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Le développement de l'industrie sucrière en Bolivie. H. KAMPF. *p.* 197–198

On donne des informations sur la production et la consommation de sucre blanc en Bolivie, avec des détails des contingents de production établis pour les trois sucreries. On mentionne la production et l'exportation de sucre brut aux Etats Unis et la quatrième sucrerie en construction près de la frontière argentine. L'importation d'adoucissants synthétiques pour la production de boissons non-alcooliques et de confiserie est interdit par le gouvernement.

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Carbonatation de liqueur. II. Floculation de $CaCO_3$. M. C. BENNETT et S. D. GARDINER. *p.* 198–202

A partir d'essais avec une liqueur westindienne et sudafricaine les auteurs ont conclut qu'un procédé de floculation joue un rôle important dans la cristallisation de $CaCO_3$ pendant la carbonatation, et que quelques impuretés peuvent influer sur cette floculation, de sorte que le degré de la conglomération du $CaCO_3$ est réduit aussi que la filtrabilité de la liqueur carbonatée. Puisque, quand la cristallisation du $CaCO_3$ est complète, des changements additionnels de l'état de la floculation ont presque aucune influence sur la filtrabilité, une inspection casuelle à l'oeil nu de liqueur carbonatée avant la filtration peut-être ne donnera pas une indication de sa filtrabilité.

* * *

Recherches sur canne à sucre au Queensland. *p.* 202–204

C'est une sommaire du rapport annuel (1966) du Directeur du Bureau of Sugar Experiment Stations à Brisbane, et traite de l'irrigation, des études sur la nutrition de canne, l'élevage de canne dans une "serre à climat contrôlé", des variétés de canne, des insectes et animaux nuisibles, et le désherbage.

Die natürliche Kühlung von Füllmassen in Kristallisatoren. H. J. SPOELSTRA. *S.* 195–197

Näherungsformeln werden zur Berechnung der zum Ende irgendeines Kühlungszeitraums erwarteten Füllmassentemperaturen in diskontinuierlichen, nur mit Rührapparaten versehenen und natürliche Kühlung anwendenden Kristallisatoren entwickelt. Man hat empirische Werte des Wärmeübertragungskoeffizients, die für die Berechnung der endlichen Füllmassentemperatur notwendig sind, in Versuchen mit einem Nachprodukt-Kristallisator in einer Rübenzuckerfabrik bestimmt. Die gemessenen Temperaturen stimmen wohl mit den entsprechenden, mittels der Gleichungen berechneten Werten auf einem Kühlung-Diagramm überein. Ein Nomogramm wird zwecks Berechnungserleichterung gegeben.

* * *

Entwicklung der Zuckerindustrie in Bolivien. H. KAMPF. *S.* 197–198

Informationen über Weisszuckererzeugung und -Verbrauch in Bolivien werden gegeben, wie auch Angaben der für die drei Zuckerfabriken festgesetzten Erzeugungsquoten. Der Verfasser erwähnt die Erzeugung von Rohzucker und dessen Export nach den Vereinigten Staaten und die vierte Zuckerfabrik, die in der Nähe der argentinischen Grenze errichtet wird. Die Einfuhr von synthetischen Süssstoffen für die Erzeugung von alkoholfreien Getränken und Süsswaren ist von der Regierung verbietet worden.

* * *

Karbonation von Kläre. II. Ausflockung von $CaCO_3$. M. C. BENNETT und S. D. GARDINER. *S.* 198–202

An Hand von Ausflockungsversuchen mit einer westindischen und einer südafrikanischen Kläre, kommen die Verfasser zum Schluss, dass ein Ausflockungsverfahren eine wesentliche Rolle in $CaCO_3$-Kristallisierung während der Karbonation spielt, und dass einige Unreinheiten diese Ausflockung beeinflussen können, so dass das Anhäufungsgrad im $CaCO_3$ vermindert wird, unter Begleitung einer Verringerung der Filtrabilität der saturierten Kläre. Weil, wenn einmal die $CaCO_3$-Kristallisierung vollendet ist, weitere Anderungen des Ausflockungszustands beinahe keine Einwirkung auf die Filtrabilität haben, wird vielleicht eine gelegentliche Besichtigung mit blossem Auge der saturierten Kläre vor der Filtration keine Andeutung über ihre Filtrabilität geben.

* * *

Zuckerrohrerforschungsarbeiten in Queensland. *S.* 202–204

Dies ist eine Zusammenfassung des Jahresberichts (1966) des Direktors des Bureau of Sugar Experiment Stations in Brisbane, und umfasst den Bewässerungszustand an den Versuchsstationen, Studien der Zuckerrohrnahrung, die Rohrzüchtung in einem Haus mit "kontrolliertem Klima", Zuckerrohrsorten, -Schädlinge und -Krankheiten, und die Unkrautbekämpfung.

El enfriamiento de masas cocidas en cristalizadores. H. J. SPOELSTRA. *Pág.* 195–197

Fórmulas aproximativas se derivan para calcular las temperaturas de masas cocidas que pueden aguardarse al fin de algún periodo de enfriamiento en cristalizadores de cargas, provisto con agitadores y usando enfriamiento natural. Desde experimentos usando un cristalizador de bajo grado en un azucarera remolachera, el autor ha determinado valores empíricas del coeficiente de transmisión de calor, necesidades para la estimación de la temperatura final de la masa cocida. Temperaturas medidas concordan estrechamente con los valores correspondientes sobre una curva de enfriamiento que se cálcula por medio de las ecaciones. Se presenta una nomograma para facilitar calculación.

* * *

Desarrollo de la industria azucarera Boliviana. H. KAMPF. *Pág.* 197–198

Un informe se presenta sobre la producción y consumo de azúcar blanco en Bolivia, con detalles de las cuotas de producción fijada para las tres fábricas. Se menciona la producción de azúcar crudo y su exportación a los E.U.A. Un azucarera—la cuarta—se construye a cerca de la frontera argentina. El Gobierno ha prohibido la importación de edulcorantes sintéticas para la manufactura de bebidas y confites.

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Carbonatación de licor. Parte II. Floculación de $CaCO_3$. M. C. BENNETT y S. D. GARDINER. *Pág.* 198–202

Desde pruebas de floculación de licor originado en las Indias Occidentales Británicas y en Sud-Africa, los autores han concluido que el proceso de floculación juega un papel muy importante en la cristalización de $CaCO_3$ en carbonatación y que ciertas impurezas pueden afectar esta floculación de modo que el extento de conglomeración en el $CaCO_3$ se reduzca, acompañado con una caída de la filtrabilidad del licor carbonatado. Pues que, cuando es completa la cristalización del $CaCO_3$, cambios adelantes del estado de floculación estan casi sin efecto sobre la filtrabilidad, un examen casual de un licor carbonatado por el ojo inayudado no proveerá necesariamente algún indicación de su filtrabilidad.

* * *

Investigaciones sobre la caña de azúcar en Queensland. *Pág.* 202–204

Este es un sumario de la Reporte Anual para el año 1966 del Director del Bureau of Sugar Esperiment Stations en Brisbane. Se trata del regadio, de estudios sobre la nutrición de caña, de la crianza de caña en una casa de clima regulada, de variedades de caña, de plagas y enfermidades, y de control de malas hierbas.

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Notes & Comments

World raw sugar price.

After a period of relative stability, the world raw sugar price rose by £6 to £32 per ton (the highest price since 12th November 1964) on 6th June, when war broke out in the Middle East. However, it fell again following the cease-fire and stood at £21 10s on 20th June, rising to £22 on 21st June.

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Sugar Board surcharge.

The surcharge levied by the U.K. Sugar Board was reduced from 3¼d per lb (30s 4d per cwt) to 2¼d per lb (21s 0d per cwt) on 8th June when the world raw sugar price increased substantially as a result of the Middle East war, but was increased again on 21st June to 3¼d per lb (30s 4d per cwt) when the world price had fallen again.

* * *

French sugar refineries take-over.

An international consortium, Cie. Européenne de l'Industrie Sucrière (C.E.I.S.), which includes European Sugars (France), Eridania Zuccherifici Nazionali S.p.A. and Süddeutsche Zucker A.G. and is headed by the Société F. Béghin, has acquired full control of the largest French sugar producer, Société des Raffineries Say. Of the 2 million Say shares, it is believed that 1,200,000 have been bought by the group for about 200 million francs (£14½ million). European Sugars (France), which will hold 51% of the shares of the consortium, is a company formed by Tate & Lyle Ltd. and Raffinerie Tirlemontoise S.A., of Belgium. (In April 1966[1] these two companies formed European Sugars S.A. with the object of examining "opportunities for expansion in the European sugar market".) The French Beet Growers' Association will be represented on the Board of the consortium.

In answer to the take-over, four French sugar firms have merged to become the most important French sugar producer, with a turnover of some 800 million francs. The companies are: Société Industrielle de Raffinerie de Sucre de Saint-Louis, Sucreries et Raffineries Bouchon et Pajot, Cie. Nouvelle de Sucreries Réunies, and Société Nouvelle de Raffinerie Lebaudy-Sommier.

U.S. sugar supply quota, 1967.

The U.S. Department of Agriculture announced on the 19th April that the total quantity of sugar to be imported from foreign countries during the second quarter of this year was to be increased by 75,000 short tons, raw value, to a total of 1,225,000 tons. The overall quota requirement of 10,400,000 tons was not changed by this action. The extra quantity of second-quarter sugar was to be shared out on the basis of average deliveries during the first half of each of the years 1963 to 1966.

Announcement on the 28th April of an increase in the guide price to 7·23 cents per pound, c.i.f. duty-paid, triggered off a further rise in quotations on the U.S. domestic market, however, which prompted further action from the Department. After receiving applications against the earlier increase, it announced at the beginning of May that all restrictions on arrivals of raws during April/June were lifted completely. Foreign suppliers are permitted to ship the balance of their 1967 quotas at any time during the remainder of the year[2].

The U.S. Secretary of Agriculture declared, on 17th May, a deficit of 415,000 short tons, raw value, in the sugar quota for Puerto Rico and 15,000 tons in that for the Virgin Islands. On 11th May the Dominican Republic was given a special allocation of 105,000 short tons, raw value, which represents a portion of the unused Philippine share of the Puerto Rican and Virgin Island deficits (the Philippines had advised the U.S.D.A. on 26th January that it would not be able to participate in servicing the deficits arising in other areas), plus its pro rata share of the balance of these deficits and of any other deficits that might be declared in 1967. Honduras has notified the Department that it will be able to fulfil its statutory quota this year, set at 5033 tons. This quantity had previously been prorated to other members of the Central American Common Market. After the assignment of the unused Philippine share of the deficits to the Dominican Republic, the balance of 325,000 tons was prorated to the Dominican Republic, Honduras and certain other countries.

The deficits and prorations and revised quotas are listed elsewhere in this issue.

