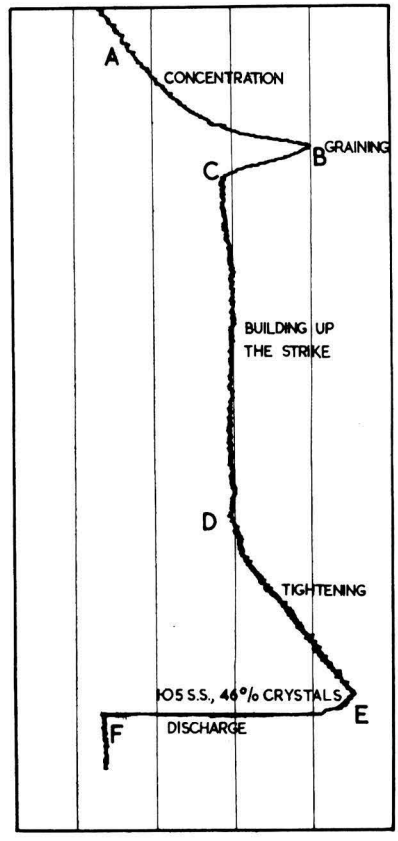

Fig. 8

of an industrial pan. In Fig. 8 the course of the recording obtained is presented in which it is possible to note the various phases of graining (*A*—*B*—*C*), of building of the strike (*C* to *D*) at a supersaturation of about 1·05 and tightness constant to all intents and purposes in spite of the presence of crystals, and eventually the tightening-up phase *D* to *E*.

Conclusions

The measurement of the tightness of a massecuite during a boiling by means of a rotating disc or blade meets with difficulties due to the need to insulate the motor from the massecuite by a gland which is subject to a severe friction couple. The ultrasonic viscometer permits the avoidance of this difficulty and furthermore allows the measuring probe to be located in the pan where it has the best chance of giving valid control.

In addition, the apparatus indicates a value in close relationship with the supersaturation of the mother-liquor during at least the first half of the boiling, which is most important because it is after the graining that one must be able to control the supersaturation as precisely as possible. At the end of the boiling, the increase in the proportion of crystals affects the measurement, but much less than with the other techniques, which consequently permits a crystallization programme to be followed more easily.

Finally, the apparatus may be equipped with a multiple-outlet block permitting the use of the same apparatus with a number of probes successively joined to it. It thus becomes possible to control simultaneously several pans as well as the Brix of the syrups and molasses which feed them.

Summary

The object of the present work was to determine the significance of viscosity measurements as a function of the basic parameters of crystallization. The instrument used (a Bendix "Ultra-Viscoson") measures the damping, due to the solution, of a metallic strip excited in longitudinal vibrations of 28 kHz frequency. A difficulty with supersaturated liquors was the development of sugar crystals on the measuring strip. A solution was found to this difficulty. After a study of pure and impure sugar solutions, a diagram showing the relationship between viscosity, purity and degree of supersaturation is presented. These results are practically independent of boiling temperature (70 to 90°C). Crystals added to the sugar solution change the measurement; the ultrasonic viscometer possesses an interesting peculiarity by comparison with other types, however, in that the influence of the crystal content is much lower and is only appreciable at higher than 25% of crystals. The effect of the crystals is reduced the greater their size. The apparatus has been used for industrial boiling control.

Variety Yield Decline Research in the United States

By R. E. COLEMAN, Plant Physiologist, Crops Research Division,
Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md., U.S.A

THE problem of variety yield decline (VYD) has bewildered sugar cane agriculturalists throughout the world for many years. Many papers suggesting causes for this phenomenon have appeared, and a considerable amount of research work has helped to explain specific cases of yield losses. Still, growers in every major sugar cane producing area in the world are continually seeking new varieties to replace current varieties which they recognize will ultimately "run out". The insidious nature of this phenomenon probably explains the persistence of the problem throughout the industry. Frequently a variety fails quite suddenly, and in many cases a specific disease is eventually found to be the cause of this decline. But the yield decline which is the subject of this paper is the more gradual loss of vigour and yielding ability of a clone over a period of years, the cause of which is unexplained or obscure. Thus, by definition, when a specific cause for a decrease in yield is determined, the problem is no longer considered a part of yield decline. For example, ratoon stunting disease (RSD) has been considered a cause of VYD; research work has specifically defined the virus, the extent of yield losses, and control measures. Still, in the absence of RSD, varieties continue to "run out". Similarly, since 1962 there have been reports[1,2,3] of decreasing sugar yields in Puerto Rico, but these have been attributed to an actual reduction in sucrose content, and not to a gradual decline in vigour or yield of cane.

[1] CHARDON: *Sugar J.* (La.), 1962, **25**, (1), 32–39.
[2] SAMUELS: *ibid.*, 1963, **26**, (1), 62–67.
[3] SHOJI and SAMUELS: *Sugar y Azúcar*, 1965, **60**, (4), 121–125

A symposium on yield decline at the 10th Congress of the International Society of Sugar Cane Technologists in 1959 included reports of research on many aspects of the problem, such as soil, physical and chemical properties[4], insects[5], genetic[6], biological[7], and diseases[8,9]. These reports adequately reviewed literature and research on the subject up to that time and emphasized the need for continued research on VYD. Since the 10th Congress, the Experiment Station of the Hawaiian Sugar Planters' Association has continued research on this subject. In 1963, the United States Department of Agriculture expanded its research on VYD, attacking the problem with a team of pathologists, physiologists, agronomists, geneticists, and soil microbiologists. The work is carried out primarily at Canal Point (Florida), Houma (Louisiana), Gurabo (Puerto Rico), Honolulu (Hawaii) and Beltsville (Maryland). Each year the scientists meet to report on their research findings and plan continuing research. This paper reports briefly the lines of investigations and progress thus far.

Our research efforts have integrated the work of several disciplines, since past work indicates that there may be many or multiple causes of VYD. For example, agronomists, pathologists, and soil microbiologists are working together on long-range variety yield decline experiments in Louisiana, Florida and Puerto Rico. In these experiments we are attempting to measure the yield of several varieties continuously grown in the same plots for at least 10 years. Pathologists attempt to maintain the plots "disease-free", and the soil microbiologists study soil samples taken periodically to measure changes in the microbiology of the rhizosphere. Such tests should determine more exactly the rate of yield reductions, or if, in fact, they exist. Scientists in some countries[10] have not been able to show appreciable declines, and others that report declines [11, 12, 15] base their decisions on averages for years in which changes in cultural practices also occurred. The long-time variety yield-decline experiments should also define clearly differences between varieties in rate of decline. Literature on the subject contains several references to varieties differing in their longevity[14,15]. The soil microbiologist would be able to determine to what extent adaptation of strains of soil micro-organisms affect yields, as has been suggested in Hawaii[16]. Some of these long-time experiments have gone through two ratoons, but it is too soon to show significant changes.

The physiologists have attacked the problem to determine if the plant itself is in fact decreasing in its ability to produce either cane or sugar per unit area, sugar per unit of cane, or both. They are also considering the physiology of senescence and if VYD may in fact be the normal deterioration with time of a living system. In Louisiana the physiologist has found that varieties differ in rates of photosynthesis, and that these differences are associated with leaf thickness and leaf porosity. A change in the photosynthetic rate in a variety, in time, would gradually reduce yields. Another physiologist in Louisiana has developed a technique for growing "standardized" sugar cane plants to measure small changes in yields for short periods. This will enable us to measure effects of different stresses such as heat, cold, osmotic pressure, drought, and presence of a virus upon yield over long periods of time. Work along these lines has reconfirmed that yields do not appear to be influenced by growth stresses imposed on previous crops, or by size or condition of the seed piece in the absence of diseases. However, yield differences have been observed with different seed cane sources when RSD was present.

Certain aspects of VYD are similar to the replant problem that occurs with other monoculture crops. Phytotoxic substances from living roots, crop residues, decomposing roots and soil organisms have clearly been demonstrated to have an effect in reducing the yield of specific crops. In Hawaii we investigated the physiological aspects of phytotoxins and their possible rôle in the sugar cane VYD problem. The results thus far have demonstrated that inhibitory compounds are present in fresh cane tissue and roots, and in dried roots. These phytotoxins are of several types, some water-soluble and others soluble in organic solvents; some are heat-stable and exist in quite complex forms. Research is continuing to determine the fate of these toxins in a soil-rhizosphere complex. Here again we shall have the physiologist working with microbiologist.

Traditionally, the pathologists have done much of the work of VYD, and in our broad approach they continue their efforts. They, of course, are always on the lookout for unidentified and symptomless diseases. They have recently demonstrated that the maize dwarf mosaic virus (MDMV) can occur as a symptomless virus in some varieties of sugar cane, and it is known that the presence of viruses in a plant reduces yields. Survey work is now in progress to determine whether MDMV is present in the sugar cane areas of Louisiana. It is present in Johnson grass and corn north of the cane area in that State. Although VYD existed a long time before heat treatments for disease control were a farm practice, long-time studies are underway to determine if heat treatments over an extended period reduce yielding

[4] HUMBERT: *Proc. 10th Congr. Int. Soc. Sugar Cane Tech.*, 1960, 51–59.
[5] PEMBERTON: *ibid.*, 59–62.
[6] MANGELSDORF: *ibid.*, 72–76.
[7] MARTIN *et al.*: *ibid.*, 77–85.
[8] ABBOTT: *ibid.*, 66–71.
[9] KING: *ibid.*, 62–65.
[10] CROSS: *I.S.J.*, 1959, **61**, 195; 1960, **62**, 87–88.
[11] ARCENEAUX and HEBERT: *Agron. J.*, 1943, **35**, 148–160.
[12] ARCENEAUX: *Sugar Bull.*, 1948, **26**, 289–299.
[13] MATHERNE *et al.*: *Sugar y Azúcar*, 1965, **60**, (12), 30–33.
[14] ANON: *Hawaiian Sugar Planters' Assoc. Expt. Sta. Comm. Rpt.*, 1951, 43–44.
[15] KING: *Cane Growers' Quarterly Bull.*, 1951, **14**, 122–126.
[16] KOIKE and WARNER: *Ann. Rpt. Expt. Sta. Hawaiian Sugar Planters' Assoc.*, 1965, 29.

capacity. While RSD and mosaic have been recognized and ruled out as causes of VYD, more precise knowledge must be obtained on the identification of these diseases, so that we can be certain they are not influencing yields in our present "disease-free" tests. Along these lines the pathologists have made good progress in virus purification techniques for RSD and mosaic, and have identified the spherical nature of the RSD virus. They have also demonstrated that in variety POJ 234 there is a difference among strains of mosaic in their susceptibility to heat treatment *in vivo*.

Our soil microbiologist working in Puerto Rico has isolated several potentially pathogenic fungi from sugar cane roots, and he is studying their associations and interactions with other micro-organisms of the rhizosphere, as a possible cause of yield decline.

Geneticists have held that the genotype of a variety is fixed, and that with asexual propagation (except for rare mutations) the variety should persist without change. At present the concepts of mutations in somatic cells and ageing renew the possibilities of metabolic changes occurring within a clone which could gradually lead to reduced yields. Our geneticists are investigating whether or not clones with different yielding capacities exist within a variety which can not be phenotypically identified but which are heritable. Another phase of the problem is being studied under contracts with the Experiment Station of the Hawaiian Sugar Planters' Association. Their study will investigate physiological and biochemical causes of VYD, including evaluations of different types of stress, for the purpose of accelerating the induction of yield decline.

While we are still a long way from solving the problem of variety yield decline, the concentrated efforts with the team approach have begun to show new possibilities for explaining this phenomenon.

ADSORPTION OF COLOURING MATTER ON DECOLORIZING RESINS

(*continued from page* 69)

limited to the outer zones of the particle as soon as the inside is saturated. For particles of different sizes there must therefore be a specific surface capacity which with a greater number of cycles is always met. Fig. 11 shows that this is indeed the case. The results given concern column tests with 4S resin. The difference in the specific surface capacity for different particle sizes is always smaller at higher cycle numbers.

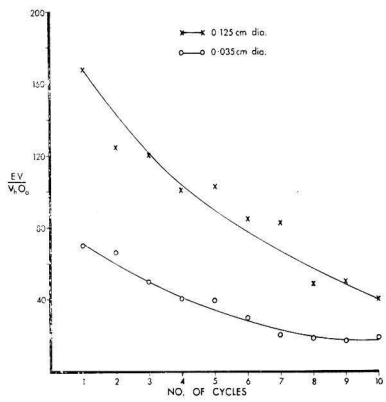

Fig. 11

SUMMARY

The authors report on the establishment of colouring matter balances for the adsorption of colouring substances on exchanger resins of different structure. They used resins with macropores (S-types) and those with gel structure (G-types), applying as colouring matter solutions technical raw sugar liquors and a fuscazinic acid fraction for model tests. In general there were no differences between results for the two colouring matter solutions although they contained colouring substances of different molecular weights and molecular weight distributions. However, the experiments with the test solutions allowed more unequivocal indication of the mechanism of adsorption.

The portion which cannot be eluted from the exchanger in the usual regeneration process is referred to as the "irreversible" fraction; this fraction comprises colouring matter diffusing during regeneration into the resin interior plus that which, from a physical point of view, is very firmly fixed on its inner surface. During the normal cycle the interior of the resin particles is slowly charged with the above "irreversible" colour fraction. The proper and active portion of the resin particles which is responsible for the permanent capacity represents a relatively thin spherical shell.

It is possible to demonstrate these processes which occur during charging and regeneration by means of sectioned resin particles. It can also be stated that a sharp adsorption front migrates through the particle, the migration velocity depending on the diffusion of the colouring substances. It has been possible to confirm experimentally the mathematical model established for this phenomenon. Using particles of different diameter but of the same chemical and physical structure, the authors have shown that the capacities for adsorption of colouring matter, relative to the surface area, tend to converge as the number of cycles increases. This proves that the active adsorption zone proper only extends to a spherical shell which is relatively near to the surface.

Sugar cane agriculture

The advance in mechanization on the Xicotencatl estate (Mexico). ANON. *Bol. Azuc. Mex.*, 1966, (210), 11–14.—On this Mexican sugar estate, in Tamaulipas, over 15,000 hectares are devoted to sugar cane with an average yield of cane of 52 tons/ha. An account is given of the advances recently made in mechanization in the field and in irrigation. Vehicles are equipped with radio to facilitate communication. The main varieties cultivated, four in number, and their contribution to the crop are indicated, the variety Co 421 accounting for nearly half.

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Dolichos lablab—**an alternative green manure crop.** W. J. DRAPER. *Cane Growers' Quarterly Bull.*, 1967, **30**, 119.—With velvet bean and cowpea seed in short supply and *Dolichos lablab* (Bonavista bean) seed freely available, this pulse has been used as a green manure crop with cane. Its properties are discussed. Is is a good drought resister and does not flower or set seed until late autumn.

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The wild cane breeding programme—1966 season. J. C. SKINNER. *Cane Growers' Quarterly Bull.*, 1967, **30**, 120–122.—This is a short progress report of results obtained in 1966. The tall photoperiod room at Meringa (Queensland) was used to make varieties of the wild species *Saccharum spontaneum* flower at the same time as sugar cane. Natural autumn flowering was prevented by lighting with overhead incandescent lights from 11 p.m. until 1 a.m. Temperature was controlled. Out of 29 varieties, 18 were successfully induced to flower at the time required and crosses were made, some 2000 seedlings being field planted for selection.

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A warning about herbicide damage. C. A. REHBEIN. *Cane Growers' Quarterly Bull.*, 1967, **30**, 123.—With aerial spraying of cane with herbicide, growers are warned about the susceptibility of the two varieties Q 68 and Q 80 to damage by overdoses of hormone-type herbicides. The recommended dosage rates are given.

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Unusual cane damage—lightning strike. L. G. W. TILLEY. *Cane Growers' Quarterly Bull.*, 1967, **30**, 124. Lightning strike in cane fields, often a mystery and source of unnecessary worry to growers, is described. The area affected is usually circular with the most intense damage in the centre. Spindles may be killed and shredding of the leaf sheaths and leaf blades takes place. A purplish discoloration of the leaf blades and sheaths is also characteristic.

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H 48-3166—a useful variety for the central area. A. A. MATTHEWS and E. A. PEMBROKE. *Cane Growers' Quarterly Bull.*, 1967, **30**, 129–131.—Details are given of the performance of this Hawaiian variety under Queensland conditions. It is recommended for poorly drained clay loams or "gluepot" soils on account of its rapid germination and early vigour and for irrigated farms of medium to poor fertility. On rich alluvial or better class soils lodging may be a problem.

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Promising results from selection on Meringa Experiment Station (Queensland). J. C. SKINNER. *Cane Growers' Quarterly Bull.*, 1967, **30**, 132–134. — A general account of the selection work is given. In November 1966 a total of 637 bunches (breeding crosses) and 17,331 single seedlings were transplanted to the field. It is expected that in the northern districts of Queensland the variety Pindar will be replaced as the leading commercial variety by one of the newer varieties.

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Giant sensitive plant control measures. G. H. WHITAKER. *Cane Growers' Quarterly Bull.*, 1967, **30**, 135–136.—The need to combat this cane weed (*Mimosa invisa*) constantly is stressed, especially as seed may germinate at any time of the year and is capable of remaining dormant for a considerable time. Information is given on the herbicides that can be useful in control and how they should be applied.

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Funnel ant control—apply "Heptachlor" correctly. G. WILSON. *Cane Growers' Quarterly Bull.*, 1967, **30**, 137.—To obtain good mixing of the insecticide in the soil it is recommended to give a preliminary mixing in the soil with discs and then plough.

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A boom sprayer for weeds in mature cane. A. I. LINDALE. *Cane Growers' Quarterly Bull.*, 1967, **30**, 138–140.—With the advance of mechanical harvesting in Queensland cane growers are becoming more conscious about weeds in mature cane. An "over-the-row" boom sprayer developed by a grower at low cost is described. The unit consists basically of a Ransome inter-row crawler tractor drawing a detachable "over-the row" boom (made of 1-in galvanized

piping). The unit is capable of accurately spraying three rows of mature cane at a time.

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Half of the crop cut by mechanical harvesters. ANON. *Producers' Rev.*, 1967, **57**, (3), 33.—It is claimed that Australia now leads the world in number and variety of the machines being used in the sugar cane harvest. These have been developed in the main from the inventive genius of individual Queensland cane growers. The 1966 harvest constituted a 42% increase in mechanical harvesting over 1965. In 1967 considerably more than half the Queensland crop will have been mechanically harvested and almost all of it mechanically loaded.

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Intensification of war on soldier fly. ANON. *Producers' Rev.*, 1967, **57**, (3), 43.—Reference is made to proposals to intensify research on the behaviour in the soil of insecticides used against the soldier fly, such as BHC, "Heptachlor" and "Dieldrin". In trials BHC has given poor results in the sandier soils. It is considered that more knowledge is needed on the longevity and degradation of these insecticides in different soils when used singly or in combination. In some areas only "Dieldrin" is being recommended for control because of this uncertainty.

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Dissatisfaction with dirty cane penalties. ANON. *Producers' Rev.*, 1967, **57**, (3), 87.—The argument is put forward that some cane inspectors, i.e. the men responsible for inspecting cane on the line between the delivery point and the mill, were not adequately trained or instructed in the work and that further training should be given to such men.

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New BMC Mini is a revolutionary tractor. ANON. *Producers' Rev.*, 1967, **57**, (3), 123–124.—Technical details are given of this new 15 h.p. diesel-engined economical tractor which has a 9-speed gear box. A demonstration showing its performance with 18 different agricultural and industrial attachments is referred to.

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Toft cane harvester demonstrated in Florida. ANON. *Producers' Rev.*, 1967, **57**, (3), 124.—The difficulties of mechanical harvesting of sugar cane under Florida conditions, where loose soil types and shallow root systems present special problems, are referred to, as is the increasing difficulty of recruiting labour from Jamaica for the harvest. The successful demonstration in Florida of this Australian-made and designed harvester, the single-row Burdekin Special whole-stick cane harvester (model BSH 250), is described.

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Experimental mechanical harvesting of green cane. ANON. *Australian Sugar J.*, 1967, **58**, 780.—The functioning of a modified Massey Ferguson chopper harvester, fitted with two 9-inch blowers, driven at 4000 r.p.m. from the power take-off of a MF 175 tractor, is described with photographs. The cane was the variety Q 57, mostly erect, which yielded about 28 tons per acre. A well packed bin of 3¼ tons capacity was filled in approximately 12 minutes.

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Mechanical harvesting of cane in Queensland during 1966 season. L. G. VALLANCE. *Australian Sugar J.*, 1967, **58**, 795–807.—The results of a survey of mechanical harvesting throughout Australian cane growing areas are discussed with special reference to recent developments and innovations. The functioning or behaviour of various makes of harvester is dealt with (e.g. light and heavy whole-stalk machines and chopper harvesters) as are the question of dirt or extraneous matter, cut cane deterioration and the economics of mechanical harvesting.

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Effect of "Agallol" treatment of setts under different dates of planting on germination and yield of sugar cane. H. S. GILL, S. SINGH and B. S. SIDHU. *J. Res. Punjab Agr. Univ.*, 1965, **2**, (2), 92–95.—The effect of treating cane setts with "Agallol" before planting was tested, planting being at fortnightly intervals. Treated setts gave significantly higher cane germination with all dates of planting, particularly with early and late plantings. The number of millable canes at harvest and cane yield were significantly higher with treated setts. Increase in yield, over untreated setts, averaged 18%.

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The mineral content of sugar cane leaves under saline conditions. F. A. FOGLIATA and P. J. ASO. *Rev. Ind. Agric. Tucumán*, 1965, **43**, 95–107; through *Hort. Abs.*, 1967, **37**, (1), 237.—Analysis figures for saline and normal soils were compared with those for sugar cane grown on these soils. Correlation was high for N, K and Cl and very high for Na and P. A detailed study of one variety showed that soil salinity increased the contents of N, P, K, Ca, Mg, and particularly Fe and Mn in the leaves, in spite of the presence of Fe-deficiency symptoms. In no case was there evidence that soil Na impeded the uptake of the major elements.

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Roads damaged by overloading vehicles. ANON. *S. African Sugar J.*, 1967, **51**, 317.—Attention is drawn to a letter from the Chief Engineer of the Natal Roads Department to the damage to roads that is caused by the overloading of vehicles. The maximum permissible load on a single axle allowed by Ordinance is 18,000 lb. Exceeding this amount causes wear, tear and damage to the road.

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More praise for N:Co 310. ANON. *S. African Sugar J.*, 1967, **51**, 325.—Details are given of recent increased cultivation of this Natal-bred cane in some parts of Queensland and reasons for its popularity, the variety having become the second major variety grown. It has shown good all-round performance over a wide range of soil conditions, has a high sugar content early in the season and maintains this until the crushing season is ended. It ratoons and resists cold well. A tendency to arrow freely in some areas of Queensland in some seasons is a drawback.

The sugar cane pest *Numicia* and its control. A. J. M CARNEGIE. *S. African Sugar J.*, 1967, **51**, 326–327. This indigenous leafsucker (*Numicia viridis*), first recognized as a sugar cane pest in 1962, has proved to be more troublesome in inland irrigated areas than in other areas. A possible reason is that in the dry season grasses, which are alternative host plants, become dry and the insect is attracted by the green cane. Information about the insect and its habits, brought to light by recent studies, is discussed.

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Glucose regulation of enzyme synthesis in sugar cane tissue. K. T. GLASZIOU, J. C. WALDRON and B. H. MOST. *Phytochemistry*, 1967, **6**, 769–775.—The relative effectiveness of glucose, other sugars and sugar derivatives in repressing invertase synthesis in sugar cane storage tissue was compared. Rapid peroxidase synthesis was demonstrated concomitantly with invertase synthesis. Fructose repressed synthesis of both peroxidase and invertase, but glucose repressed only the latter. The work was carried out at the David North Plant Research Centre, Indooroopilly, Queensland.

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Salt tolerance of N:Co varieties of sugar cane. I. Sprouting, growth and yield. L. BERNSTEIN, L. E. FRANCOIS and R. A. CLARK. *Agron. J.*, 1966, **58**, 489–493; through *Plant Breeding Abs.*, 1967, **37**, 352. The variety N:Co 293 was more salt-tolerant than N:Co 310 at moderate and high salinities but the varieties had similar tolerance at low salinities. Differences in tolerance between the varieties diminished during the second year of growth.

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Factors concerned in estimating the value of cane received at the factory. G. MILLER A. *Brasil Açuc.*, 1967, **69**, (4), 34–42.—The writer argues that the housewife pays for her rice, beans, fruit or other provisions accordingly to quality and that the same should apply with sugar cane arriving at the factory. The methods in other major cane producing countries of the world for evaluating cane received at the mill, according to sucrose content and freedom from "dirt" or foreign matter, are described.

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Response to irrigation at Fairymaed (Queensland). G. C. BIESKE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 81–86.—Since 1961 investigations on the evaluation of response to irrigation have been carried out by the Fairymead Sugar Company on their plantations. In the present paper, results from the Fairymead plantation, where soil may differ from other areas, are discussed. The maximum quantity of supplementary irrigation appeared to be in the vicinity of 18 acre-inches and in drought-stricken areas for improvement in c.c.s. is to be expected. Excess water from either rainfall or irrigation had a detrimental effect on the crop's growth. Response to irrigation may be very dependent upon temperature.

Soil fertility review of the Innisfail-Tully district (Queensland). A. I. LINEDALE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 101–106. In order to promote more efficient fertilizer usage, over 600 soil samples from the four mill areas were analysed. Results are summarized. In general approximately two-thirds of the soils sampled required an application of lime to correct acidity, and a general deficiency of potash existed.

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Cicadas as pests of sugar cane. G. WILSON. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 141–143.—The two species of Cicada, *Melampsalta puer* and *Parnkalla muelleri*, soil pests responsible for ratoon failure in Queensland, are discussed and the desirability of using insecticides that retain toxicity in the soil for a long time pointed out. Results of laboratory or pot experiments with 12 different soil insecticides and their effects on *Parnkalla muelleri* are given. Results indicated the desirability of continuing to use "Dieldrin", gamma-BHC and "Aldrin" for field tests.