[1] *I.S.J.*, 1966, **68**, 162.
[2] C. Czarnikow Ltd., *Sugar Review*, 1967, (813), 88.

U.S.S.R. beet area[1].

The following beet areas are reproduced from the Soviet *Statistical Yearbook:*

		hectares
1963	.....	3,748,000
1964	.....	4,107,000
1965	.....	3,882,000
1966	.....	3,800,000

Based on reports in the Soviet press that 1,907,000 hectares, about half the target area, had been sown by 31st April 1967, and subsequently that 2·7 million hectares, or about three-quarters of the earmarked area had been completed, it is estimated that the beet area in the Soviet Union this year will be in the region of 3·7 million hectares.

* * *

India sugar exports reduction[2].

India has decided to export less sugar this year to save the money which the Government has to spend in subsidizing losses incurred by Indian sugar exporters. An official statement said India expects to export 300,000 metric tons of sugar this year as against 441,000 tons in 1966. In general, exports this year will not exceed the volume needed to meet quota obligations under international agreements. The international price of sugar is usually much lower than the domestic cost and the consequent loss in 1967 is expected to be 160 million rupees for a foreign exchange earning of 140 million rupees. In 1966 the loss was 200 million rupees for a foreign exchange earning of 175 million rupees.

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Dominican Republic sugar industry study.

The Dominican Republic Government has contracted with American Factors Associates Ltd. of Honolulu and Ralph M. Parsons Corporation, an international engineering firm based in Los Angeles, to carry out the preliminary phase of a programme for rehabilitation of the 12 sugar mills owned by the Government. Financing of this phase will be under the auspices of the United States Agency for International Development.

The Government-owned mills produce about two-thirds of the approx. 900,000 tons annual sugar output of the island. An objective of the study by American Factors and Parsons will be to determine the requirements and work plan to put the industry back on its feet after several problem years. Factory, agriculture and cost specialists from Hawaii will carry out American Factors Associates' portion of the contract and Parsons will conduct the engineering, construction and economic analysis phase of the study.

* * *

Annual Report of the Booker Group, 1966.

In the statement made by the Goup's Chairman, Mr. DAVID POWELL, it is mentioned that the Guyana sugar crop was disappointing at 237,000 tons of sugar compared with a 5-year average of 250,000 tons and a 1965 production of 252,000 tons. The poor crop is attributed to drought and to a series of strikes "originating in political rivalries rather than industrial disputes". Severe drought was also recorded in 1964. However, the weather since spring 1966 has been ideal for cane growing, and the 1967 crop is forecast at 280,000 tons. It is pointed out that, despite the low world price of sugar, "it is essential to make the largest crop possible, since markets must be secured and performance established to safeguard future quotas and outlets. Bookers Sugar Estates have therefore steadily and cautiously increased their acreage in cane over the years; and cane farmers have been encouraged to do the same. In 1966, 10,000 tons of sugar were made from farmers' cane". It is stated that a commission has been set up to enquire into the whole economics of the Guyana sugar industry, in particular the current dispute over union demands for a bonus for 1965 and the possibility of a wage increase for 1966.

The sugar factory at Innswood, in Jamaica, suffered from labour troubles and serious cane fires, so that a substantial amount of cane had to be left over into the 1967 crop. Nevertheless, a record sugar production was expected.

The recent political events and dislocation of road and rail transport have made it difficult and expensive to transport sugar from the Bacita factory in Nigeria to the main markets in Northern Nigeria, although the whole of the crop was expected to be sold during 1966/67. The production of 21,000 tons of sugar expected is far in excess of the estimate of 17,500 tons. The area under cane was being increased by 350 acres to 6450 acres.

* * *

Verenigde H.V.A.-Maatschappijen N.V. 1966 report.

Sugar production at the Wonji and Shoa sugar factories, in Ethiopia, during 1965/66 amounted to 68,861 metric tons, compared with 61,698 metric tons in the 1964/65 season. An even greater sugar production is expected for 1966/67, while consumption continues to rise. H.V.A.-Ethiopia S.C. even had to import some thousands of tons of sugar to meet domestic requirements and prevent a temporary shortage. Third-party imports of foreign sugar making their reappearance on the market towards the end of 1965/66 helped to produce stocks that were higher than strictly necessary.

Production at the Kilombero sugar estate, in Tanzania, managed by Verenigde H.V.A.-Mij. N.V., was 26,100 tons compared with 24,813 tons in the 1964/65 season. The decrease was attributed to diseases of certain cane varieties aggravated by the adverse climatic conditions. The crushing capacity of the factory was to be increased from 1530 to 1750 t.c.d.

[1] Through C. Czarnikow Ltd., *Sugar Review*, 1967, (816), 103.
[2] *The Times*, 27th March 1967.

The Natural Cooling of Massecuites in Crystallizers

By H. J. SPOELSTRA (Stork-Werkspoor Sugar N.V.)

Introduction

FOR the cooling of massecuites (principally low grades) a very great many sugar factories are still using ordinary discontinuous working crystallizers, only provided with stirrer devices, in which, by natural cooling to the surroundings, the massecuite temperature is lowered until the desired exhaustion has been reached.

For a given massecuite the rate of exhaustion is a function of the temperature and therefore it may be useful to evaluate the cooling effect of a crystallizer which can be reached under the prevailing conditions as a function of the cooling time.

The purpose of this article is to present some approximation formulae with which the massecuite temperature to be expected at the end of any cooling period may easily be calculated. Conversely such calculations may be helpful in project work concerning crystallizers and massecuite cooling plants.

Natural cooling should not be neglected in consideration of cooling with water-cooled crystallizers, especially over relatively long cooling times and it may also be useful to know this extra cooling effect by heat transfer to the surroundings.

Derivation of the formulae

To arrive at suitable approximation formulae we have to make some simplifications and for the whole cooling time we shall reckon with constant average values of:

V_c = actual massecuite volume in the crystallizer (hl).

γ = specific gravity of the massecuite (kg/litre).

$M = 100\ V_c\ \gamma$ = weight of massecuite (kg).

c = specific heat of the massecuite (kcal/kg/°C).

t_1 = temperature of surrounding air (°C).

α' = heat transfer coefficient* (kcal/sq.m./hr/°C).

* It is to be observed that a' is *not* identical to the usual heat transfer coefficient a between a surface and its surrounding air, based on the real shape and temperature of the surface. In our case the introduced a' is an average "overall" heat transfer coefficient based on a standardized crystallizer surface F (to be defined later) and on the mean logarithmic temperature difference between massecuite and the surrounding air, thus involving the whole complexity of factors which have an influence upon the heat transfer.

For any cooling period the equation for transferred heat is:

$$Mc\Delta T = \tau F \alpha' \Delta_m \quad \ldots\ldots(1)$$

where: ΔT = temperature drop of massecuite (°C),

τ = cooling time (hr),

F = heat transfer surface (sq.m.) and

Δ_m = mean log. temperature difference (°C).

With: T_0 = initial massecuite temperature (°C)

$T = T_0 - \Delta T$ = final massecuite temperature (°C)

$$\Delta_m = \frac{\Delta T}{\ln \dfrac{(T_0 - t_1)}{(T_0 - t_1) - \Delta T}}$$

Equation (1) can now be written as

$$\ln \frac{(T_0 - t_1)}{(T_0 - t_1) - \Delta T} = \frac{F\alpha'}{M c}\tau \quad \ldots\ldots(2)$$

After transformation, equation (2) can be written in the general form:

$$\Delta T = y\,(T_0 - t_1) \quad \ldots\ldots(3)$$

where: $$y = \frac{e^{x\tau} - 1}{e^{x\tau}} \quad \ldots\ldots(4)$$

$$x = \frac{F\alpha'}{M c} \quad \ldots\ldots(5)$$

If V_0 is the volume in hl of the empty crystallizer without any inner parts and $\beta = V_c / V_0$, the filling ratio, we can write: $M = 100\ \beta\ V_0 \gamma$ kg.

For U-shaped crystallizers F and V_0 will be defined respectively as the total surface and the total volume of a trough-shaped body with a height equal to its width D. For cylindrical crystallizers F and V_0 are respectively the total surface and the total volume of the full cylinder with diameter D.

When L is the crystallizer length and $f = L/D$ (both in metres) equation (5) can be transformed into the general form

$$x = \frac{AB}{\beta} \quad \ldots\ldots(6)$$

in which:

$$A = \frac{F}{V_0} = \frac{2f + 1}{5fD} \quad \ldots\ldots(7)$$

and $$B = \frac{\alpha'}{100\ \gamma\ c} \quad \ldots\ldots(8)$$

We now propose to refer to:

A as the *crystallizer factor* dependent only on its dimensions, to B as the *operating factor* dependent only on the operating conditions, and to x as the *cooling exponent*, identical to the *specific cooling intensity*, i.e. the ratio between transferred heat per unit of time at a certain moment and the heat content of the massecuite at the same moment with regard to the temperature of the surrounding air, and to y as the *cooling factor*.

It is clear that the execution of the calculations can be greatly simplified by using nomographs. This is especially the case with equation (4) which has been constructed in the form of a nomograph (Fig. 1) from which the y values can be taken as a function of x and τ.

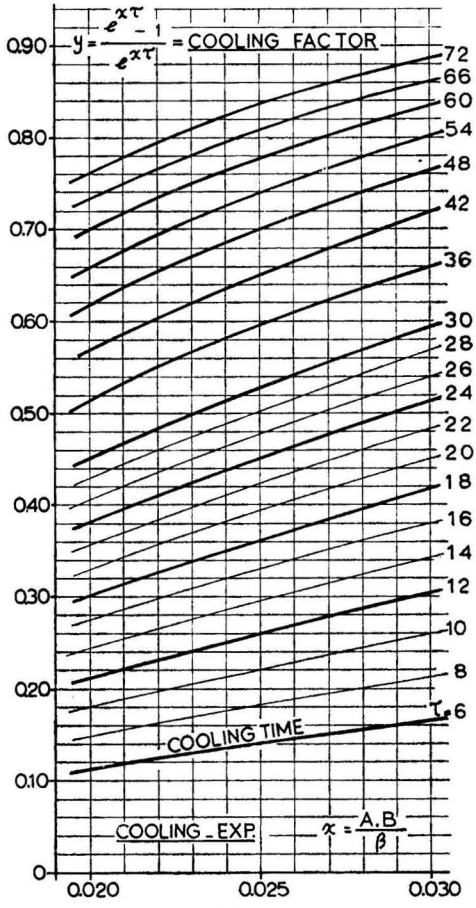

Fig. 1

The heat transfer coefficient α'

Estimation of the final massecuite temperature (by calculating ΔT) to be reached in a certain crystallizer under predetermined conditions can only take place by assuming a certain value for α', which in its turn can only be done empirically.

At a beet sugar factory three tests were carried out on a cylindrical low grade crystallizer with cooling coils, the water supply to which was cut off during these tests with natural cooling. During these tests the values found for α' were 7·1, 7·2, and 6·7, respectively, giving an average of $\alpha' = 7{\cdot}0$. The temperatures of the massecuite at the start and of the surrounding air were respectively $T_o = 73{\cdot}0$, 74·3, and 87·8°C, and $t_1 = 25{\cdot}0$, 31·3, and 29·1°C.

We do not expect great variations in α' under the average conditions of crystallizer stations in sugar factories, and in view of their approximate character we propose to adopt for the time being in these calculations the average value $\alpha' = 7{\cdot}0$, until from future additional cooling tests it might appear that this value for α' needs revision. Then possibly also a more accurate estimation of α' could be made in accordance with the operating conditions.

It would be possible to take for instance $\alpha' = 7{\cdot}5$ and $\alpha' = 6{\cdot}5$, respectively, for extraordinarily favourable or unfavourable heat transfer conditions.

On the other hand the formulae show only a very moderate influence of α' on the cooling factor y, resulting in deviations in ΔT of probably not more than + or —1·5°C, which of course is of no substantial importance.

Suitability of the formulae

In order to check on the suitability of the formulae developed, calculations are made for the following case:

The low-grade massecuite cooling station of a cane sugar factory consisted of a number of U-shaped crystallizers with $D = 1{\cdot}8$ m, $L = 6{\cdot}1$ m, giving $f = 3{\cdot}4$ and $A = 0{\cdot}255$.

For low-grade massecuite we may take as an average 100 $\gamma c = 65$ and with $\alpha' = 7{\cdot}0$ we find $B = 0{\cdot}108$. Assuming $\beta = 1{\cdot}0$ we find $x = 0{\cdot}0275$.

Years ago, for quite another purpose we measured at random in these crystallizers the massecuite temperature at different cooling times.

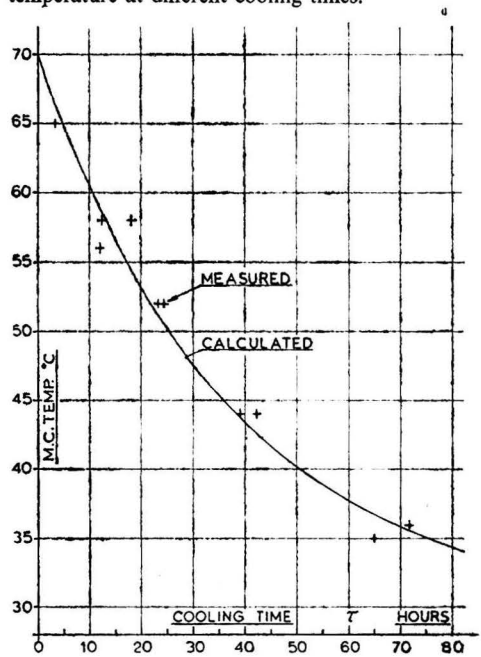

Fig. 2

Unfortunately we do not have available accurate initial massecuite temperatures nor those of the surrounding air, but most probably their averages can be assumed to be $T_0 = 70°$ and $t_1 = 30°C$.

For these conditions we have drawn the calculated cooling curves as shown in Fig. 2 in which also are indicated the individual massecuite temperatures actually measured at various cooling times.

The measured temperatures correspond satisfactorily with those on the calculated curve. This justifies the conclusion that the proposed formulae are suitable for the predetermination of cooling curves for massecuite in discontinuously working crystallizers exclusively exposed to natural cooling.

When during a cooling period the conditions are subject to great alterations in such a way that it becomes unpractical to work with constant averages (for instance considerable increase or decrease in air temperature) the cooling process can be split up into different periods and the calculations carried out for each period separately.

Acknowledgement

The author wishes to express appreciation to Mr. D. HOKS, technician of our Research Section, for the carrying out of the cooling tests and his further technical assistance.

Bolivian Sugar Industry Development

By Dr. H. KAMPF, F.R.I.C. (Chief, Sugar Industry Production, Bolivia)

THE fourth Session of the "Cómision Nacional de Estudio de la Caña y del Azúcar" (National Commission for the Study of Cane and Sugar) was held in La Paz, Bolivia, from the 10th to the 14th of April 1967. The Session was presided over by Dr. ROLANDO PARDO ROJAS, Minister of National Economy of Bolivia. It was attended by representatives of the Bolivian sugar factories, the cane growers of the Santa Cruz area, the directors and the staff of the Commission.

It was noted with great satisfaction that domestic consumption of white sugar was continuing to rise; from the 1st May 1966 to the 30th April 1967 consumption had increased by 10·3% compared with the corresponding period of 1965/66. At the end of the 1964 season Bolivia had a large surplus of about 22,000 metric tons of white sugar and it was decided to institute production quotas, boost the sale of sugar on the domestic rural market and increase exports. As a result of these measures there is at present no excess sugar in Bolivia. Furthermore for the period 1966–1971 Bolivia has received, under the new United States sugar programme, an annual quota of raw sugar and during the last season it was for the first time possible to produce and export 4681 short tons of raw sugar via the port of Antofagasta to New Orleans, La. The improved condition of the Bolivian sugar industry enabled the Government to raise the production quotas from 83,159 metric tons to 96,600 tons and 119,600 for the 1967 and 1968 campaigns respectively.

On the 12th April 1967 a supreme decree No. 07964 was issued fixing the quotas for each mill (as in table) for 1967.

During the last three years or so a new cane area has been developed at Bermejo in the Department of Tarija near the Argentine border. There the Corporación Boliviana de Fomento (Bolivian Development Corporation) is erecting a white sugar factory, the fourth in Bolivia. The equipment has been supplied by a Japanese combine, Kawasaki-Itoh.

	Quotas of white sugar				
Guabirá	680,000	quintals*	(31,280	metric	tons)
La Belgica	880,000	„	(40,480	„	„)
San Aurelio	540,000	„	(24,840	„	„)
Total	2,100,000	„	(96,600	„	„)

* 1 quintal = 46 kg

The daily capacity of the mill will be 1000 metric tons of cane; the trial run has been scheduled for December 1967 and full operation should start during the first months of 1968. For this initial period the mill, to be called Stephen Leigh factory, will have a free sugar production quota.

It is estimated that Bolivia uses annually non-caloric synthetic sweeteners such as saccharin, "Dulcin", cyclamate, etc., equivalent to 2,300 metric tons of white sugar. Just before the opening of the fourth session of the CNECA the Bolivian Government published a supreme decree No. 07959 dated the 7th April 1967 prohibiting the use of synthetic sweeteners in the manufacture of soft drinks or of sweets, chocolate and other confectionery products. As the Bolivian sugar industry is now in a position to supply sufficient refined sugar for the production of soft drinks and food processing, the import of saccharin and similar synthetic sweeteners has been strictly prohibited. For diabetic subjects and for the preparation of certain medicines pure saccharin etc. may be imported with the special authorization of the Ministries of National Economy and Public Health. It is believed that this is the first instance of Governmental protection of a domestic sugar industry against inroads by synthetic sweeteners.

Liquor Carbonatation

Part II. Flocculation of $CaCO_3$

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Introduction

In a previous paper[1] it was shown that the effect of impurities in liquor carbonatation could be demonstrated by the change in filtrability with $CaCO_3$ concentration (C). At high values of C, the average specific resistance ($\bar{r}$) of the cake is independent of C and different liquors show different values for $\bar{r}$ in this region. It was suggested that impurities affect the filtrability by some modification of the $CaCO_3$ crystallization processes.

Results were given for carbonatated liquors prepared using a miniature copy of the refinery plant and process. In this paper a complete departure from refinery practice is made in order to demonstrate the extreme sensitivity of the calcium carbonate crystallization to reaction conditions. As before, the behaviour of a West Indian liquor is compared with that of a South African, and a further indication of chemical interference by impurity is presented.

Experimental

Affined sugars were taken from the refinery while the required raw was on melt; the sugar was dried and packed in polyethylene bags.

The various methods of precipitating calcium carbonate are described more appropriately in the text below but they were all carried out at 75°C. The lime was British Drug Houses Ltd. "Extra Pure" $Ca(OH)_2$, which is manufactured from "Analar" (analytical reagent grade) $CaCO_3$. Cylinder CO_2 was diluted with air as indicated using flow meters.

Filtration measurements were made at 50 p.s.i.g., without the addition of filter aid. Results are quoted in terms of $\bar{r}$, the average specific resistance of the cake, and the filtrability term $\sqrt{F}$, where $F = 1/\bar{r}C$ and C is the concentration of $CaCO_3$. Reasons for the choice of these terms and experimental details of the filtration are given in the previous paper[1].

The extent of flocculation of the carbonatation precipitate was assessed by separating the flocs in a centrifuge and determining the quantity of calcium carbonate remaining in suspension. The separation was, of course, quite arbitrary; centrifuging conditions of 20 min at 1000 g were chosen so that the separation was not sensitive to small changes in time or g factor. The "stability" was defined as the percentage remaining in suspension under the chosen centrifuging conditions, and on this basis the stability was found to vary from 2 to 75%.

Calcium was determined using EDTA, carbonate by CO_2 evolution, and pH measured with a direct-reading E.I.L. meter at the temperature of the liquor; pH values quoted here are those of samples cooled to 20°C.

Results

(1) *Flocculation in the West Indian liquor*

Liquor was prepared at 65% solids and milk-of-lime was added to give 0·5% CaO on solids, the normal refinery dose; the limed liquor was maintained at 75°C in a water bath. Pure CO_2 was bubbled in through a sintered glass disc and samples of liquor were withdrawn for analysis.

In Fig. 1, curve (i) shows the precipitation of $CaCO_3$ as a function of $pH_{20°C}$; it is seen that the system was well buffered at pH 10·2 and that the precipitation was complete at pH 8·5. Flocs appeared in the system when the pH had fallen to about 10·1 and curve (*iii*) shows the quantity of $CaCO_3$ remaining in stable suspension after centrifuging. When points on curve (*iii*) are expressed as a percentage of the corresponding point on curve (*i*), the stability curve (*ii*) is obtained. It appears that the precipitation is characterized by the existence of a critical pH below which the mass of chalk particles flocculate. The change is illustrated by the photomicrographs in Fig. 2 (magnification × 1000) which show the $CaCO_3$

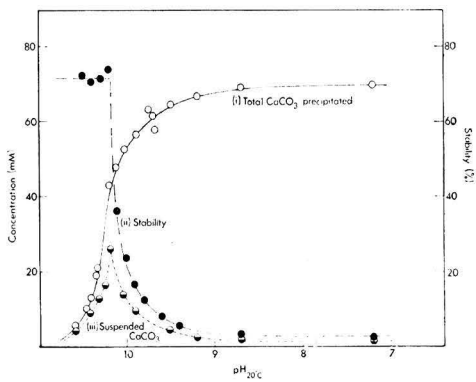


Fig. 1. West Indian liquor. The precipitation and flocculation of $CaCO_3$ as a function of pH.

particles (*a*) above and (*b*) below the critical flocculation pH. The curves shown in Fig. 1 were not changed when the precipitation time was varied between 30 min and 2 hr.