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Nut grass trials at Mackay. L. S. CHAPMAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 145–149.—A brief account is given of four strip trials where the Monsanto product C.P. 31675 was used as a soil-incorporated chemical against nutgrass (*Cyperus rotundus*) in sugar cane. The chemical was selected from twelve others after pot trials. It gave excellent control of nut grass for as long as 16 months after being incorporated in the soil prior to planting. This resulted in significant increase in cane yield. The rate used was 6 and 7·5 lb of active ingredient per acre. Further confirmatory field trials are proposed before a firm recommendation for its use against nut grass can be made.

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Striate mosaic disease of sugar cane. C. G. HUGHES. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 151–155.—This comparatively new disease, not known in other parts of the world, occurs only in the Lower Burdekin district of north Queensland. The disease is often associated with areas or patches where cane growth is poor. Symptoms and susceptibility of different varieties of cane are discussed. Spread of the disease is through the planting sett. It is considered that two viruses are involved, the one producing the striations and the other the stunting that takes place.

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Cooperative cane fly control on Clarendon—1964. J. R. METCALFE. *J.A.S.T.J.*, 1965, **26**, 33–36.—In Jamaica a policy of integrated control is being widely adopted with the cane fly (*Saccharosydne saccharivora*). It is shown how a single spraying with "Malathion" over a wide area at the right time, i.e. when there is no oviposition, gives very effective control but spraying must be thorough, otherwise re-infection soon takes place.

Sugar beet agriculture

Spring work with sugar beet: labour requirement decreases. J. J. KRUIZENGA. *Landbouwvoorlichting*, (Holland), 1966, **23,** (4), 122–126; through *Field Crop Abs.*, 1967, **20,** 144.—Data are given on a trial in which an attempt was made to grow 19·5 ha of sugar beet on a two-man farm. The herbicide used ("Endothal" + "Propham" mixture) was not sufficiently persistent and plots which were sown early needed intensive hand-weeding to control *Alopecurus myosuroides* (a grass). Machine thinning reduced hand labour by 60%.

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Effect of time and rate of application of nitrogen and date of harvest on the yield and sucrose content of sugar beets. C. S. BALDWIN and J. F. DAVIS. *Agron. J.*, 1966, **58,** 373–376; through *Field Crop Abs.*, 1967, **20,** 145.—Sugar beet was given 6 rates of N from 0 to 150 lb/acre on one of four dates and was harvested during the 2nd or 4th week of October or first week of November. The highest yields of sugar were usually given by 90 or 120 lb N/acre applied before sowing, or 60 to 90 lb/acre side dressed in mid-June and by delayed harvesting. Sugar yield was affected more by harvesting date than by N treatment. The intensity of leaf blight caused by *Cercospora beticola* decreased with increasing rates of N.

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Effect of fumigating sandy soil on the growth of sugar beet. G. D. HEATHCOTE, D. N. GREET and A. G. WHITEHEAD. *Plant Pathology*, 1966, **15,** 120–124. Stunted beet, deficient in nutrients, was grown on untreated land at Hopton in Norfolk containing parasitic nematodes. Treatment with D-D and chloropicrin gave plants with normal foliage, greatly increased yields and reduced the incidence of soil-bearing virus diseases. In another area in Norfolk where beet grew normally and yielded well on untreated soil, fumigation increased seedling emergence but gave many poor roots, as also happened at Hopton. D-D was damaging to beet at the rate used (400 lb/acre).

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Double treatment of sugar beet for the control of broad-leaved and grass weeds with combined and separate applications of herbicides. G. BACHTHALER and F. GRAF VON HOYOS. *Zucker*, 1967, **20,** 297–301. Results are given of field experiments carried out during 1963–65 on the control of grass weeds in sugar beet using single and combined herbicides in various combinations. These included 3·5 litres/ha "Triallate" (40% AS) pre-sowing and 4 kg/ha "Pyrazone" (80% AS) post-sowing, 3·5 litres/ha "Triallate" combined with 4·0 kg/ha "Pyrazone" pre-sowing, 2·5 kg/ha "Triallate" combined with 3·0 kg/ha "Pyrazone" pre-sowing and 2·5 kg/ha "Triallate" combined with 1·25 kg/ha "Lenacil" (80% AS) pre-sowing application. The "Triallate"-"Lenacil" mixture was slightly superior to the others.

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The balance of nutritive elements and the effects of manuring. L. DE LEENHEER and M. VAN RUYMBEKE. *Sucr. Belge*, 1967, **86,** 413–431.—N-P-K studies in sandy soils used for sugar beet and manured in various ways, including the use of green manures such as rye grass, are described.

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An investigation into the spacing of monogerm sugar beet seed in the development of the spring mechanization of the crop. L. F. HANBURY and G. L. MAUGHAN. *J. Agric. Sci.*, 1967, **68,** 275–280.—A series of field trials are reported, designed to find means of establishing a full stand without hand singling, machine thinning, or hand weeding and to compare labour costs with different methods. The multigerm control required 10 more man-hours an acre to single and weed than the monogerm control. Neither herbicide nor machine thinning affected the number of bolters in the monogerm crop.

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Field experiments on sugar beet downy mildew (*Peronospora farinosa*). W. J. BYFORD. *Ann. Appl. Biol.*, 1967, **60,** (1), 97–107.—Downy mildew causes losses with sugar beet in most seasons in England, where crops are grown near seed crops of sugar beet or mangolds. Observations on the behaviour of the disease are recorded. The number of plants infected increased slowly from the middle of May until August, less than half the plants being infected. Most infected plants recovered. Plants infected when young produced small roots.

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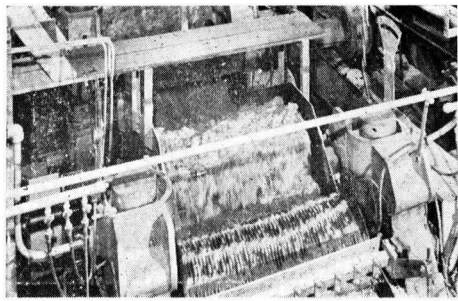
Urgent tasks in breeding monogerm beets. M. G. BORDONOS. *Sakhar. Svekla*, 1967, (3), 22–23; through *Plant Breeding Abs.*, 1967, **37,** 579.—Hybrids from monogerm × multigerm crosses are used in genetic studies at the All-Union Sugar Beet Institute. A study of individual plants in monogerm varieties at the above institute showed that a high proportion of these develop polygerm seed bolls on the central portions of the stems.

Cane sugar manufacture



The use of the general purpose analogue computer in the design of control systems for evaporators. P. C. BROOKS. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 225–228.—Preliminary work on the use of the analogue computer in a study of the control of multiple-effect evaporators is outlined. It is pointed out that while various control loops are concerned with evaporator operation independent of process conditions, the major basic quantities under control are the throughput rate, expressed as liquid level in the clarified juice tank, and product quality, expressed in terms of syrup Brix. These two controlled conditions must be kept within selected limits irrespective of any disturbances. The flow rate of steam to the evaporator is also a parameter requiring consideration in the design of an evaporator control system. Steady state calculations are considered inadequate, while dynamic analysis will give a set of equations from which the behaviour of the system may be evaluated as well as required control settings and defined changes in process conditions (disturbances). Equations have been derived for the parameters in each effect by workers in the Dept. of Chemical Engineering at Queensland University. The relations for which the equations have been developed are listed and have been linearized for computer processing. Brief reference is made to the various ways of arranging a computer circuit for given equations, and mention is made of the fact that some lags were approximated in order to reduce the number of computer components required. Proposed extensions to the work are also discussed.

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The sizing of pipelines for molasses and massecuite. P. C. BROOKS and D. J. NICKLIN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 229–236. The behaviour of Newtonian and non-Newtonian fluids is described, from which it is shown that the flow curve for a non-Newtonian fluid cannot be found by a single measurement, since viscometers are calibrated for Newtonian fluids. However, it is pointed out that most materials exhibiting significant departure from Newtonian behaviour are of low mobility, so that their flow in pipelines is generally laminar. Three methods of calculating pipe flow for massecuite and molasses are presented, of which the most suitable is considered to be that which uses the principle of the so-called "pipeline viscometer", which is a length of straight pipe through which the material is forced with a constant pressure gradient, provisions being made for measurement of flow rate and maintenance of a required temperature. It is based on correlation between Q/D^3, where Q = flow rate and D = pipe diameter, and $(D\Delta p/4L)$, where this equals the shear stress, Δp = pressure difference between the two ends of the pipe and L = pipe length. The flow properties of massecuite and molasses are briefly considered, and a worked example of the above method is presented. A curve of Q/D^3 *vs.* $D\Delta p/4L$ can be drawn from measurements at just a few pressure values, a log-log plot giving a straight line for any material following the power law.

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Alga and slime control in water cooling towers. K. G. NEWTON. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 237–244.—The organisms responsible for growths found in freshwater cooling towers are described under three headings: algae, bacteria and protozoa, and fungi. The toxic effects of various groups of chemicals are discussed. The fate of chlorine in impure water, the chlorine demand of the water, the risks in handling chlorine gas, the corrosive properties of the gas in the presence of water, and sources of chlorine are all briefly examined. At Inkerman a tower cooling 400,000 gal of cooling and process water per hr was treated with 100–200 lb of "Chlorosene" (containing 30% available chlorine) per week (in one week 300 lb was used). Results indicated the possibility of using liquid chlorine, for which a Fischer & Porter chlorinator was tested. It was found that a usage of 150–200 lb/week was sufficient to maintain the tower in a continuously clean condition, the tower being free of alga and slime growth at the end of the trial period and suffering from only normal corrosion. It is pointed out that since cooling tower systems vary, a method that is successful for one may be ineffective for another, although chlorination is recommended where other methods have failed and where new cooling towers are planned.

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Cane diffusion—where are we going? B. H. P. SAUNDERS. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 253–255.—Cane diffusion processes are discussed under two main headings: those employing coarse cane preparation (BMA or Egyptian, De Smet and DDS), and the Silver process, which uses fine cane preparation. Brief mention is made of trials made by the staff of the Sugar Research Institute at Pleystowe sugar factory during 1966, results of which

indicate that (i) extraction ultimately depends on the proportion of cane cells opened, whether by mechanical preparation and/or milling, (ii) if the preparation involves no extraction, then the additional extraction to be made by the diffuser necessitates a relatively small increase in its size, and (iii) when the bed depth is decreased from 6 to 3 ft, the area required to give the same results is increased by only 30–40%. While the author prefers fine preparation of cane and the elimination of as many milling steps as is possible, he admits that the process involves problems of some magnitude. These are discussed under preparation, bed depth and milling. Other points raised are de-watering of bagasse and alternatives to the above-mentioned cane diffusers, such as a centrifugal continuous diffuser acting as a low-speed spin dryer.

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A single tube experimental evaporator. A. G. CLAIRE. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 263–270.—A description is given of a single-tube evaporator designed for heat transfer tests and installed at the Bundaberg Sugar Experiment Station in 1964. It was subsequently modified in 1966 to allow water and sugar solutions up to 60°Bx to be boiled under vacuum. Results of tests indicated that: (i) brass tubes gave higher heat transfer rates than did stainless steel tubes, although this advantage was reduced by scale formation; (ii) for tubes of equal length, the heat transfer rate was greater in a 1·5 inch dia. tube than a 2 inch dia. tube, irrespective of material of construction, while the rate was the same in 4 ft long tubes as in tubes 6 ft long; (iii) the optimum liquid level for the maximum evaporation rate was one-third of the tube height. In mentioning a possible correlation between surface finish and scale formation, the author points out that, should this be substantiated, stainless steel tubes would prove superior to brass tubes for heat transfer work.

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Final molasses measurement and storage. W. R. DUNFORD. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 271–275.—A description is given of the "pneumercator"[1], which measures the weight of molasses in a storage tank from its hydrostatic pressure, which is balanced against a column of mercury (molasses height × molasses s.g. = mercury height × mercury s.g.). A diagram illustrates how the device can be readily made in any sugar factory factory workshop and how it is fitted at the bottom of a storage tank. "Pneumercators" are used at molasses terminals for weighing incoming and outgoing molasses. At the end of the 1966 season the difference between the weight of molasses indicated by "pneumercator" at Babinda sugar factory as having been sent to the Cairns terminal and the weight indicated at the terminal was 0·6% (2028 minus 2015 tons). A warning is given regarding the injection of compressed air into molasses to reduce frothing, since this can lower the density of fresh molasses. This is illustrated by reference to experience at Babinda. However, proper control of compressed air injection will permit this to be used to raise the molasses density after it has fallen as a result of storage conditions. Air will also reduce the temperature of molasses and so prevent spontaneous decomposition. The average temperature of 98°F (maximum 104°F) at Babinda during 1966 compares favourably with the 95°F recommended by HONIG[2], at which losses in fermentable sugar are of the order of 3% per annum.