[1] Bennett: *I.S.J.*, 1967, **69**, 101.

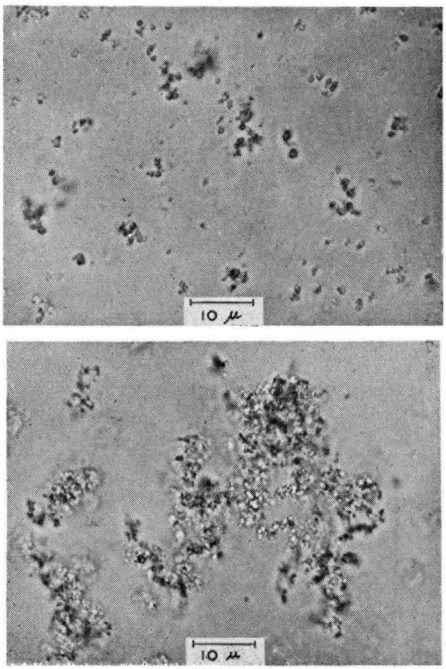


Fig. 2. West Indian liquor. $CaCO_3$ particles at ×1000 magnification (*a*) above and (*b*) below the critical flocculation pH.

By adding NaOH to the limed liquor before gassing, the precipitation of $CaCO_3$ was completed above the critical pH and no flocculation occurred. The pH could now be reduced either by the dropwise addition of HCl or by the continued passage of the CO_2 gas. In the former case, flocculation occurred at the same critical pH 10·1, and the stability curve was almost identical with that in Fig. 1. In the latter case, the flocculation was delayed until pH 8·8. The experiments serve to illustrate the important rôle of the electrolyte environment in determining the surface properties of precipitated $CaCO_3$. Unfortunately the equilibrium constants for the various dissociations are not known for 65% sucrose solutions; in water at 25°C a decrease in pH around 10 causes a marked increase in the concentration of Ca^{++} ions.

(2) *Filtration of the West Indian liquor*

When the various systems described above were filtered, very large values of $\bar{r}$ were measured. For example, the system described in Fig. 1 at pH 8·6 gave $\bar{r} = 278 \times 10^{10}$ cm/g while the system precipitated in presence of NaOH gave $\bar{r} = 200 \times 10^{10}$ cm/g. The filtration of systems not fully "gassed-out", (e.g. Fig. 1, at pH 10·0) gave values for $\bar{r}$ around 400×10^{10} cm/g.

These values are about 100 times greater than those which may be calculated from the operational data of a refinery filter station and, indeed, measured on liquor drawn from the refinery carbonatation tanks and filtered in the laboratory cell. Apparently, the laboratory carbonatation described by Fig. 1 yielded a $CaCO_3$ product entirely different from that of refinery practice.

One of the major differences between the two types of precipitation concerns the environmental conditions. In the laboratory carbonatation every particle of $CaCO_3$ was nucleated and grown in a slightly different environment, the first $CaCO_3$ to appear being formed in the presence of about 0·5% CaO as free lime, the last in zero free lime. This is not the case in the refinery carbonatation tanks where the reactants (lime and CO_2) are fed simultaneously and mixed into a large volume of liquor already at some pre-set condition, the rate of addition of reactants being regulated to preserve that condition. For a 3-tank continuous carbonatation plant operating with 25% free lime in the first tank, it is seen from Fig. 1 that with this West Indian liquor, the tank would show pH 10·1 and that effectively 75% of the $CaCO_3$ would be nucleated and grown in the environment described by pH 10·1.

The normal residence period for the carbonatation is one hour, so that with a 3-tank system, the average resistance period in each tank is only 20 min. On this basis, an experimental procedure was established to reproduce the conditions which exist in the first carbonatation tank without resorting to a continuous flow device. Two vessels were employed, a storage vessel and a carbonatation vessel, the latter being fitted with a CO_2 gas distributor and pH electrodes. The liquor was limed as before and placed in the storage vessel from which it was fed slowly using a peristaltic pump into the carbonatation vessel so as to complete the transfer in about 20 min; the CO_2 flow was adjusted to preserve a constant pH 10·1 throughout the transfer. This simulated the reaction in the first carbonatation tank and the partly carbonatated liquor could now be returned to the storage vessel in readiness for the second transfer, at a constant pH equal to that of the second carbonatation tank, say pH 9·5. Repeating the process a third time at, say, pH 8·2 completed the carbonatation in a total gassing time of one hour, the $CaCO_3$ having experienced the same environmental conditions as those of the refinery plant.

The first carbonatations using this technique gave values for $\bar{r}$ of about 20×10^{10} cm/g but considerable difficulty was experienced in controlling the pH and reproducibility was poor. A significant improvement was achieved when 10 ml of the limed liquor was gassed to the required pH before starting the transfer. This volume, representing about 4% of the total, provided seed for the subsequent $CaCO_3$ precipitation and was sufficient to cover the pH electrodes. Furthermore, the experiments became reproducible only when the CO_2 was diluted with air, about 20% CO_2 v/v proving satisfactory; this was presumably the effect of improved mixing caused by the much larger total volume of gas.

In Table I are shown the values for $\bar{r}$ obtained with different pH combinations; in experiment (c) the

first and second "carbonatation tanks" were combined and the carbonatation adjusted to take 40 min at the pH of the previous second tank. Further reduction in pH led to further improvement in the filtrability until eventually all three tanks were combined into a single constant condition precipitation taking 60 min [experiments (e) and (f)].

Table I. Carbonatation of West Indian liquor at 0·5% CaO on solids, total residence 1 hr

Experiment	*Carbonatation tank* pH_{20}°C (1) 20 min	(2) 20 min	(3) 20 min	*Filtration resistance* $\bar{r} \times 10^{-10}$ cm/g
a	10·3	9·6	8·2	26
b	10·0	9·6	8·2	15·4
c		9·6 (40 min)	8·2	6·1
d		9·4 „	8·2	4·5
e		9·0 (60 min)		3·2
f		8·4 („)		2·2

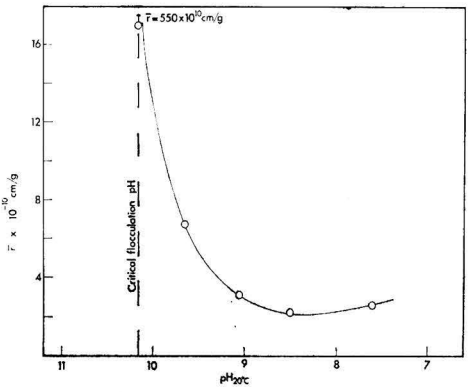


Fig. 3. West Indian liquor. Average specific filtration resistance ($\bar{r}$) *vs.* pH in single tank carbonatation at 0·5% CaO, 65% solids, 75°C and 1 hr reaction time.

Thus a simple procedure was established for studying the effects of changes in the environment upon the filtration behaviour of the precipitate. In Fig. 3 is shown the striking relationship between $\bar{r}$ and the constant pH for this homogeneous precipitation. It is seen that optimum filtration is obtained at pH 8·2 ($\bar{r} = 2{\cdot}1 \times 10^{10}$ cm/g) and that the curve approaches an asymptote at pH 10·1, the value of $\bar{r}$ at pH 10·1 being 550×10^{10} cm/g. It is to be noted that the asymptote lies at the critical flocculation pH shown in Fig. 1, and that $CaCO_3$ precipitated above this pH is, by the standard of refinery practice, unfiltrable.

The experiments above have all been carried out at a constant lime dose of 0·5% CaO. From the results of the previous paper[1] it was clear that lime dose has a most important bearing on the precipitation and so the effect of % CaO has been studied at the optimum pH $_{20°C}$ 8·2 found in Fig. 3. The changes in $\bar{r}$, $\sqrt{F}$ and suspended $CaCO_3$ (after centrifuging a separate sample of the carbonatated liquor for 20 min at 1000 g) are shown in Fig. 4. With increase in

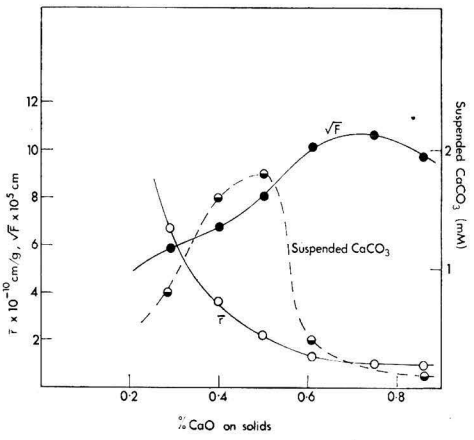


Fig. 4. West Indian liquor. Filtration and flocculation behaviour of carbonatated liquor as a function of lime dose in single tank carbonatation.

% CaO, $\bar{r}$ decreases to a plateau value $0{\cdot}92 \times 10^{10}$ cm/g, but, as the quantity of cake per unit volume of filtrate increases, $\sqrt{F}$ passes through a maximum around 0·7% CaO where $\sqrt{F} = 11 \times 10^{-5}$ cm. The suspended $CaCO_3$ concentration initially rises with % CaO, but then decreases sharply to a very low plateau value (0·1 mM) over the region where $\bar{r}$ is not sensitive to % CaO.

It is interesting to compare the values determined here with those actually obtained while this raw sugar was on melt at Plaistow Wharf refinery. For the two weeks concerned, the average lime dose was 0·68% CaO, $\bar{r} = 4{\cdot}4 \times 10^{10}$ cm/g and $\sqrt{F} = 4{\cdot}7 \times 10^{-5}$ cm. The 3-tank carbonatation plant over this period operated at pH 9·8, 9·0 and 8·3.

The values of r obtained in this investigation have varied from 550 to 0·92 ($\times 10^{10}$ cm/g). The decrease in $\bar{r}$, illustrated for example by the results in Table I, is largely attributable to the growth of $CaCO_3$ particles, and some examples are shown in the photomicrograph (at $\times$ 1000 magnification) in Fig. 5

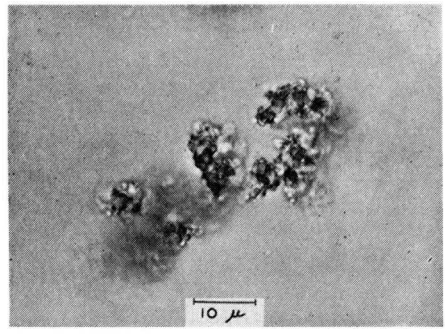


Fig. 5. West Indian liquor. $CaCO_3$ particles ($\times$1000) from single tank carbonatation at the optimum pH.