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pH control in clarification. C. S. HENDERSON and E. WHAYMAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 277–282.—The liming system at Racecourse sugar mill is described. This consists of a lime dilution tank, with a feed loop recirculating diluted lime to the tank. Lime is bled off to juice through a automatic valve regulated by the pH recorder-controller. Four factors which must be tightly controlled are discussed: mixed juice flow, conditions of the lime, response time, and valve characteristics. Teething troubles experienced at the factory included fluctuations in lime concentration during recharging of the 4000-gal tank. This was eliminated by ensuring that lime and diluent entered the tank simultaneously. Choking of valves with sand and grit proved very troublesome. The butterfly control valve had to be relocated at the highest point of the ring main, while a spring-type relief valve regulating pressure in the ring main had to be replaced with a Saunders K.B. valve operated by a Taylor 395R pressure regulator. This latter measure eliminated pressure fluctuation. Because of fouling of the glass electrode, causing a fall in sensitivity, cleaning had to be done every 4 hr by dipping in concentrated nitric acid. The modifications led to an improvement in juice quality, the optical density of which fell from an average of 0·23 to approx. 0·17 at 800 mμ, while the pH was kept constant to within ± 0·1 units of the required value.

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The settling of cane muds in an A.T.V. clarifier. K. J. NIX. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 283–292.—Tests conducted at Isis sugar mill in an investigation of the settling behaviour of muds in compartment D, the second lowest compartment in an A.T.V. clarifier, are discussed. The clarifier was modified by adding a fifth compartment to the top of the unit and installing deflector baffles over some of the mud boots. Clarified juice was withdrawn from three points around the top periphery of each compartment, primary mud flowing under gravity from a point in each mud boot. At normal mud levels, the mud concentration was uniform over the settling area of the clarifier. At low mud levels the concentration of the mud in this settling zone was found to be identical to that of the feed, while

[1] SMITH: *I.S.J.*, 1941, **43**, 276.

[2] SPENCER-MEADE: "Cane sugar handbook", 9th Edn. (John Wiley & Sons Inc., New York.) 1963, p. 273.

at high mud levels concentrations exceeding those of the feeds were observed. While at the same level and radius from the centre of the clarifier there was no significant change in concentration with position of the measuring point, the overflow points could, it was discovered, cause some disturbance in their immediate vicinity if the mud levels were sufficiently high, but normally did not have any effect. The deflector baffles over the mud boots were found to have a beneficial effect on clarifier performance as regards mud consistency, but had little effect on radial mud profiles, which in all cases were essentially horizontal with a slope down to the feed point. At the same level around the circumference, the pattern of pH rise and fall with position was not regular, while a difference of approx. 0·1 unit was found between the average pH values at each level. pH variation radially was negligible, although that of each layer was different from that at other levels, the highest values occurring at the level in the zone of constant solids concentration and decreasing with distance of the other levels from this.

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Tests on clarifiers and coagulants (at) Babinda mill, 1966 season. W. R. DUNFORD and P. TAYLOR. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 293–300.—Tests were conducted with three different types of clarifier. The clarifiers included a 59,000-gal A.T.V. clarifier with six juice outlets per compartment instead of two, a 40,000 gal 7-compartment Bach clarifier (Bach No. 1) built onto a 5000-gal Queensland "cone", and a modified Walker-Bach clarifier of 43,000 gal capacity (Bach No. 2). The tests were carried out in August and October, and the results were expressed in terms of clarified juice thoughput, turbidity and phosphate content, mud flow, density and solids content, and total throughput. The results showed that there was little difference between the Bach No. 2 and A.T.V. clarifiers in August, while the efficiency of the Bach No. 1 was limited by its inability to cope with the quantity of mud. In October, on the other hand, the Bach No. 1 was the most efficient, while the Bach No. 2 gave a better clarified juice than did the A.T.V. Laboratory tests with "Separan NC 1273", "Separan AP 30", "Sedipur T.F.2" and "Sedipur T.F." flocculants showed that although the first gave lowest phosphate content and turbidity, it gave the highest mud volume and formed much larger flocs than the others, so that the settling flocs had a tendency to collect air bubbles, and consequently the mud as a while rose after forming on the bottom. The "Sedipur T.F.2" was considerably less effective than the "Separan AP 30" and "Sedipur T.F." which were tested in factory trials. The results showed that while "Separan AP 30" gave better juice quality the "Sedipur T.F." gave lower mud volumes. The question remains as to whether it would be better to operate the clarifiers at low mud levels with reduced clarified juice quality or at high mud levels with higher juice quality, but with the risk of overflow of mud particles.

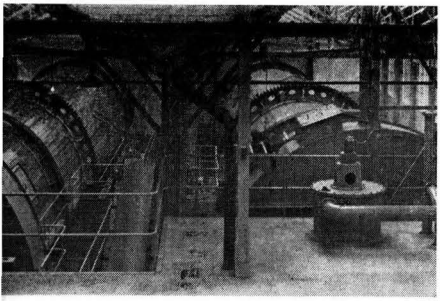
("Separan) AP 273" and other settling aids. D. J. HALE and E. WHAYMAN. *Proc. 34th Conf. Queensland Soc. Sugar Cane Tech.*, 1967, 301–306.—Tests with "Separan AP 30", "Separan AP 273" and "Sedipur T.F.2" were conducted at a number of Queensland sugar factories, generally 2·8–3·0 p.p.m. being added as a 0·1% solution. The results are discussed, and show a general superiority of "Separan AP 273" over the others.

* * *

Some observations on the nature, quantity and effect of the extraneous matter received in cane at the New Yarmouth factory during the 1965 crop. I. DE F. SMYTH. *J.A.S.T.J.*, 1965, **26**, 52–56.—The different types of extraneous matter are listed under vegetable matter and mineral matter. While the percentage of extraneous matter accompanying manually harvested cane varied only slightly from month to month during the first six months of 1965 in the range 2·38–4·34, with an average of 3·03%, that with mechanically harvested cane varied quite considerably in the range 6·00–19·04%, with an average of 10·78%. It was found that when supervision of mechanical loading was relaxed the quantities of extraneous matter increased, particularly towards the end of the crop. These findings were confirmed by results at another factory. The extraneous matter caused $\frac{7}{8}$ inch wear on the mill rollers compared with a normal $\frac{3}{8}$ inch. trash plates were adversely affected, the grinding rates dropped by up to 20–25 tons/hr, components of the chokeless pumps wore more rapidly, and the DSM screen suffered from the abrasive action of the extraneous matter. It was also found difficult to plan quotas because of the irregular mill throughput, so that cane accumulated in the yard and fields and became stale. Payment on a "net cane" basis is considered a possibility in the near future, and a washing plant is being installed at New Yarmouth. In a discussion of the paper, a washing plant is considered necessary where extraneous matter constitutes 10% or more of the cane weight, and more work on the most suitable and accurate method of sampling and size of sample is urged. The author considers it unlikely that burning of the cane would reduce the amount of extraneous matter, but feels that the extra dust clinging to the cane would have a polishing effect on the mill rollers.

* * *

A discussion on the rôle of chemicals in factory processes. M. B. FLORO. *J.A.S.T.J.*, 1965, **26**, 63–65.—The role of chemicals in the sugar factory is discussed under a number of headings, including boiler feed water treatment, mill sanitation and mill efficiency (with mention of chemicals which increase the penetrating action of mill maceration liquor), coagulants and flocculants, heating surface conditioners, chemical accelerators (additives to cleaning chemicals), and chemicals for reducing massecuite viscosity and surface tension.



Beet sugar manufacture

Alkaline degradation of invert sugar and relation of the degradation products to the methods employed for juice purification. S. Z. IVANOV and A. R. SAPRONOV. *Zeszyty Probl. Post. Nauk Roln.*, 1966, (62b), 205–215. See *I.S.J.*, 1963, **65**, 24.

* * *

Application of ion exchange resins for 2nd carbonatation juice purification in beet sugar manufacture. P. V. GOLOVIN, A. A. GERASIMENKO and M. A. ABRAMOVA. *Zeszyty Probl. Post. Nauk Roln.*, 1966, (62b), 275–279. See *I.S.J.*, 1963, **65**, 22.

* * *

Determination of the throughput of pulp drum dryers. A. K. NAIDENOV. *Sakhar. Prom.*, 1967, **41**, (5), 13–17. A formula is presented for calculation of the daily pulp throughput of a gas-fired drum dryer, based on the moisture tension and drum capacity. This is preferred to a nomogram presented by ZVORYKIN & KHAZIN[1] which assumes a lower moisture tension than usually occurs. Calculated values are tabulated and compared with true values obtained at various Soviet sugar factories, showing that generally dryers are being operated at throughputs below their capabilities.

* * *

Control of milk-of-lime density and feed rate. F. A. SANONOV, A. S. SIDOROV and V. V. RADCHENKO. *Sakhar. Prom.*, 1967, **41**, (5), 32–36.—A Soviet-built density indicator and flow meter are described. In tests over 45 days milk-of-lime density was maintained constant in the range 1·13–1·21 g/c.c. Maximum feed rate error was $\pm$ 0·6 cu.m./hr.

* * *

Some suggestions on modernization of a Duncan Stewart diffuser. N. A. NASONOV, V. D. BAZHENOV and V. I. NOSOV. *Sakhar. Prom.*, 1967, **41**, (5), 37–39. Modifications to a Duncan Stewart (RT) continuous rotary diffuser installed at Dmitro-Teranovsk sugar factory in 1961 involved the transmission gearing and the cossette feeding scheme.

* * *

Study of causes of sugar losses in beet en route to the factory. V. F. LOMOVTSEV and D. V. TARASOV. *Sakhar. Prom.*, 1967, **41**, (5), 42–45.—Detailed investigations of sugar losses in beet at a Soviet sugar factory showed that much sugar was lost in fluming of bruised beet stored in annular piles. Other losses occurred in the piles, washer section and in the production of brei for polarization.

The reducing matter content as a measure of juice quality. K. VUKOV. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—The reducing matter content in beet and juices is shown to be a good indicator for certain processes. The content in beet lifted no more than 10–12 days earlier can be used to estimate the sucrose diffusion constant in the beet tissue and hence diffusion efficiency. There is close correlation between raw juice invert content and that in beet, as there is between 1st carbonatation juice filtration coefficient F_k and sedimentation rate S_k and the quantity of reducing matter decomposed during defecation and 1st carbonatation. The quantity of decomposed reducing matter also determines the colour and reducing matter content in 1st carbonatation juice under given process conditions. These two factors will permit calculation of the colour and reducing matter contents in thin juice, bearing in mind simultaneous sucrose hydrolysis. The thin juice reducing matter content is shown to approach a limit which depends on the optimum active alkalinity of 2nd carbonatation juice. Calculations are made of the quantity of reducing matter decomposed, the colour content, pH fall during evaporation and final reducing matter content in thick juice. The last factor also approaches a limit determined almost entirely by juice active alkalinity. The reducing matter in beet thick juice decomposes relatively quickly, because of its high amino-N content, into colouring matter and acids in contrast to the reducing matter in cane juice.

* * *

Crystallization of calcium carbonate during 2nd carbonatation. K. VUKOV. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Tests showed that calcium carbonate occurring during 2nd carbonatation tends to form supersaturated solutions. The excess hardness, i.e. the difference between the true hardness and the residual hardness after elimination of the supersaturation (mg CaO/100°Bx), is suggested as a practical measure of supersaturation, which can be eliminated by adding crystalline calcite at < 96°C with vigorous agitation to juice leaving the carbonatation vessel. (The calcite is obtainable e.g. from 2nd carbonatation mud concentrated in a hydrocyclone.) The precipitate consists of spherolite-type granules measuring 2–3μ, most of which form aggregates.

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[1] *I.S.J.*, 1965, **67**, 183.

Application to the sugar industry of a continuous ion exchange unit "Aconex". G. ASSALINI. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Details are given of a continuous unit which consists of a circular frame on guide rails supporting resin containers or columns. At pre-set intervals of time the unit rotates through an angle determined by the number of containers, so that the resin in each container is subjected, successively, to regeneration, first rinse, second rinse, juice treatment, and backwash. A pair of units used for thin juice demineralization at an Italian sugar factory contained "Amberlite IR-120" cation exchanger and "Amberlite IRA-68" anion exchanger, respectively. Throughout one campaign the average purity was raised from 85·56 to 96·95 and the average non-sugars content reduced from 1·753% to 0·28% on juice, with a total sucrose loss over the campaign of 0·0017%.

* * *

Development of micro-organisms in beet juices, flume and wash water at low temperatures. F. SCHNEIDER, H. P. HOFFMANN-WALBECK and M. A. F. ABDOU. *Paper presented to the 13th Congr. C.I.T.S.*, 1967. Press juice was infected with soil and incubated for 30 days at 3, 8 and 13°C and development of mesophiles, psychrophiles, yeasts and fungi determined. Results are shown in graph form. Laevan and dextran, both resulting from the metabolism of certain micro-organisms in thawed beet, were also found by thin-layer chromatography in flume and wash water, raw juice and press juice. Decomposition occurring in the thawed beet was found to be mainly due to the mesophiles and psychrophiles, whereas the yeasts and moulds are of minor importance. A relationship was established between temperature conditions during the 1965/66 campaign and infection in beet caused by polysaccharide-forming bacteria originating in the soil.

* * *

Laboratory study of evaporator tube corrosion. Effect of pH, aeration and certain salts. J. DUBOURG, P. DEVILLERS and A. LEMAITRE. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Corrosion of steel evaporator tubes was studied by measuring the amount of iron dissolved in pure sugar solution at 100°C during 100 hr at constant pH. The quantity of acid formed by sugar decomposition was also determined. Steel corrosion was much greater at lower pH. In the range studied (pH 6·8–7·8) acid formation was independent of pH but was considerably increased by the presence of oxygen. If not maintained constant by artificial means, pH tended to drop, the more so in the presence of oxygen, thus increasing corrosion. The action of salts added to the sugar solution depended on the nature of the anion. While Cl^- increases corrosion, CO_3^{--} and particularly PO_4^{---} reduced corrosion.

* * *

Reaction activity—basic parameter of the quality of burnt lime used in the sugar industry. R. OSVALD and H. VLČKOVÁ. *Listy Cukr.*, 1967, **83**, 115–118.—For the sugar industry it has been found that lime containing more than 90% active CaO and having a reaction activity (maximum heat obtained after a given time) greater than 90°C at a maximum reaction time of 10 min is suitable but not lime having less than 85% active CaO and a reaction activity less than 85°C during 15 minutes' reaction.

* * *

Investigation of heat exchange during the heating of sugar solution-air mixtures. I. M. FEDOTKIN, S. M. KONSTANTINOV and G. S. DEMCHUK. *Izv. Vuzov, Pishchev. Tekhnol.*, 1967, (2), 144–147.—Experiments showed that the passing of air with sugar solution through a vertical and a horizontal heating chamber considerably increased convective heat exchange, particularly when flow was converted from laminar to turbulent. In horizontal flow at small flow rates and high sugar solution concentrations convective heat exchange was independent of air feed but was determined by the simultaneous effects of relative flow rate of the air and sugar solution and of degree of wetting of the tube wall by the solution.

* * *

$20 millions beet sugar factory opens in Arizona, U.S.A. ANON. *Sugar J.* (La.), 1967, **29**, (12), 31–33. Details and illustrations are given of the new Spreckels Sugar Co. white sugar factory at Chandler, Arizona, which has a daily slicing capacity of 4250 tons of beet.

* * *

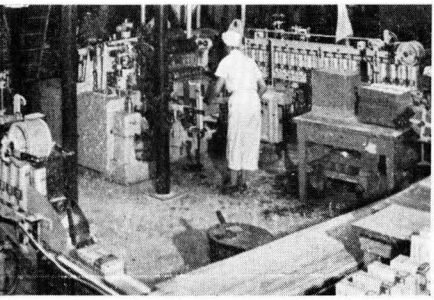
The evolution of the Swedish sugar industry. ANON. *Sugar y Azúcar*, 1967, **62**, (6), 33–37.—An illustrated survey is presented of the Swedish beet sugar industry which provides about 65% of Sweden's total sugar consumption.

* * *

The German beet sugar industry. H. AHLFELD. *Sugar y Azúcar*, 1967, **62**, (6), 51–54.—A brief survey is presented of the history, development, present state and future prospects of the German beet sugar industry.

* * *

Moisture exchange during storage of sugar beet. A. A. MOVCHAN. *Zb. Aspirantsk. Prats. Odes'k. Tekhnol. Inst. Kharch. ta Kholodil'. Prom.*, 1963, **1**, 33–41; through *S.I.A.*, 1967, **29**, Abs. 109.—The drying rates of beets were measured at 4–5°C under normal conditions of ventilation. Moisture exchange coefficients β (kg/sq.m./hr/mm Hg) were calculated. In healthy beets the value of β decreased from ~0·005 to ~0·002 during the first 24 hr and to 0·0016 after six days. When the skin was removed initially, the corresponding values were 0·0036 and 0·0028, indicating a less marked decrease in the rate of moisture loss. Beets with damage to the skin showed somewhat larger values of β than healthy beets, but considerably smaller values than skinned beets.



Sugar refining

Processing of raw sugar at refineries. V. D. PETRUNYAK, B. G. NERUBAL'SHCHUK and V. E. ONISHCHUK. *Sakhar. Prom.*, 1966, **40,** (11), 32–36.—At Odessa refinery raw sugar is affined and washed with water in the affination centrifugals to yield two run-offs. The water wash (of 90·6 purity) is boiled to a 1st recovery sugar (of 99·0 purity) and a mother liquor which is combined with the other affination run-off and boiled to a second recovery sugar (of 98·5 purity) and molasses. The affined raw sugar is sent to the refined sugar house where it is melted to a 58–60°Bx syrup (of 99·1 purity) and raised to 63°Bx by melting part of the "white sugar". This 63°Bx syrup is purified by carbonatation, sulphitation and active carbon treatment, and three crops of refined sugar are produced from it, the run-offs from each crop being treated with active carbon or other adsorbents before further boiling. The refined sugars are combined for packaging, while the run-off from the last crop (of 96·5 purity) is treated with carbon and sent to the white sugar house. The recovery sugars are melted in this liquor before sulphitation, filtration and boiling to give the white sugar, which is separately processed and packaged for sale, except for the part sent to the refined sugar house. White sugar run-off is used as the syrup for affination of the raw sugar, while the wash is returned to the melt for a subsequent white sugar boiling. Advantages of the scheme are claimed to be increased white sugar yield to 94·5–95·0% on raws and increased refinery capacity, etc.

* * *

Experience in utilizing candle filters at Krasnopresnensk sugar refinery. R. G. GRANATOVA, S. D. GRINMAN, A. B. LANDER and A. I. SHAPIRO. *Sakhar Prom.*, 1966, **40,** (11), 37–38.—Despite improvements to their structure, the performance of Soviet-built candle filters used for preliminary filtration of white sugar liquor (to remove turbidity) was still below standard. Subsequent investigations showed that a dark, somewhat impermeable layer formed on the outside of the kieselguhr pre-coat and eventually prevented percolation of the liquor. This dark layer was formed of dust and dirt on the white sugar entering the refinery. This is now removed by adding one-third of the kieselguhr previously applied as pre-coat to the liquor after its discharge from the grit filters, the quantity of pre-coat being reduced accordingly. By reducing the pressure limit on the filter from 4 atm to 2 atm and filtering at 1·5–2·0 atm, the effective filtration cycle was increased from 1 hr to 5–7 hr per filter and the sweetening-off time also reduced. One filter can now handle sufficient liquor to give 200 tons of refined sugar/day, i.e. half of the refinery's output.

* * *

Application of perlite for refinery syrup filtration. N. M. FEDOTOV. *Sakhar. Prom.*, 1967, **41,** (1), 27–29. Comparative tests were conducted on filtration of 62–64°Bx refinery syrup at 80–85°C through candle filters. Perlite (containing 75% silica) used as a precoat gave an average filtration rate of 1·0–1·2 cu.m./sq.m./hr, compared with 0·6–0·7 and 0·3–0·4 cu.m./sq.m./hr with Johns-Manville and a Soviet kieselguhr, respectively. The active filtration period was 9–10 hr with perlite, 6–7 hr with Johns-Manville kieselguhr, and not more than 2 hr with the Soviet kieselguhr. Since perlite has a density of 100 kg/cu.m., compared with 290 and 650 kg/cu.m. for the Johns-Manville and Soviet kieselguhrs, respectively, its daily consumption was much lower than either, while sweetening-off and disposal took less time than in the case of the kieselguhrs. The quality of perlite-treated syrup was claimed to be good. Apart from the technological factors, the perlite is much cheaper than the Johns-Manville kieselguhr; while the Soviet-produced kieselguhr is cheaper still, its properties are so poor as to make it unpractical for use with candle filters.

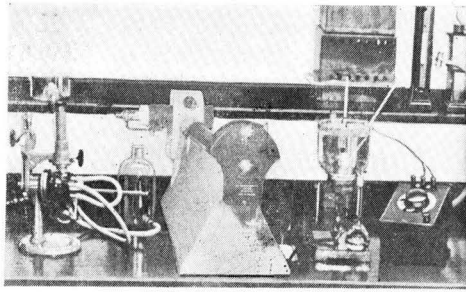
* * *

Bulk transport of white sugar. F. TESCHNER. *Die Lebensmittelindustrie*, 1966, **13,** 457–460.—The subject is dealt with in the light of East German experience. The effect of relative humidity on white sugar in storage is discussed, followed by information on road vehicles, particularly tanker trailers used for transporting bulk sugar. The two primary methods of loading sugar into tankers (gravity feed from a hopper and pneumatic feed along a flexible pipeline) are described, and experiments carried out in East Germany are referred to. The economics of bulk transportation are also discussed.

* * *

Kinetic evaluation of continuous and batch refining methods. III. Determination of characteristic values for equipment used for continuous crystallization. J. BURIÁNEK. *Listy Cukr.*, 1966, **82,** 294–300.—Three time relationships concerning the sucrose flow and the water evaporated during continuous crystallization are established. It is assumed that continuous crystallization proceeds in the same way as the batch process.

Laboratory methods & Chemical reports



Recrystallization during massecuite boiling. I. G. BAZHAL and O. D. KURILENKO. *Sbornik Pishchev. Prom.*, 1966, (4), 212–218.—A sugar solution saturated at a given temperature was placed in a laboratory vacuum pan and seeded with a given quantity of sugar containing crystals measuring from 20–30μ to 2–3 mm. Intense boiling of the massecuite was then carried out over a long period. It was found that during boiling some crystals grew while others reduced in size and then completely disappeared, although the total weight of crystals remained constant, i.e. recrystallization took place. The recrystallization process was more intense the smaller were the initial crystals and the higher was the concentration of crystals in the massecuite. In further tests the automatically controlled scales used were replaced with a reflux cooler in which the water evaporated during boiling was condensed and returned to the pan, thereby maintaining a constant intercrystalline solution in the massecuite. The results were identical to those in the first tests, and with tests using other substances, both organic and inorganic. The phenomenon is explained as a natural spontaneous process of transfer of a heterogeneous system (massecuite) from a less stable to a more stable thermodynamic state at the expense of a reduction in the total free surface energy of the system.

* * *

Is there pyridine in refined sugar when syrups are purified by ion exchangers? T. A. KLOCHKOVA, E. V. SHCHUKINA and V. A. POKROVSKII. *Sakhar. Prom.*, 1967, **41**, (4), 22–24.—Although pyridine in strongly basic AV-16GS anion exchange resin (a polycondensate resin containing 15–20% pyridine base and substituted amino groups of the aliphatic series) was easily extracted by 60°Bx syrup after 6 months' storage of the resin in polyethylene, during boiling the pyridine was easily entrained with the vapour, so that spectrophotometric examination of the resultant sugar revealed no pyridine.

* * *

Thermo-physical characteristics of white sugar. M. A. GROMOV and G. I. KRASOVSKAYA. *Sakhar. Prom.*, 1967, **41**, (5), 24–26.—Values obtained by various authors for heat conductivity (λ), temperature conductivity, and specific heat (c) are tabulated, showing wide differences. Approximation formulae are given for λ and c based on bulk weight of sugar in the range 800–1200 kg/cu.m.

Kinetics of crystallization of sugar. W. J. DUNNING. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967. The significance of crystal imperfections, particularly screw dislocations, in the process of crystal growth is discussed. Illustrations demonstrate the growth of crystal steps in the form of spirals. The formation of bunches of steps was investigated and an explanation of this phenomenon is given. In a study of the kinetics of growth steps, the effect of temperature on the rate of advance was determined at 1·25 supersaturation. The activation energies for the rates of advance in different directions were identical, and were much higher than the activation energy for sucrose diffusion through the solution, indicating that diffusion is not a rate-controlling factor. An almost linear relationship was established between growth rate and supersaturation. Various sugar additives had little or no effect on the rate of advance, while raffinose and stachyose present in small concentration (1·5%) had a marked retarding effect, and produced definite changes in the shape of the growth spirals.

* * *

Sugar crystallization. P. M. SILIN. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967.—While the first phase in sucrose crystallization on the surface of crystals (diffusion of dissolved sugar through the thin layer of syrup) determines the entire crystallization process, the second phase (passage of sugar drawn by diffusion to the crystal face into a crystalline state) nevertheless is significant as regards crystal habit. However, it has received little attention in crystallization studies. The diffusion theory of sucrose crystallization has been applied to studies of the rate factor K, which has been found to be proportional to supersaturation, is considerably increased by forced agitation (although it is not affected by the rotary speed of crystallizers), is markedly reduced as the viscosity of a saturated solution rises, and is considerably affected by temperature and purity, but is independent of crystal size and crystal content in a massecuite.