(single tank carbonatation, pH 8·5). The structure of these particles is seen to be that of a mass of individual crystals which have grown together to form a conglomerate, in some cases 10 μ in diameter; the structure is quite different from that of the floc shown in Fig. 2*b* at the same magnification. Here the forces holding individual crystals in the floc are so weak that the floc is destroyed simply by stirring, and under pressure filtration the floc collapses to behave as a cake composed of the unit crystals.

These structures allow one to distinguish two extreme types of $CaCO_3$ precipitation:

(a) $CaCO_3$ is nucleated in an environment where it exists as single crystals and these grow to almost final size before the system is flocculated (Fig. 2).

(b) $CaCO_3$ is nucleated in an environment where it is immediately flocculated and each floc grows into a conglomerate in which the constituent crystals have apparently fused together (Fig. 5).

(3) *Comparison with South African liquor*

To examine the flocculation behaviour of the South African liquor, the experiment described by Fig. 1 was repeated using this liquor at 0·5% CaO. A volume of the limed liquor was slowly saturated with CO_2 and changes in the precipitate followed as a function of pH. The result was similar to that shown in Fig. 1 but the critical pH was 10·6 compared with 10·1 while the minimum stability attained at $pH_{20°C}$ 8·0 was 15% compared with 2·5%.

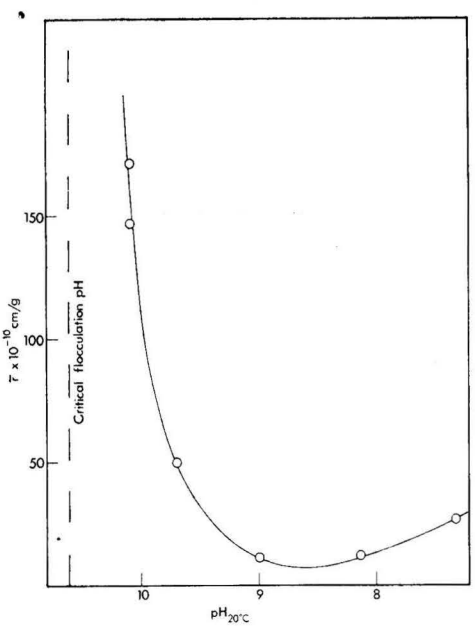


Fig. 6. South African liquor. Average specific filtration resistance ($\bar{r}$) *vs.* pH in single tank carbonatation at 1·2% CaO, 65% solids, 75°C and 1 hr reaction time.

It was clear that an appreciable quantity of the precipitated $CaCO_3$ in this liquor was not able to flocculate and that this was likely to have a profound effect on the filtrability of the carbonatated liquor. The actual concentration of $CaCO_3$ in stable suspension was found to depend on the lime dose used and increased to a maximum of 12 mM at 0·7% CaO, thereafter decreasing to around 7 mM at 1·2% CaO. In the West Indian liquor, the maximum concentration of $CaCO_3$ remaining in stable suspension after this type of heterogeneous precipitation reaction was only 2 mM.

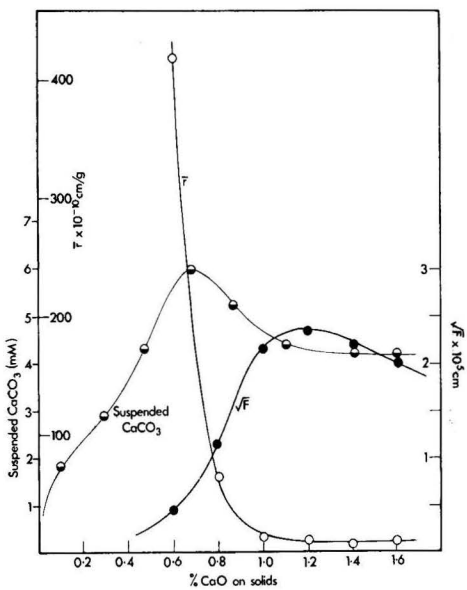
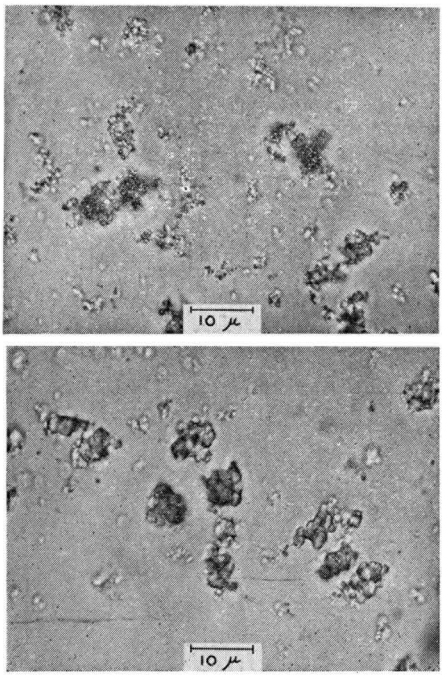


Fig. 7. South African liquor. Filtration and flocculation behaviour of carbonatated liquor as a function of lime dose in single tank carbonatation.

Using the technique of homogeneous precipitation at constant pH, i.e. "single tank carbonatation", the effect of pH was studied at constant $CaCO_3$ concentration. Following the results of the earlier paper[1], 1·2% CaO was chosen as the lime dose, giving 180 mM $CaCO_3$ concentration when fully gassed out; extra lime was therefore added for pH values above 9. The result in Fig. 6 shows a minimum value for $\bar{r}$ (4×10^{10} cm/g) around $pH_{20°C}$ 8·5 and an asymptote in the vicinity of the critical flocculation pH.

The effect of changes in lime dose on flocculation and filtrability has therefore been examined using this "single tank carbonatation" technique at constant pH 8·5. Graphs of $\bar{r}$ and $\sqrt{F}$ are shown plotted against % CaO in Fig. 7 which also shows the concentration of $CaCO_3$ remaining in stable suspension. At the lime dose for maximum $\sqrt{F}$, the concentration of suspended $CaCO_3$ was about 4 mM, a concentration rather lower than that obtained by the heterogeneous precipitation method above. This concentration is,

however, very much greater than the corresponding value for the West Indian liquor (ca. 0·1 mM) at the lime dose for its maximum $\sqrt{F}$ as shown in Fig. 4.



(a) (b)

Fig. 8. South African liquor. $CaCO_3$ particles (×1000) in carbonatated liquor at (*a*) 0·5% CaO and (*b*) 1·2% CaO, single tank carbonatation at pH 8·5.

Important features of the two types of carbonatated liquor are noted in Table II.

In accordance with the views expressed in the previous paper[1], it is suggested that the flocculation effect concerns an interaction between some impurity and the freshly precipitated $CaCO_3$ which prevents

Table II. Comparison of West Indian and South African carbonatated liquors

	$\bar{r}$ (min) ($\times 10^{-10}$ cm/g)	$\sqrt{F}$ (max) ($\times 10^5$ cm)	lime dose	$CaCO_3$ not flocculated
West Indian	0·92%	11·0 at 0·7% CaO		0·1 mM
South African	4·0	2·3 at 1·2% CaO		4·2 mM

conglomeration into massive particles. Photomicrographs of the precipitate obtained in the South African liquor at 0·5 and 1·2% CaO (constant pH 8·5) are shown in Figs. 8*a* and *b*, respectively, at × 1000 magnification. These products may be compared with that in the West Indian liquor at 0·5% CaO shown in Fig. 5.

It is concluded that a flocculation process plays a very important part in the crystallization of $CaCO_3$ in liquor carbonatation. In some liquors certain impurities can affect this flocculation process and the degree of conglomeration in the $CaCO_3$ is reduced, with a concomitant reduction in carbonatated liquor filtrability. However, once the crystallization of $CaCO_3$ is complete, further changes in the state of flocculation, brought about for example by addition of polymeric flocculants, have almost no effect on filtrability and it is for this reason that casual inspection by naked eye of carbonatated liquor before filtration does not necessarily provide any indication of its filtrability.

Sugar Cane Research in Queensland

66th Annual Report of the Director, Bureau of Sugar Experiment Stations, Brisbane, 1966

IN his introductory remarks the Director expresses the view that the most worrying problem of the Queensland sugar industry today is still the deterioration of sugar cane during the period between pre-harvest burning and the crushing of the cane, notably the deterioration of cut or harvested cane and the loss of sugar due to bacterial agency (*Leuconostoc*). This opinion was held last year and nothing has taken place to alter that opinion. If anything, there has been a hardening of opinion among Bureau research workers who have worked on the problem that the solution does not lie in using any chemical or antibiotic agency to inhibit the destruction of sugar which occurs as a storage rot. "The prevention of the deterioration of sugar cane requires the removal of certain industrial obstacles which lie in the way of reducing or eliminating the week-end carry-over of sugar cane stocks. The amount of money involved in c.c.s. losses to growers, and in processing difficulties and sugar losses to millers, makes it difficult to understand why a united approach is not made by all organizations engaged in the industry with the object of eliminating such a leakage in gross income. No industry which claims high production efficiency can support the claim while it allows the loss of much of the produced sugar because of a processing delay. The number of harvesters producing cut-up cane continues to increase and this must result in still greater amounts of sugar being destroyed by *Leuconostoc* bacteria. It is a curious paradox in a cost-conscious industry that, parallel with poor financial returns for the product, efficiency standards are — in the case of deterioration — being allowed to slip".

Irrigation

During the past twelve months detailed analyses of 383 samples of irrigation water were carried out by

the Bureau. This was an increase of some 30% over the previous year and indicates the cane growers' increasing interest in the quality of the irrigation water he uses.

It became possible to provide adequate irrigation facilities at the Bundaberg Experiment Station which should greatly enhance the value of the Station. Two of the Bureau's four experiment stations are now adequately provided for in regard to irrigation. The two remaining stations are in heavy rainfall areas where irrigation is not so vital. Since the inception of the Bundaberg Station, experimental work has periodically been rendered useless or inconclusive through insufficient rainfall. During the last 40 years various attempts to locate water for irrigation have not met with much success until now. Recent findings of deep water below the basalt formation prompted a further attempt at the Experiment Station and this met with success at a depth of some 240 feet. The exploration of such deep supplies has been made possible by modern, multistage bore pumps. There is now an adequate irrigation system, which, through underground mains, reaches every block on the Station. The principal hazard to experimental work at the Station has thus been removed.

Sugar cane nutrition

As it was considered desirable that fertilizer-variety interactions should receive more attention, several trials for this purpose were commenced. The long-term effects of cane growing and various fertilizer practices on the availability of such nutrients as phosphorus, sulphur, calcium, magnesium, copper, zinc and iron were also brought under more detailed investigation.