* * *

Sugar crystallization. A. VANHOOK. *Paper presented to the* 13th *Congr. C.I.T.S.*, 1967.—The subject is discussed under three headings: the activity theory, growth rates at low supersaturation, and crystal habit. Because of the lack of data on the thermodynamics in the supersaturated region and on the effect of additives on crystal growth, and because of

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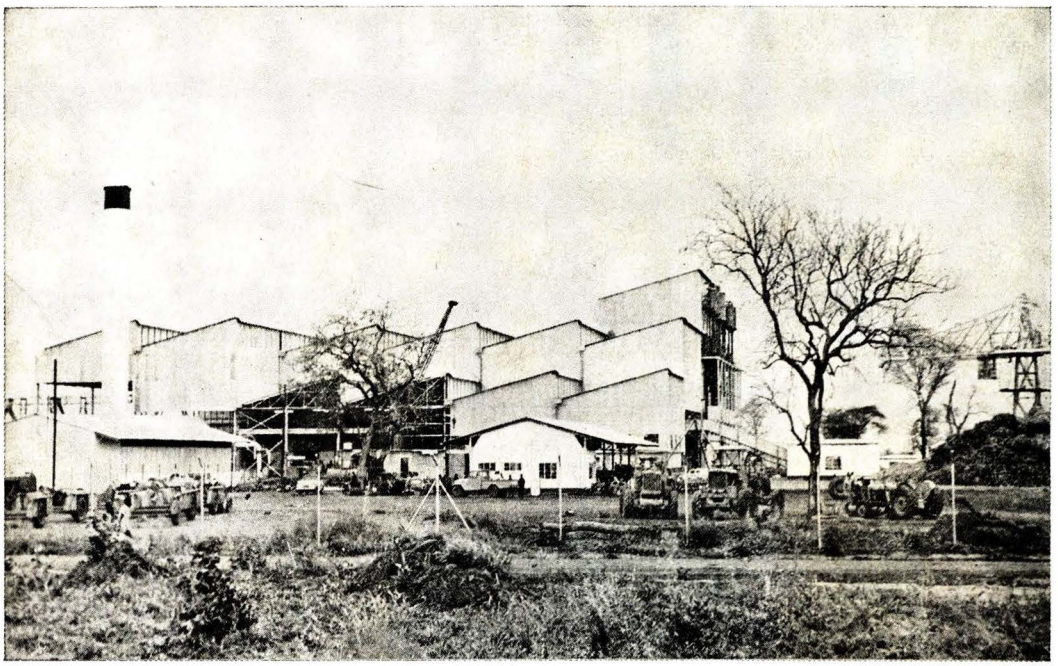

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unreliability of certain rate data caused by false grain formation and polycrystalline growth, the suitability of the activity theory to describe crystallization kinetics is qualitative rather than quantitative. However, two equations are presented describing the two most common cases of crystal growth, i.e. at constant molality and constant supersaturation. Lineal measurements at 30°C of single crystals pregrown to visual perfection indicated first order kinetics down to 1·01 supersaturation and even lower. It is inferred from the results that the mechanism for normal growth involves a constant density of growth centres without any nucleation barrier. Habit modifications and growth rate changes caused by dextrose and levulose are in accordance with the chemical and crystallographic constitution of sucrose crystals.

* * *

Theory of continuous crystallization. S. HILL and W. J. H. ORCHARD. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—One of the problems encountered in continuous crystallization is the difficulty of obtaining a product having a satisfactory crystal size distribution (C.S.D.). Approaches to a solution of this problem are considered in the case of (i) continuous crystallizers connected in series, and (ii) a steady state system, in which massecuite is extracted from a stirred crystallizer and circulated at constant rate through a crystal classifier which directs crystals of suitable size into a product stream and returns rejected crystals to the crystallizer. (The classifier may be inside or outside the crystallizer.) In (i) nuclei are fed into the first crystallizer and massecuite transferred from each crystallizer to the next, product crystals being withdrawn from the last. Cumulative C.S.D. values are calculated for 1, 2, 4 and 8 crystallizers. At a normal distribution of growth rates among the crystals, the coefficient of variation with as many as eight crystallizers proved unsatisfactory, the effect of the growth rate C.V. (at 25%) on the overall C.V. of the product being considerable with this number of crystallizers. Eight cumulative C.S.D. values are calculated for (ii). Rapid massecuite circulation, good classifier discrimination and a narrow range of crystal growth rates are necessary for acceptable C.V. values. At a crystal:syrup ratio in the crystallizer of 1:8, the capacity is about the same as that of a conventional crystallizer of the same size.

* * *

Reactive nitrogen in beet and its effect on sucrose crystallization. V. PREY and B. SHAHMIRIAN. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Beet albumin is partly decomposed to peptides, which during carbonatation react with reducing carbohydrate components, causing either marked coloration of thin juice or the formation of melanoidin precursors. These then cause further juice coloration through condensation reactions. The melanoidin precursors formed by reaction between peptide and reducing sugar are characterized by an absorption band at 320/340 nm in the U.V. spectrum. The nitrogen in the peptides or melanoidin precursors is known as "reactive nitrogen"[1]. Experiments showed that peptides or invert sugar alone did not affect crystallization velocity under the conditions studied, while melanoidin precursors caused a marked drop in the crystallization rate in acid medium, although in alkaline medium they have no effect.

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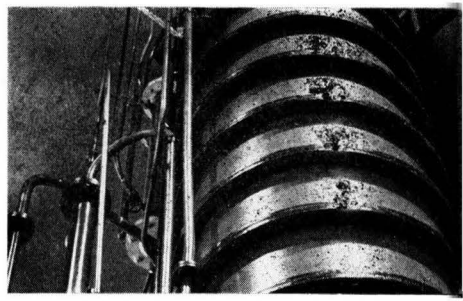
Surface mechanisms of crystal growth and dissolution. H. E. C. POWERS. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Large single crystals of sucrose were immersed each in a slightly supersaturated syrup in a growth cell sealed with a glass cover. The crystals were gently warmed until some dissolution was observed, then allowed to cool slowly for some weeks at fairly constant temperatures. The growth formations were studied in transmitted and reflected light and are discussed. The surface mechanism was found to be a continuum of layer growth and dissolution. The mechanism on the fluid side of the crystal interface is also briefly considered.

* * *

The partition of non-sugars between sucrose crystals and the surrounding liquor. M. L. A. VERHAART, P. W. VAN DER POEL and N. H. M. DE VISSER. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Experiments to determine the proportion of massecuite non-sugars in the sucrose crystals and syrup showed that the saponin:potassium ratio in washed sugar was 5–6 times greater than in the massecuite and syrup, demonstrating the selective adsorption of saponin[2]. On the other hand, the selectivity was not marked in sugar spun without wash water. Results obtained with varying amounts of wash water are expressed in the form of graphs relating the potassium and saponin contents, respectively, in sugar to the amount of wash water applied. The graphs agree qualitatively with the previous curves[3], and indicate that some ash will remain in the sugar despite increase in the wash water and will behave as if included in the crystal. Saponins are more difficult to eliminate from the syrup layer than are sodium, potassium and lithium. None of the last three appeared to be included during normal crystallization. The quantities in which they remain in the sugar are directly proportional to their contents in the massecuite under standard curing conditions, and are not affected by whether the non-sugars are added to syrup before or after crystallization. The phenomenon of non-sugars which cannot be removed by washing and which nevertheless are not incorporated in the sugar crystals is attributed to mass transfer, the mechanism of which is explained.

[1] *See I.S.J.*, 1967, **69**, 152.
[2] CARRUTHERS *et al.*: *I.S.J.*, 1961, **63**, 285.
[3] "Principles of sugar technology". Vol. III. Ed. P. HONIG. (Elsevier, Amsterdam) 1963, p. 253.

By-products



Fermentation of sugar cane molasses in Brazil. W. DREWS. *Brasil Açuc.*, 1967, **69,** (2), 47–51.—In Europe it is necessary, especially in winter, to heat the medium to maintain the best temperature for fermentation; by contrast, in Brazil cooling is necessary, and yeasts have had to be developed which will ferment the sugar to alcohol before other bacteria can produce secondary fermentations. Good functioning of the fermentation room has required strict control of conditions to give a clean well-fermented molasses comparable to that produced with beet molasses. During recent years, the quality of alcohol produced in certain Brazilian distilleries has risen to the equal of European alcohol as a result of the adoption of careful and controlled techniques, and the importance of high quality is emphasized in view of the increasing use of alcohol as a raw material in chemical synthesis.

* * *

Addition of sucrose to concretes: an industrial reality. A. LÓPEZ RUIZ. *Quím. e Ind.*, 1966, **13,** 85–89; through *S.I.A.*, 1967, **29,** Abs. 31.—Experiences in the construction of foundations for a blast furnace in 1965 are reported. 0·07% of sucrose was added on weight of cement, using a water:cement ratio of 0·45. Advantages are: a 30% increase in resistance to compression, the use of less water, better flow and mixing, and suitability for pre-mixing and bulk transport of concrete.

* * *

Bagasse board plant on Réunion prepares for year-round production. R. HESCH. *Sugar y Azúcar*, 1967, **62,** (4), 17–20.—Details are given of equipment and processes used at the new Bagapan Linex-Verkor bagasse particle board plant recently started up in Réunion. The plant has a finished board capacity of 42 tons/day and uses the Siempelkamp tray system. This system uses two heavy hydraulic presses supplied by G. Siempelkamp & Co., of Germany, and a moulding case. The case is conveyed at constant speed from the first press (pre-press) to beneath the spreading machine, where it is filled with half the quantity of bagasse needed for one board. The moulding case then continues to the end of the forming line, is returned to the spreading machine to receive the second half of the bagasse, and then continues to the pre-press where it is pressed cold. Before the press ram is retracted, a hydraulic device lifts the moulding frame from the aluminium sheet serving as the bottom of the case and lays it on a special extracting rail at an elevated level. When the ram has been extracted, the moulding frame and the aluminium caul are removed from the pre-press, and the mat fed to the charging device which passes it to the multi-opening hot press. At the same time, the moulding frame is laid on the aluminium caul to form another moulding case. The cold pressing has been found to give the boards sufficient stability, the hardening of the boards without the use of cauls in the hot press making the system more economical than conventional methods with cauls, which are claimed to result in considerable tolerances in board thickness because of warping under the effects of heating and cooling. The savings in raw material with 19- and 8-mm boards manufactured by the caulless system compared with the conventional process are calculated as 746·5 tons and 1254 tons per year of 250 working days.

* * *

Mechanical handling of bagasse bales. H. S. TOUPS. *Sugar J.* (La.), 1967, **29,** (10), 32–33.—Details are given, with the aid of photographs, of the bagasse bailing system installed by Thibodaux Boiler Works Inc. at a South Coast Corporation sugar factory in Louisiana. The system incorporates a belt conveyor receiving the bales from a slide located after the baling press, and a gravity roller conveyor feeding a short section of belt conveyor which transfers the bales to a pusher table. The bales are pushed by hydraulic rams onto a flat car conveyance in batches of four and are transferred to flat rail trucks in batches of twelve by a grab. Normal capacity of the system is 72 short tons/hr, with a maximum capacity of 86 short tons/hr. Information is given on the various automatic controls. It is claimed that the system will pay for itself in approx. three seasons through the savings in manual labour.

* * *

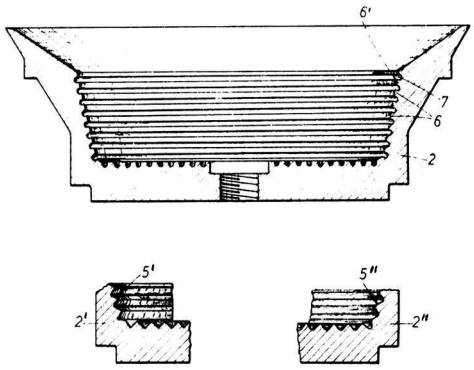
The effect of various amino acids on the growth of *T. utilis.* H. S. TSOU, Y. C. KUO and C. HSU. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (43), 113–118.—The effect of various amino acids on the total growth, growth rate and growth lag of *Torula utilis* NRRL-Y-900 was studied. Of eighteen amino acids added individually at a concentration of M/1000, threonine, tyrosine, serine, lysine and valine were found to stimulate growth. Of ten amino acids added to determine their individual effects on growth rate and lag, only arginine increased the growth rate, while several other acids, particularly glutamic and aspartic acids, reduced the lag phase.

Patents

UNITED STATES

Continuous centrifugal. W. HIRSCH, *assr.* HEIN, LEHMANN & Co. A.G., of Düsseldorf, Germany. **3,275,153.** 17th October 1963; 27th September 1966.

The height of the acceleration cup in a continuous cone-type centrifugal must be sufficient to allow adequate residence time for the massecuite to achieve the necessary impetus to carry it evenly onto the basket. To achieve a reduction in this height, so saving space and reducing the tilting moments and



unbalancing torques which can arise as a result of the distance from the supporting bearings, but without reducing the residence time below that required, the smooth surface of the cup is replaced by a corrugated surface with e.g. grooves 7 in flat surface 6, pointed ribs forming faces 5', or rounded ribs and grooves forming a wavy surface 5".

* * *

Dried sugar juice as animal fodder. R. HEAP and G. H. OWTRAM, *assrs.* CHARLES PAGE & Co. LTD., of London, England. **3,278,309.** 6th September 1962; 11th October 1966.—Juice from cane or beet, concentrated to syrup of at least 85°Bx (e.g. 85–90°Bx) is treated in a first stage with at least one dry powdered material of a group including tricalcium phosphate, kaolin, talc, and alkaline earth carbonates (tricalcium phosphate or calcium carbonate) in an amount of 1–15% (2–8%) by weight of solids in the juice. In a second stage the product is dehydrated to form a non-hygroscopic powder [containing $\not>$ 5% (3%) of moisture]. Part of the powder may be added with the dry powdered material to the syrup, the total weight used being up to 10% on the solids in the syrup.

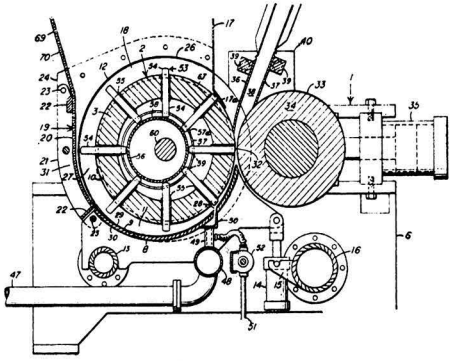
* * *

Continuous centrifugal. J. VON ROTEL, of Dortmund, Germany. **3,279,611.** 15th September 1964; 18th October 1966.—The capacity of a single centrifugal is increased by enlarging its screen area without altering the external dimensions. This is achieved by having the screen in a series of loxodromes or wing-shapes extending from a small diameter to a larger diameter, supporting one another and permitting the crystals to pass over their surface to the periphery of the screen assembly while having separate collector ducts for the molasses passing through the screens[1].

* * *

(Cane) Juice press. J. FARMER, of Oahu, Hawaii, *assr.* HONOLULU IRON WORKS Co. **3,279,357.** 31st January 1964; 18th October 1966.

The press is designed for dewatering of bagasse from a diffusion plant. This drops by gravity from a hopper 17 into the space between a rotating grooved roller 2 and the perforated wall 19 which is supported



by ribs 21. The roller 2 is provided with end assemblies which pass through side walls, fitted with bearings,

[1] *I.S.J.*, 1966, **68**, 141–142.

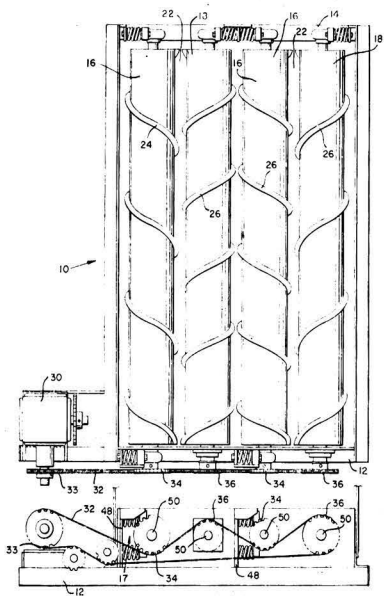
Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 U.S.A. (price 50 cents each).

and at one side the assembly is connected to a shaft drive. Flanges on the roller rotate with it and co-operate with side plates connected to ribs 21 to retain the bagasse within the unit. Beyond the end of wall 19 is a pressure plate 8 having a continuous inner surface 9 coated with an anti-friction material. It is also supported by ribs which pivot about a hinge bar 13 but are supported by hydraulic cylinders 14. The space 11 between the outer surface 10 of roller 2 and the inner surface 9 of plate 8 becomes progressively smaller, reaching a point of maximum compression at the point 32 where the surface 10 is adjacent that of a second roller 34 which rotates in the opposite direction to roller 2 and is hydraulically loaded through cylinder 35. The bagasse, which passes through the gap, is removed from the roller surfaces by scrapers 36, 37. Passage of the bagasse through the space 11 is assisted by the tines 54 which slide within apertures 55, retracting inwardly as the space contracts. This is achieved by locking them through a tongue-and-slot mechanism to a stationary cylinder 56 which is coaxial with the cylindrical surface 9 of pressure plate 8.

Water is supplied under pressure through a pipe 47 to a lateral chamber 50 feeding a slot 28 in plate 9; this is driven back through the incoming bagasse feed and is discharged through the perforations in plate 19, carrying with it incoming juice remaining in the bagasse as discharged from the diffuser.

* * *

Beet cleaning apparatus. E. C. ROLLINS, of Ogden, Utah, U.S.A., *assr.* HESSTON MANUFACTURING CO. INC. **2833,,895.** 18th May 1964; 8th November 1966.



The cleaner conveyor comprises two pairs of counter-rotating parallel rollers 16, 18 suspended between side frames 12, 14 by spring mechanisms 17 which allow limited horizontal movement sufficient e.g. to allow small rocks only slightly larger than the normal gap 22 to pass through; larger rocks would be carried along with the beets. The beets are moved along the conveyor under the action of intermeshing ridges 24, 26 and earth clods and mud are knocked off the roots to fall through gaps 22. The rollers are driven by an endless chain 32 which passes around sprockets 34 and 36 on the ends of the shaft; these sprockets are of different diameters and have different numbers of teeth so that the speeds of the rollers are different and mud which may collect on their surfaces is removed by the frictional abrasion caused by this relative difference in rotational speed.

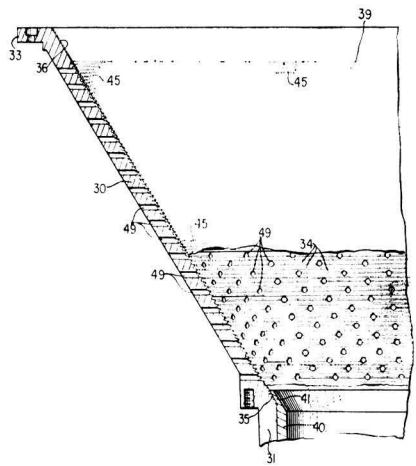
* * *

Polyoxyethylene derivatives of sucroclycerides. L. NOBILE, of Milan, Italy, *assr.* LEDOGA S.p.A. **3,277,080.** 28th January 1964; 4th October 1966. Products having improved surface-active properties are obtained by condensation of sucroglycerides obtained by transesterification of a natural triglyceride with sucrose in the presence of an alkaline catalyst (tallow, coconut or lard sucroglycerides) with 0·5–9 (2) parts by weight of ethylene oxide.

* * *

Centrifugal basket. W. GRIESELHUBER and C. B. SAZAVSKY, of Hamilton, Ohio, U.S.A., *assrs.* THE WESTERN STATES MACHINE COMPANY. **3,283,910.** 2nd April 1964; 8th November 1966.

The frustro-conical basket includes a wall 30 provided with annular grooves 34 recessed within its inner surface and separated by ribs which support



the screen 39. Drain holes 49 are drilled at intervals in alternate ribs, each thus being connected with two grooves, and molasses separated from crystals passing

over the screen 39 passes through its slots 45 into the grooves 34 and so through the drain holes 49. The latter are drilled with alternate spacing in each row so as to maintain maximum strength in the wall 30. The grooves are so shaped that the edge of each rib is smooth and will not damage the screen which is pushed against it by centrifugal force. In addition, the angles of the sides of the grooves are such as to direct the molasses to their peripheral limit for effective drainage.

* * *

Production of citric acid by fermentation. W. GOLD and R. J. KIEBER, *assrs.* STEPAN FERMENTATION CHEMICALS INC., of Keyport, N.J. U.S.A. **3,285,828.** 16th December 1964; 15th November 1966.—To a cool sterile fermentation medium containing a fermentable carbon source (an impure cane-derived material, e.g. blackstrap molasses), is added a sterile water-soluble ferrocyanide or ferricyanide salt and sufficient of a citric acid-producing organism (in spore form) to produce a high yield, and the pH maintained at 6·5–9 (7–8) (with aeration and agitation) while fermentation proceeds. The medium is prepared by diluting the molasses to about 20–30% w/v, sterilizing by heating, cooling, adding 0·05–0·4% by weight of the ferro- or ferricyanide (on weight of 20% w/v molasses) and adjusting the pH from 5·5 to the required level.

* * *

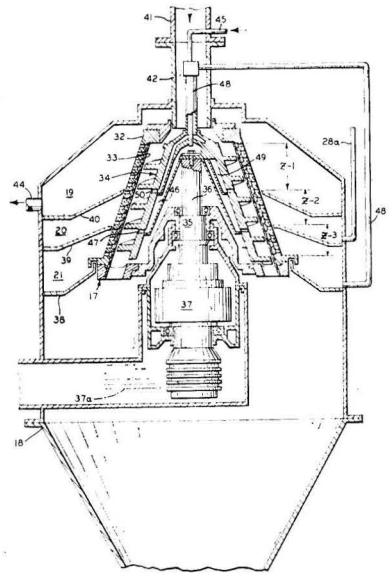
Cane planter. L. J. JULIEN, of Donaldsville, La., U.S.A. **3,286,858.** 19th November 1964; 22nd November 1966.

* * *

Centrifugal screening apparatus. P. NYROP, of Norwalk, Conn., U.S.A., *assr.* DORR-OLIVER INC. **3,289,843.** 19th March 1964; 6th December 1966.

A massecuite enters the top of the apparatus through pipe 41 and flows onto the frustro-conical basket section 32 below, where its molasses content is separated through screen 33 into compartment 19 which it leaves through pipe 44. It continues along the screen and is eventually discharged over the edge of the rotor 17, to fall into the hopper-shaped housing 18. Fresh water is admitted through pipe 45 into the ducts 46 from which it is delivered to openings 47 below the partition 39; the water washes the crystals on the screen and passes into the chamber 21 between the partitions 38 and 39. It is collected through pipe 48 from this chamber and transferred by a pump (not shown) to the hollow sleeve 48 surrounding pipe 45. This sleeve delivers the once-used wash water to ducts 49 and so to openings 50 beneath partition 40. It thus is used again in counter-current fashion to wash the crystals freshly separated from molasses and passes into chamber 20 between partitions 39 and 40, to be withdrawn through pipe 28a, and returned to the evaporator station.

The washed crystals are moved along the screen by the scraper mechanism 34 which is mounted on shaft 36 while the screen rotor is mounted on concentric shaft 35; a differential drive mechanism 37 driven by



the enclosed belt 37a gives the two shafts different speeds.

* * *

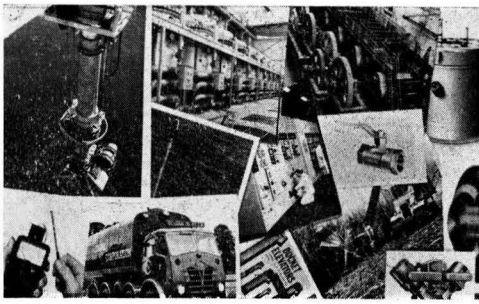
Continuous centrifugal. W. DIETZEL and H. HILLEBRAND, *assrs.* BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **3,290,172.** 16th June 1965; 6th December 1966.—See U.K. Pat. 1,054,884[1].

* * *

Reactions involving sucrose dissolved in monohydric alcohols. B. M. SMYTHE and C. J. MOYE, *assrs.* THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,290,263.** 2nd August 1962; 6th December 1966.—Water, nitrogenous heterocyclic compounds, substituted amides (e.g. dimethyl formamide), dimethyl sulphoxide and γ-butyrolactone have been used as a solvent for reactions involving sucrose, but all have disadvantages. An umber of reactions involving sugars and sugar derivatives may be carried out successfully using as solvent an anhydrous water-miscible high-boiling monohydric alcohol containing the grouping $-O-\overset{|}{C}-\overset{|}{C}-OH$, e.g. ethylene glycol monomethyl ether or monoester, diethylene glycol monomethyl ether, diethylene glycol, 2-hydroxymethyl tetrahydrofurfuryl alcohol or 2-hydroxymethyl tetrahydropyran.

[1] *I.S.J.*, 1967, **69**, 219.

Trade notices



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

Beet topper-windrower. Lockwood Division, Seilon Inc., Box 160, Gering, Nebr., 69341 U.S.A.

A new six-row pull-type beet topper-windrower has been introduced by Lockwood for the 1967 campaign. Driven through the power take-off, it can be attached to a tractor in just a few minutes. All controls are hydraulic with the control console located at the tractor seat. Great manoeuvrability and a shorter turning radius are provided by a hydraulic steerable tongue, while other features are adjustable conveyor length and wheel height, 30-in wide conveyors having greater capacity, and the use of heavy alloy steel tubing for greater strength. A unique sensing mechanism for accurate crowning of large or small beets, and an exclusive knife design which prevents beets being knocked over are other important features. The "Topmaster" has a flail attachment as standard equipment to remove second growth leaves without excessive beet crowning. The topper-windrower is adjustable for six 20–22 in rows, or four 30-in rows.

* * *

SUGAR ENGINEERING BETWEEN PLANTATION AND PRODUCT. Stork-Werkspoor Sugar N.V., P.O. Box 147, Hengelo (O.), Holland.

This is the title of a well-presented, 22-page brochure giving details of the firm's activities and services. It outlines the various stages in establishing a sugar factory, from the initial project study to starting-up of the factory.

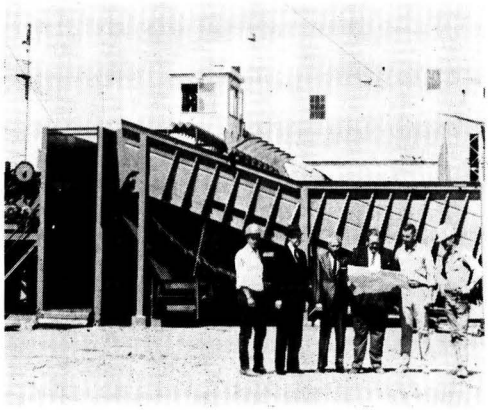
* * *

FLAME-PROOF MOTORS. Mather & Platt Ltd., Park Works, Manchester 10, England.

Publication E 2844 gives information on A.C. flame-proof squirrel-cage and slipring induction motors ranging from 100 to 600 h.p. for which the rated electrical supply is 3·3 kV, 50 c/s, 3-phase. All motors are weatherproofed for outdoor operation and are suitable for tropical duty and chemical works conditions.