Further work in magnesium deficiency confirmed previous indications that the orange freckling of cane leaves in the Tully and Mossman districts was associated with a deficiency of magnesium. Observation plots were set out with magnesium carbonate at 560 and 2000 pounds per acre and magnesium oxide at 1000 pounds per acre in various combinations with lime, copper, zinc, iron, manganese and molybdenum treatments. Only in those plots to which magnesium had been applied was there any effect on the orange freckling and in most instances the freckling was eliminated. Where the magnesium had been applied before planting or where the cane had been very young at the time of application, improved growth also occurred.

Further experimental work with copper was commenced as the area of cane land subject to copper deficiency has increased considerably with the expansion of the industry into tracts of coastal sands. Field trials were designed to ascertain what the optimum rate of initial application should be. Lateral movement of the copper in the sandy soils was found to be considerable. Leaf and leaf sheath analyses indicated that there were marked differences in the copper contents of healthy and deficient plants.

Controlled climate house and breeding

As pointed out in the report, "It is claimed that all of the hybrid sugar cane varieties grown in the cane-sugar world today have been derived by intercrossing noble canes with only two or three of the many wild *spontaneum* types. This strange restriction of plant breeding activities stems from the fact that, despite a wide available range of *spontaneums*, some do not flower and others produce their inflorescence during a period which prevents crossing with other canes. Studies on photo-periodism and on the effect of temperature and humidity control have led to the development of controlled climate houses, with the help of which flowering may be induced and timed to fit into a normal cross pollination season. Such structures are not costly when compared with phytotrons, and give promise of allowing the introduction of many more *spontaneum* types into modern breeding programmes.

"With those new types may come a new range of genes which could affect such important characteristics in their progeny as thickness, sugar content, vigour, stooling, disease resistance, lodging, deterioration rate, etc.

"The controlled climate house at the Meringa Sugar Experiment Station came into operation early this year. Immediate results, not otherwise attainable, were achieved. Twenty-nine *spontaneum* varieties were subjected to the flowering induction treatment and, of those, nineteen produced flowers at the predetermined time when crossing with field-grown nobles or hybrids could be performed....Twenty-three crosses were made with the *spontaneum* flowers, thus creating the foundation for cane breeding programmes which were never previously possible."

Cane variety position

The variety Pindar retained the position of leading variety in the State but its pride of place is being threatened by the variety N:Co 310, which is now responsible for some 2¾ million tons of cane or about 17% of the total crop, compared with 20% for Pindar. The Queensland variety Q57 ranks third, with no marked change in regard to other commercial varieties. New releases in the northern cane districts, notably Q 77, Q82 and Q 83, may well reduce the amount of Pindar grown. It is also thought that the varieties Q 78 and Q 83 may make big inroads on the area devoted to Q 57, which for several years has been the major variety of the wetter districts of the far north.

The development of a number of promising new varieties led to a number of changes in the approved lists for 1966, The variety Q 83, one of the most promising to be developed for many years, was approved for growing in all eight mill areas from Tully northwards. It is thought that rapid propagation in these areas may lead to large tonnages within the next few years.

Among varieties removed from approved lists was POJ 2878, better known as "Java" or "wonder cane".

It "was once amongst the leading varieties in the State and, in fact, of world-wide importance. In Cuba it still assumes a major rôle and it is a little sad to see this variety which, in the past, meant so much to southern Queensland, finally making its journey to the Valhalla of all once-good varieties."

Pests

A notable feature of pest damage to cane during the year was the damage done by rats. This was estimated at over 48,000 tons of millable cane, as compared with some 16,000 for 1964. Most of the loss, i.e. 44,360 tons, took place in areas north of Townsville. Observations on the life history and habits of *Rattus conatus* and *Melomys littoralis*, by far the two most destructive pests, are recorded. Among losses from other animal pests, that from wallabies (6062 tons) was higher than usual, largely due to drought depriving animals of natural grasses. Wild pigs destroyed an estimated 1581 tons of cane in central and northern areas and the striped phalanger 426 tons. Among birds the white cockatoo destroyed 112 tons (on 32 acres), less than in some previous years.

Experimental work was continued on a large number of insect pests, directed in the main to improving methods of control. Major pests included cane grubs (greyback grub, *Dermolepida albohirtum*, and frenchi grub, *Lepidiota frenchi*), soldier fly, Rhyparida grub (*Rhaparida dimidiata*), and funnel ants. Other, minor, pests which also received attention were ground pearls (*Eumargarodes laingi*?), cicadas, wart eye mites, army worms, small and large moth borers, black beetles, wireworms, termites, scale insects and grasshoppers.

Diseases

The unusual season resulted in some abnormalities in regard to cane diseases. Drought conditions also had a serious and sometimes nullifying effect on some of the disease resistance trials. In the far north, Pindar, the most important variety, was severely affected with yellow spot in many areas. Despite widespread yellow spot, c.c.s. at the beginning of the season was higher than in 1964, which was also a bad yellow spot year. It is thought that the earliness of the development of the disease allowed cane to make sugar at the normal time. Dry conditions also increased the incidence of leaf scald in many districts.

With regard to ratoon stunting disease an account is given of trials designed to throw some light on what might be done to prevent poor germination which sometimes results after the long hot water treatment of setts. The number of days between cutting and hot water treatment was varied, but heat treatment was always given just before planting. Results indicated that delay between cutting and heat treatment may be an advantage.

Work on chlorotic streak disease (probably a virus) was designed to find out the minimum exposure required for transmission of the disease. Results showed that an infection period of one hour was adequate (under the conditions of the experimentl. They also showed that waterlogging is not essentia) to virus multiplication once infection has occurred.

Work on the deterioration of chopper-harvested cane (through *Leuconostoc* bacteria) was continued without yielding any promising results. Fumigation tests were carried out with billets or cut cane enclosed in gas-proof containers with alcohol, chlorine from calcium hypochlorite, and formalin. The last showed some effect in reducing deterioration and it was noted that fumigation could be commenced up to six hours after cutting without any noticeable increase in deterioration in comparison with the billets placed in the vapour immediately after cutting. A fumigation period of at least 24 hours was necessary. It would appear that the fumigation treatment was hopelessly uneconomical.

Weed control

A number of experiments were carried out in connexion with control of the giant sensitive plant (*Mimosa invisia*) which was reported from two new areas far removed from known infestations. The promising results with "Picrolam" in 1965 led to further trials being conducted. "Picrolam" + 2,4-D and TBA-MCPA combinations were also tried. Results indicated that TBA-MCPA is only effective against young plants, "Picrolam" + 2,4-D is more effective against well-grown plants, while the "Picrolam" + 2,4,5-T ("Tordon M2962") mixture was effective on plants at all stages of growth. In general results with the "Picrolam" + 2,4-D mixture by either aerial or ground spraying were not superior to the commercially applied mixture of 2,4-D + 2,4,5-T. At the current price of "Picrolam" + 2,4-D it is considered unwise to promote general use of this product for giant sensitive plant control.

Work on the eradication of various troublesome grasses and other weeds, including sedges, is reported. "Bromacil" proved effective in controlling Para grass (*Brachiaria mutica*), responsible for blocking important drains. The overall cost of the "Bromacil" treatment was considered to be competitive with the more normal drain cleaning operations using 2,2-DPA. Water hyacinth (*Eichhornia crassipes*) proved susceptible to two applications of 2,4-D amine at 2·5 lb a.i. plus 0·5 per cent surfactant per acre per application, spaced 3 to 4 weeks apart or when regrowth occurred. Application by boom spray or power mister proved 100% effective but the effectiveness of aerial application needs further investigation.

F.N.H.

Austria-Czechoslovakia trade a reement[1].—Under a new long-term trade agreement between the governments of the two countries, Czechoslovakian sugar will be imported by Austria free of duty and quota restriction.

[1] C. Czarnikow Ltd., *Sugar Review*, 1967, (811), 81.

Sugar cane agriculture

A study of juice analysis as diagnosis for sugar cane nutrition. C. S. YEH and C. S. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (40), 127–172.—This consists of three separate papers: (Part III) Trends of juice N content in the stubble within a stool at different stages of growth (by C. S. YEH), (Part IV) Juice nitrogen of basal internodes in relation to cane yield at harvest time, and (Part V) Effect of nitrogen top dressing on the yield of sugar cane.

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Effect of soil alcohols upon young plant growth. T. T. CHUANG, T. S. C. WANG and M. B. TSAI. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 1–8.—The effect of methanol, ethanol, *n*-propanol and *n*-butanol on young plants of sugar cane, maize and rice was tested in water culture at different concentrations. In general the more concentrated the solution the more was growth restricted. The more carbon atoms an alcohol contained the more toxic it was. The sensitivity of cane and rice to the alcohols was about equal but *n*-propanol at dilute concentration and methanol promoted the growth of young sugar cane.

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Effect of soil phenolic acids upon young plant growth. T. K. YANG, T. S. C. WANG and M. B. TSAI. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 9–18.—The toxic effect of phenolic acids (syringic and ferulic), at different concentrations on young sugar cane plants was studied. At concentrations of 150 p.p.m. and above root growth of cane was severely depressed. The roots were more sensitive than the aerial parts.

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Effect of soil aliphatic acids on young cane growth. H. TUNG, S. Y. CHEN and T. S. C. WANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 45–50.—The investigations were carried out in water culture with a number of acids. At the higher concentrations all the acids suppressed cane growth although not significantly. At the lower concentrations most of the volatile acids suppressed growth whereas most of the dibasic or hydroxy acids promoted it.

* * *

Studies on increasing soil nitrogen in Taiwan sugar cane fields. J. J. SHIUE. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 57–68.—This investigation was undertaken to study the factors concerned with the fixation of nitrogen in the soil. Sunlight, water, carbohydrate material (bagasse, cane trash and glucose were used), phosphorus and lime were the important factors. The growth of nitrogen fixing green algae under different conditions was observed.

* * *

A preliminary investigation on the mechanical composition of stony, gravelly soils in relation to sugar cane yield. L. H. LEE and S. T. LIUO. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 87–96.—Much of the cane land in Taiwan is of a stony, gravelly nature, better land being used for food crops. Sugar cane yield decreased with increasing percentages of stones or gravel. In the top 30 cm layer 57·2% of the cane roots were located, in the next 30 cm 28·2% and in the 60–150 cm layer 15%.

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Experiments on irrigation, fertilizing and tillage depth in growing cane. T. P. YEH, K. T. WEI and C. T. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1966, (41), 129–144.—Depths of tillage were 15, 20 and 25 cm. Deep tillage increased yield of cane but was not statistically important. In general deep tillage along with fertilizers (N, P and K) and irrigation gave the highest yields as might be expected.

* * *

Effects of fertilizer on sugar cane characteristics. ANON. *International Fertilizer Correspondent*, 1966, **7**, (10), 1146.—Long term experiments at Mount Edgecombe and Chaka's Kraal (Republic of South Africa) are referred to. Mixed fertilizer (100 lb N: 80 lb P_2O_5, 200 lb K_2O) on the third ratoon gave double the yield from unfertilized plots. Efficiency of all ratoons was maintained by fertilizer treatment. In a fifth ratoon fertilizer/trashing experiment the effects of K were isolated and yield response was significant.