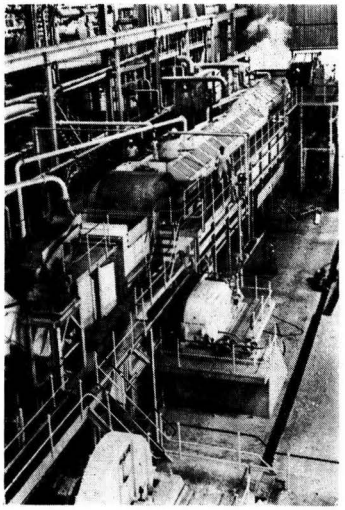
* * *

Cane unloading station.—The hydraulically-controlled cane unloading station illustrated was designed and built by Thomson Machinery Co. Inc. for Cedar Grove sugar factory in Louisiana, USA. Cane is dumped directly from wagons or trailers onto one of two 20-ft wide × 35-ft long mechanized tables which together handle 4000 t.c.d. Levellers ensure a constant cane mat depth of 12–18 inches for uniform washing by nozzles applying 3000–4000 gal of water/min. The levellers and angle of the tables give a tumbling action to remove dirt, which is carried to a pit, while clean trash is returned to the centre cane carrier whence it is removed for disposal. Use of the levellers is claimed to obviate the need for a first shredder. The unloading time for a 30-ton trailer (containing 15 tons of cane in each of two compartments) is 5 min.



* * *

BMA cane diffusers.—The illustration shows a BMA cane diffuser supplied to a sugar factory in South Africa. At a daily throughput of 6100 short tons, it is claimed to be the largest cane diffuser yet built, although BMA have received an order from the Philippines for two 6600-ton diffusers. Other BMA diffusers are under construction for Brazil.



United Kingdom Sugar Imports and Exports[1]

IMPORTS	1967	1966	1965	1964
	Long tons, tel quel			
Refined and White Sugar				
Canada	163	2	2	1,602
W.Indies & Guyana	1,129	3,306	1,794	4,200
Other Commonw'th	11	21	8	503
Belgium	1,452	87	46	40
Cuba	—	—	2	497
Czechoslovakia	26,528	32,022	24,266	8,647
Denmark	—	—	1	11,977
France	882	858	5,151	3,098
Germany, East	5,136	1,427	1,894	3,525
Germany, West	104	503	1	3,237
Ireland	10,725	12,530	8,339	16,587
Netherlands	25	—	—	900
Poland	—	3,721	1,409	571
USSR	—	1,421	1,624	—
Other Foreign	2,239	91	278	1,017
TOTAL	48,394	55,989	44,815	56,401
Raws—Cane and Beet				
Australia	434,395	412,653	401,758	458,760
Barbados	114,088	135,549	128,835	112,994
British Honduras	15,786	17,123	24,063	19,823
Fiji	144,399	131,433	166,622	143,500
Guyana	140,965	58,971	119,051	96,196
India	76,902	96,948	74,120	10,270
Jamaica	199,091	211,198	257,606	240,451
Leeward Is.	34,419	35,739	36,744	40,855
Mauritius	370,139	436,808	404,691	421,890
Rhodesia	—	20,163	34,439	20,540
Swaziland	87,539	81,985	86,240	37,725
Trinidad & Tobago	145,502	122,943	139,567	130,390
Other Commonw'th	817	—	—	500
Commonwealth Raws	1,764,042	1,761,513	1,873,736	1,733,894
Argentina	—	500	—	15,601
Belgium	4,000	—	—	5,911
Bulgaria	3,995	—	—	—
Brazil	17,826	162,090	52,558	20,493
Colombia	11,706	30,040	—	—
Cuba	79,923	65,341	90,569	90,151
Czechoslovakia	—	—	183	—
Dominican Republic	9,949	—	10,328	52,411
Ecuador	—	—	—	5,430
France	—	824	24,204	3,494
Germany, West	—	—	—	727
Guatemala	—	—	—	9,429
Haiti	—	9,470	—	—
Indonesia	—	—	—	40,211
Malagasy	—	12,612	—	—
Mexico	—	12,605	—	20,295
Netherlands	26,013	—	—	—
Peru	—	—	—	57,572
Poland	31,905	5,882	16,172	37,602
South Africa	158,539	58,360	19,938	95,373
Taiwan	—	—	—	10,354
Turkey	—	—	—	10,192
Yugoslavia	1,008	250	—	—
Other Foreign	2	3	2	2
Foreign Raws	344,866	357,977	213,954	475,248
TOTAL RAWS	2,108,908	2,119,490	2,087,690	2,209,142

[1] C. Czarnikow Ltd., *Sugar Review*, 1968, (851), 31.

EXPORTS	1967	1966	1965	1964
	Long tons, tel quel			
Bahamas/Turks & Caicos Is.	1,101	954	981	665
Bahrein	102	270	6,341	5,851
Barbados	259	496	369	243
Bermuda	583	684	539	506
British Honduras	716	1,072	580	418
Canada	2,032	1,289	538	59
Ceylon	665	907	1,944	1,223
Cyprus	11,541	9,163	10,359	7,434
Gambia	775	807	458	220
Ghana	19,301	19,171	556	8,178
Gibraltar	1,184	994	1,443	833
Guyana	90	70	104	310
Hong Kong	2	303	3	8
Indian Ocean Islands	246	281	590	99
Kenya	3,580	3,237	2,123	263
Leeward Is.	1,367	1,000	727	49
Malaysia	523	22,691	18,831	18,183
Malta	935	857	1,002	1,327
Nigeria	24,469	24,918	25,016	23,520
Sierra Leone	8,281	10,181	10,228	9,393
Singapore	5,535	9,072	*	*
South Arabia	216	473	966	1,828
Trinidad & Tobago	26	1,294	155	98
Trucial States	100	816	9,499	2,465
Windward Is.	2,298	1,231	596	17
Zambia	2,017	—	—	—
Other Commonw'th	603	364	477	178
Total Commonwealth	88,547	112,595	94,425	83,368
Belgium	968	438	27	28
Bulgaria	—	—	9,340	—
Burma	—	286	149	228
Cameroons	6	8	358	211
Chile	1,287	437	5,861	1,457
French Pacific	2,353	3,730	3,443	2
Germany, East	5,000	—	—	—
Germany, West	583	593	1,491	1,240
Greece	34,168	10,997	5,119	32,218
Iceland	3,354	3,809	1,428	465
Iran	1,723	1,357	975	9,475
Iraq	3	1	—	4,946
Ireland	590	6,061	6,178	2,695
Israel	426	773	276	182
Italy	26	105	30	10,268
Korea, South	—	1	492	505
Kuwait	249	254	24,104	5,913
Lebanon	1,627	693	2,417	2,509
Liberia	555	735	906	1,217
Libya	294	446	784	420
Muscat & Oman	89	53	42	576
Netherlands	45,329	25,044	10,958	139,151
Norway	43,473	40,613	53,844	31,148
Saudi Arabia	486	514	4,894	44,367
Spain	252	1,349	4	6,812
Spanish Overseas Possessions	168	166	316	59
Sweden	9,859	2,382	1,965	18,341
Switzerland	56,566	55,219	42,005	34,818
Togo	246	404	284	25
Tunisia	12,817	24,782	20,564	2,952
UAR	7	60	152	103
USA	7	3,657	4,326	189
Vietnam, South	9,550	—	—	—
Other Foreign	933	214	380	1,244
Total Foreign	232,994	185,181	203,112	353,764
TOTAL EXPORTS	321,541	297,776	297,537	437,132

* Export figures for the years 1965 and 1964 are included in those of Malaysia.

Brevities

Taiwan cane area, 1968[1].—The Taiwan Sugar Corporation, which owns 30% of the present Taiwan cane area of 250,000 acres, is to switch about 30,000 acres to other farm crops because of low sugar prices.

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French beet and sugar prices, 1967/1968[2].—The French official journal recently announced that prices for sugar and for beet in 1967/68 were to be unchanged; however, the "taxe de rédemption" which goes to a sugar fund has been reduced from 8·80 francs per ton of beets to 0·756 francs since in 1967/68 the E.E.C. agricultural fund would for the first time be responsible for the sale of the exportable surpluses in France and its overseas departments.

* * *

Spain-Salvador trade agreement[3].—Under a recently concluded trade agreement, Spain is to import 10,000 tons of sugar a year from El Salvador over a five-year period, supplying in exchange trucks, fertilizers, steel ingots and wheat. El Salvador expects to reach similar contracts with Israel and Italy.

* * *

Beet breeding research cooperation.—Through their respective seed breeding stations "Hilleshög" and "Maribo", Svenska Sockerfabriks Aktiebolaget and A/S De Danske Sukkerfabrikker have independently contributed considerably to the development of European sugar beet growing. The two companies have now concluded an agreement regarding cooperation within this branch of their widespread activities. This collaboration will not affect the independent status of the two breeding stations nor their continued activities, and consequently the well-known "Hilleshög" and "Maribo" varieties of high-yielding sugar beet seed, which are exported to a large number of countries, will be marketed along the usual lines in the future. However, the companies intend to carry out their extensive field trials, to a certain extent on a joint basis, in order to achieve the greatest possible efficiency. Also, they plan to intensify, in close cooperation, the scientific research work which forms the basis of modern seed breeding and thereby also aid the further development of European beet sugar production.

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Philippines sugar production, 1966/67[4].—Final production for the 1966/67 crop in the Philippines amounted to 1,719,601 short tons, compared with 1,545,393 tons and 1,717,112 tons in 1965/66 and 1964/65 respectively. Production in the 1967/68 crop is estimated at 1,883,500 short tons.

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Greece sugar production 1967[5].—Total beet processed in the three Greek sugar factories amounted to 915,635 metric tons, from which 110,556 metric tons of white sugar was produced, together with 39,128 tons of molasses and 33,467 tons of pulp.

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Trinidad Sugar Technologists' Association.—The first conference of the newly-formed Sugar Technologists' Association of Trinidad & Tobago, which has been promoted by the Sugar Manufacturers' Association of Trinidad, took place at the Sevilla Club of Caroni Ltd. during the 20th-25th November 1967. The conference opened with the formal acceptance of the proposed rules of the Association and the appointment of officers. Mr. F. H. B. BLACKBURN, Managing Director of Caroni Ltd., was elected President[6].

Yugoslav sugar as animal feed for Spain[7].—The Spanish Ministry of Trade has granted a licence for the importation of 50,000 tons of denatured sugar from Yugoslavia. This sugar, which is destined for feeding purposes, will be imported by International Cereales S.A. Total imports of this firm during January–April 1968 will amount to 100,000 tons[8].

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Angola new sugar factory plans[9].—It is reported from Portuguese West Africa that the Sociedade de Empacotamento Automático S.A.R.L. in Lisbon has applied to the authorities in Angola for a licence to construct a sugar plant to have a capacity of 100,000 tons a year.

* * *

Silver diffuser bagasse quality.—A report prepared by the Central Research Division of Crown Zellerbach Corporation, one of the world's major paper producers, states that bagasse from the Silver diffuser-clarification system is "equal to somewhat better than normal". The question of this bagasse quality for paper making had been raised, and the Crown Zellerbach laboratories were called upon to investigate the bagasse in comparison with normal milling bagasse. Initial freeness was equal, bursting strength 7% higher, tearing resistance 3% lower, breaking length 2% higher, folding endurance double, sheet density 2% higher and beating time equal. Depithing was excellent and good pulp strengths show fibre damage to be minor. Screened pulp yields for the samples were 16% higher than that of the Rietz depithed (mill) bagasse.

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St. Kitts (Basse Terre) Sugar Factory Ltd. 1967 report. During the 1967 crop 327,752 tons of cane were harvested and produced 38,526 tons of commercial sugar equivalent to 39,195 tons basis 96° pol. Drought conditions again affected production but higher sucrose content from a smaller cane tonnage than in 1966 produced a slightly greater tonnage of sugar. Sugar for export amounted to 34,134 tons, all of which was sold to the U.K. Sugar Board at the Negotiated Price of £46 11s 6d per ton f.o.b. and stowed bulk. 1967 was the second year of the three-year Wage Agreement and relations with the Labour Union remained good throughout the crop. Rainfall after the crop was better than in 1966 but it came late. The probable tonnage for 1968 should not be less than in 1967.

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Brazil bulk sugar terminal[10].—Fives-Lille do Brasil, the Brazilian subsidiary of Soc. Fives Lille-Cail of Paris, is to build the bulk sugar terminal at Recife, Pernambuco, in cooperation with three other Brazilian firms. The terminal will include a storage capacity of 200,000 tons of sugar in two stores of 100,000 tons capacity each, and 10 million litres of molasses in two tanks of 5000 cu.m. capacity each. This silo system will be the biggest in the world. Sugar will be sent to a weighing tower and thence to the ship-loading installation. The cost will be about £3,000,000.

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[1] *Public Ledger*, 6th January 1968.
[2] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (35), 10.
[3] *B.O.L.S.A. Review*, 1967, **1**, 682.
[4] C. Czarnikow Ltd., *Sugar Review*, 1967, (845), 227.
[5] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (35), 12.
[6] *W. Indies Chron.*, 1968, **83**, 35.
[7] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (34), 15.
[8] See *I.S.J.*, 1967, **69**, 383.
[9] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (35), 17.
[10] *Zeitsch. Zuckerind.*, 1968, **93**, 42.