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Mineral composition of sugar cane tissues as affected by applications of lime and phosphate in Hawaii. A. J. RIXON and G. D. SHERMAN. *Trop. Agric.*, 1966, **43**, 295–305.—In parts of Hawaii the volcanic soils have relatively large proportions of iron and aluminium and are deficient in calcium. The significant increase in yield of sugar cane in response to the combined lime and phosphate treatments on soils of the Hilo series was not reflected in the mineral constituents found in either the basal node or root tissue of sugar cane produced on these soils. It is considered there is need to study other factors of the soil-plant relationships in these unusual soils.

Thirteen new varieties on secondary increase stations. L. L. LAUDEN. *Sugar Bull.*, 1966, **44**, 360.—Some details are given of these new varieties, not yet released, for American cane growers. Some of these varieties have both high sugar per ton and high yield of cane per acre. Two have good mosaic disease resistance and one will require little or no rogueing. The writer holds the view that the variety outlook for the future in the United States is brighter now than at any time in the past.

* * *

The transportation service of (the) Taiwan Sugar Corporation railway. H. Y. CHEN. *Taiwan Sugar*, 1966, **13**, 7–9, 17.—An account is given of the functions of this busy railway in Taiwan, which serves 25 sugar mills, the total length of track being 3200 kilometres. It also transports passengers from village to village. In the milling season some 60,000 metric tons of sugar cane for the mills are transported every day as well as 10–15,000 metric tons of sugar or by-products.

* * *

Recent developments of chemical weed control at Nanchow. J. C. CHOU. *Taiwan Sugar*, 1966, **13**, 13–17.—Chemical weed control in sugar cane fields was commenced at Nanchow in 1959, the two herbicides 2,4-D and "Karmex" proving to be the most suitable. In this paper later work involving the use of wetting agents or surfactants such as surfactant WK and detergent powder (sodium lauryl sulphate) is described. These proved markedly beneficial, raising the effectiveness of the herbicides with some possible reduction in dosage rates for equal results. The names of the more troublesome weeds are given.

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A study of salt-affected soils in Taiwan. T. C. JUANG *Taiwan Sugar*, 1966, **13**, 18–21.—In Taiwan there are more than 300,000 hectares of salt-affected soils; these are located on the west coast. With the present population pressure it is desirable that they be used. This study is concerned with saline soils where sugar cane will not grow or its growth is restricted. Analyses are given of a wide range of soil samples. In many areas salt may be washed out with regular leaching practices, given favourable drainage.

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Water loss in irrigation canals in central Luzon. E. L. GATUS and O. G. FLESTADO. *Sugar News*, 1966, **42**, 299–300.—Experiments carried out to determine conveyance and delivery losses of water in irrigation canals are described. Results from two soil types only (clay loam and silty loam) showed losses of 45 and 38 litres per hour per square metre of canal wetted surface.

* * *

Progress at Sucoma. A. MCMARTIN. *S. African Sugar J.*, 1966, **50**, 857–863.—A description is given of the rapid developments that have taken place with a sugar cane project in the Shire River valley, Malawi (formerly Nyasaland), where sugar is now being manufactured. Details are given of certain of the climatic and soil conditions, sources of seed cane and varieties so far established or cultivated. Irrigation and pests and diseases known to exist are also discussed. Initially the area planted was 3-4000 acres, with great possibilities for expansion.

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Taiwan Sugar Corporation's deep wells. W. C. HSU. *Sugar y Azúcar*, 1966, **61**, (10), 37–40.—The Taiwan Sugar Corporation is one of the world's largest sugar manufacturing companies and has some 45,000 hectares under cane. Available surface water is largely needed for irrigating the staple food crop, rice, and hence deep wells are of value in providing irrigation water for cane. The significance and maintenance of these wells is discussed, 150 being in existence in 1965. The average life of a deep well is 15 years.

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That grub again. ANON. *Australian Sugar J.*, 1966, **58**, 395–396.—Severe damage to cane crops in the Mackay district by the grey-back grub is described. This has been due to many growers failing to take the well-tried precautions, i.e. use of BHC dust, probably on account of the stringent financial situation. The correct methods of using the dust are outlined.

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Double-truck trailer with rock-'n'-roll axle does good work in wet areas. ANON. *Australian Sugar J.*, 1966, **58**, 407.—A description is given (with photograph) of a two-truck trailer, handled by a light Ferguson tractor. The trailers are fitted on either side with a rocking beam, pivoted at the centre, which carries the wheels so that they are in tandem. This allows the wheels to move up and down and imparts a walking motion enabling the unit to function very successfully under wet and uneven conditions.

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Back-end loader. ANON. *Australian Sugar J.*, 1966, **58**, 409.—A description is given of a modification made to a Toft Junior "Hydroload" used in conjuction with a Venton harvester. The lift is at the rear of the tractor which is modified so that it may be driven backwards during the loading operation. With the grab in this position the weight is mainly on the large back wheels of the tractor instead of the small front wheels, which are liable to sink into moist soil, making steering and manoeuvring difficult.

* * *

Reduction in yield due to cane tasseling can be minimized. ANON. *Sugarland*, 1966, **3**, (4), 42.—It is pointed out that in the Philippines the adverse effect of flowering on the quality of the cane may be prevented or minimized by restricting planting to the period July to October, whereby the canes are harvested before they reach the flowering or tasseling stage. Spraying with certain chemicals such as "Diquat", CMU and maleic hydrazide is another method of control.

Swivel-head grab loader. ANON. *Australian Sugar J.*, 1966, **58**, 393.—A new type of hydraulic swivel-head loader operating in Mackay and designed to rotate in a complete circle is described with photographs. It may be attached to the much-used ordinary type of front-end loader, a boom and adaptor replacing part of the original grab assembly. It is claimed that an important feature of the grab is that it avoids the pushing up of dirt when gathering a load of cane.

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Break-row cutter which also tops the cane. ANON. *Australian Sugar J.*, 1966, **58**, 413.—A description is given of an efficient break-row cutter that has been operating in the Innisfail district. The machine tops the cane in the row to be cut as well as cutting it at ground level.

* * *

Fertilization in Luzon with special regard to nitrogen. M. B. LOPEZ and R. R. COVAR. *Sugarland*, 1966, **3**, (5), 16–21.—The results of seven years of trials by the Philippine Sugar Institute with nitrogen fertilizing of cane in different parts of Luzon are discussed. Recommendations for nitrogen application for different parts of Luzon and Visayas are given in tabular form.

* * *

Mechanical harvesting of green cane at Babinda. ANON. *Australian Sugar J.*, 1966, **58**, 315–318.—A description is given, illustrated with a dozen photographs, of modifications to a Massey-Ferguson chopper harvester and alterations made to the chopping mechanism. An inspection of the bins on reaching Babinda mill classed them, for all practical purposes, as 100% clean cane as far as trash, tops and dirt were concerned.

* * *

What makes for poor or good germination. ANON. *Victorias Milling Co. Inc. Expt. Sta. Bull.*, 1966, **13**, (7 & 8), 3, 5.—The advantages of the 3-eye sett in planting sugar cane are discussed, as is the value of dipping setts before planting (in "Aretan" or PMA).

* * *

Sugar cane pests in Brazil. P. GUAGLIUMI. *Brasil Açuc.*, 1966, **48**, (3), 8–11.—This is a report or account of a lecture by Prof. PIETRO GUAGLIUMI on two sugar cane insect pests of Brazil ("Cigarrinhas"—*Mahanarva indicata* and *Sphenorhina liturata*). Their distribution, prevalence in Brazilian sugar cane areas, nature or severity of the damage caused and remedial measures are discussed.

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Sugar cane in the Amazon region. C. PASSOS. *Brasil Açuc.*, 1966, **48**, (3), 12–14.—The main sugar cane producing areas and the varieties of sugar cane at present cultivated for factory-produced sugar are outlined. Some brief notes on cultivation, fertilizers, pests and diseases are also given.

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Two egg-parasites of the sugar cane borer. H. D. DE SOUZA. *Brasil Açuc.*, 1966, **48**, (3), 19–22.—A discussion on the life history and behaviour in Brazil of two insects that parasitize the eggs of the sugar cane borer (*Diatraea*) is given, these parasites being *Trichogramma minutum* Riley and *Telenomus alecto* Crawford. The difficulties that are associated with laboratory breeding of the insects are pointed out.

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The cultivation of sugar cane (in Brazil). P. DE OLIVEIRA L. *Brasil Açuc.*, 1966, **48**, (3), 25–31. Climatic and soil requirements of sugar cane, as they apply in Brazil, are discussed along with the question of choice of varieties of cane. Preparation of the soil, selection and treatment of seed cane and planting are also dealt with.

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A survey of the pH status of the soils of Puerto Rico. G. SAMUELS. *Tech. Paper Agric. Expt. Sta. Puerto Rico*, 1966, (42), 33 pp.—Sugar cane is naturally included in the major crops discussed. It is grown in almost all areas of Puerto Rico and the range of pH is wide, with 43% of the cane area soil below pH 6 and 57% above. Some 36% of the cane soils are within the pH range of 3·8 to 5·4 and need liming; they amount to approximately 123,000 acres, and are mainly in the humid, northern, mountainous areas of the country.

* * *

Incidence of brown stripe disease of sugar cane in Puerto Rico. J. ADSUAR and L. J. LIU. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 73–75.—The results are given of a survey of this disease (*Cochiobolus stenospilus*) in Puerto Rico, carried out because of its increasing prevalence and the damage it causes. A number of cane varieties not previously recorded as being attacked, are quoted. In some areas incidence was severe. The apparent resistance and susceptibility of 110 seedling selections is recorded. It is considered that susceptibility is not controlled by a single dominant factor, but seems to be polygenic in nature.

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Occurrence of banded chlorosis of sugar cane in Puerto Rico. L. J. LIU, T. ROSARIO and F. MÉNDEZ-ROIG. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 76–81. Results of a survey are given, concern having been felt because a promising new variety (P.R.1059) has been found to be attacked by the disease. Outbreaks were noted to be chiefly where high air temperatures prevailed. The causal agent of the disease was not established; it may be physiological.

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The oxidizing enzymes of sugar cane: cytochrome C oxidase. A. G. ALEXANDER. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 131–145.—The distribution and properties of cytochrome C oxidase in sugar cane was studied. Fractionation of cane extracts with $(NH_4)_2SO_4$ showed this enzyme to be precipitated at a saturation range corresponding to little or no tyrosinase precipitation, so that the latter may mask the action of the cytochrome C oxidase in crude cane preparations. Richest source of the oxidase was root tissue, while moderate activity occurred in meristem tissue, and some in sheath and node preparations. The enzyme was not adversely affected by freezing but was inactivated by boiling for 5 min. The significance and potential rôles of the enzyme in sugar cane are discussed.

Sugar beet agriculture

A harvest plan. D. RACKHAM. *British Sugar Beet Rev.*, 1966, **35**, (1), 12.—With 95% of the total sugar beet harvest in Britain now harvested by machines which can lift two acres or more per day, the concrete loading base is proving its worth, especially in wet seasons, and more and more are being laid down.

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Mangold clamps, a frequent source of sugar beet aphids and virus yellows. ANON. *British Sugar Beet Rev.*, 1966, **35**, (1), 24–27.—The danger of mangold clamps harbouring aphids capable of infecting young sugar beet plants with virus yellows is pointed out. Three colour photographs show leaves infected with beet yellows (BYV), beet mild yellowing virus (BMYV) and an infected field. The latter was taken from the air and shows clearly the spread of infection from a mangold clamp.

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Mechanical harvesting of sugar beet in Belgium. ANON. *Publ. Vulg. Inst. Belge pour l'Amél. Betterave*, 1966, (2), 10 pp.—In Belgium, as in other countries, mechanization in sugar beet cultivation and production has arrived as a permanent feature in the farming community. This bulletin, in simple terms and with diagrams, explains the advantages to be gained from the formation, among Belgian sugar beet farmers, of small groups for acquisition and operation of mechanization equipment, especially thinners.

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Control of *Cercospora* leaf-spot of sugar beet with ultra-low-volume oil-based fungicidal mists. C. L. SCHNEIDER. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 563–565.—Three different treatments utilizing petroleum spray oil reduced leaf spot severity and caused a proportionate increase in gross sugar, root weight and sucrose percentage. Results demonstrated the efficiency of oil-based ultra-low-volume fungicide mists in controlling the disease. Further studies with different oils and dosages are recommended.

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The host range of the sugar beet nematode. *Heterodera schachtii*. A. E. STEELE. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 573–603.—Wild and cultivated plants known to be host plants of the sugar beet nematode are listed according to families in a table occupying some 24 pages. Many of the species are common cosmopolitan weeds. Degree of infection as recorded in California or Arizona is indicated.

***Heterodera schachtii* in relation to damage from root rot of sugar beets.** C. PRICE and C. L. SCHNEIDER. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 604–606. Reasons are given for the belief that sugar beet seedlings subject to attack by this sugar beet nematode are more prone to attack by damping-off fungi than are healthy plants.

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Weight of fruits in self-fertile, male-sterile and self-sterile diploid and tetraploid monogerm *Beta vulgaris*. V. F. SAVITSKY and H. SAVITSKY. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 621–644.—Replacement of multigerm sugar beet varieties by monogerm varieties is said to be approaching completion in the U.S.A. and the second phase of breeding monogerm varieties is starting. The weight of the fruits and germs of monogerm beets is known to be of practical importance in determining the quality of seed. The availability of monogerm self-sterile and self-fertile populations made it possible to obtain information concerning environmental (years, soils, locations) and genetic variability of the weights of fruits and germs. Environment was found to be an important factor in causing variability of the weight of monogerm fruits.

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Laboratory screening tests of insecticides for control of the beet webworm. W. E. PEAY. *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 645–648.—With increasing use of sugar beet tops as livestock feed in the U.S.A. the question of possibly harmful insecticide residue on the leaves becomes of more importance. Tests carried out with a large number of new materials for the control of the beet webworm (*Loxostege sticticalis*) are reported, results being given in a table. Several gave 100% mortality. Materials that gave the best control and which are registered for use on sugar beet tops were—"Naled", "Phosphamidon", and "Trichlorfon". Those that gave only fair control were "Carbaryl", "Carbophenothion" and "Parathion".

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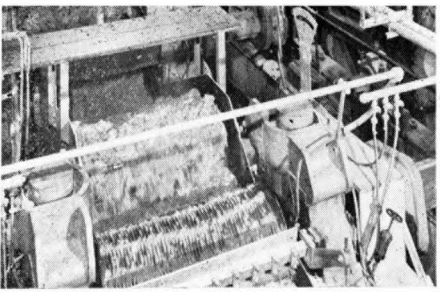
Root-top-ratio and maturity quotient in relation to sugar yield. H. LÜDECKE and M. NITZSCHE. *Zucker*, 1966, 19, 391–396, 421–427.—Results are given of analyses carried out every ten days during the growing seasons from 1959 to 1965. It was concluded that the root/top ratio was no criterion of the state of maturity but that the maturity quotient (ratio of sugar to sodium) was an index of maturity.



Cane sugar manufacture

Fuels and furnaces. P. R. A. GLENNIE. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 64–68. Development of bagasse furnaces is discussed from the original Dutch ovens to the spreader stokers which have taken over almost completely in South Africa. The various fuels available are compared and difficulties in design of a furnace for multiple fuel use are mentioned. Design features with hearth-type and spreader firing furnaces are discussed and the line of future development predicted.

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Steam and vapour distribution. R. E. MARSH. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 69–78.—The problems arising in a sugar mill concerning distribution of steam—of various types—and vapour are discussed and the benefits of preparing flow sheets during initial planning are described. Points to be considered in achieving steam economies are mentioned and detailed attention given to aspects of steam piping—size, wall thickness, bends, expansion and supports—as well as to steam valves, thermal insulation and condensate.

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Conditioning boiler feed water for the sugar mill. G. E. ANGUS. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 79–88.—The nature of minerals and other impurities in water is briefly discussed as is the need for conditioning of feed water to be used in sugar industry boilers, some of which now operate at 400 or even 475 p.s.i.g., compared with 160–200 p.s.i.g. in older plants. Scale formation, foaming and steel corrosion in the boiler are referred to, and other effects of impurities such as damage to superheater and turbines and corrosion of non-ferrous metals in the boiler and gauge glasses. External forms of conditioning are surveyed; these include clarification and filtration, precipitation softening, ion exchange, evaporation and de-aeration. Internal conditioning involves the use of softening chemicals to react with feed water hardness, sludge conditioners to prevent its sticking to metal surfaces, oxygen scavengers and alkali to prevent corrosion and anti-foams to prevent carry-over. Attention is given to caustic cracking or embrittlement of boiler steel, and to oil contamination of boiler feed water.

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Economical design and operation of process heat exchange equipment. E. J. BUCHANAN. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 89–101. It is shown that sugar industry practice based on experience agrees generally with results of the application of chemical engineering principles in heat exchange problems. However, in the absence of practical experience, designs tend to be oversized to allow for unknown factors. A gross example is quoted where a heater with a heat transfer coefficient of 450 B.Th.U./hr/sq.ft./°F had this reduced by internal and external fouling to 157 and yet was still able to meet the duty for which it had been installed. The harmful effect of heavy scaling on heat transfer, and on the rate of heat transfer increase with higher flow rate, are discussed. Since fouling in a heat exchanger masks the effect of operating variables it is easier to design for a fouled unit than for one to operate with optimum performance. Reference is made to the literature concerning economical waste heat recovery, and achievement of economy by recovery of flashed vapour and by juice control is discussed. Recent trends in heating economy are reviewed, including optimum design of a heater by a computer, and increasing condensing film and liquid film coefficients.

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Process steam production, use and control. D. T. O. GRIFFITH. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 102–107.—Aspects of steam production, use in turbines, reducing valves, desuperheating, control of temperature or pressure, steam trapping, draining and venting, and heat losses, are discussed.

* * *

Boiler operation, maintenance and testing. S. G. HOLTON. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1967, 108–112.—Aspects of boiler operation which are discussed include combustion, fuels, adjustment to firing equipment and keeping records, automatic control, care of superheaters, steam quality and purity, blowing-down, balanced draught, economizers, water-washing and soot blowing. Boiler maintenance is discussed briefly in two sections: checking and overhaul, and cleaning and inspection. The three methods of testing boiler efficiency are discussed, i.e. the overall, direct and indirect methods.

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Steam trapping and condensate conservation. J. M. CARGILL. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 132–134.—The savings which can be achieved by condensate trapping for use as boiler feed water are demonstrated and the various types of steam trap summarized. The condensate should be that produced from steam rather than juice vapour,

to minimize contamination, and sources are listed. Surplus condensate should be used in process for imbibition, washing in the centrifugals and filters, for lime dilution and for pump gland sealing.

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Residual fuel oil as a supplementary fuel. J. GUDMANZ. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 135–141.—The need for supplementary fuel in South African sugar mills steam raising plant has been met in the past with solid fuels—coal and wood—but fuel oil could serve the same purpose. The economics of oil fuel, its nature, storage, handling, firing equipment, pumps, preheaters, filters, etc., are described as are pressure sustaining valves, lagging of fuel pipes, oil burners, ignition systems and operating conditions. The same fuel can be used for operation of large stationary diesel engines instead of the lighter diesel fuels.

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Steam economies at Darnall. D. J. L. HULETT. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 142–148.—An account, with diagrams, is given of the changes made in the boiler plant at Darnall sugar factory whereby the amount of supplementary fuel required has been reduced substantially notwithstanding a large increase in water evaporated in the factory.

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How to measure and express sugar mills efficiencies. T. H. FOURMOND. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 149–151.—The yardsticks Lost Absolute Juice % Fibre and Extraction Ratio (Sucrose in Bagasse % Fibre in Cane) are examined as measures of milling efficiency and it is concluded that the second is the better. But it is better still to express this efficiency as a proportion of what is attainable in practice and a standard Extraction Ratio of 20 is suggested. Boiling house performance, or crystallized sucrose in sugar % crystallizable sucrose in mixed juice, takes into account the retention of sucrose in molasses by non-sugars, the retention factor depending on the purity. It is pointed out that the clear juice non-sugars are less than those of mixed juice so that retention factor applied to clear juice gives a truer picture of final molasses purity which may be attained. An overall performance yardstick, for use by mill managers to judge factory work as a whole, is obtained by multiplying the two efficiency figures for the mills and the boiling house.

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Alterations and improvement to Mount Edgecombe milling tandem. R. C. TURNER. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 152–161.—Major alterations were made to the milling tandem at Mount Edgecombe during the intercrop between the 1963 and 1964 seasons in order to raise the capacity from 170 to 200 t.c.h. These are reported and illustrated, together with the modifications which had to be made during the 1964 crop to maintain production. Further modifications were made during the 1964/65 intercrop, based on experience gained with the first season of operation of the new plant. Additional modifications were required during the 1965 crop. Conclusions and opinions are given, based on the successful 1965 crop.

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The electrical supply system of sugar factories. A. GRADENER. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 162–170.—General aspects of designing the electrical equipment of a modern sugar factory to arrive at the most economical and practical solutions are discussed. Emphasis is placed on the importance of power involved and short circuit conditions occurring. The influence of physical layout of the factory with regard to electrical systems is mentioned. The dimensioning of alternators, switchgear, cables and motors is discussed in detail.

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Phosphoric acid as an aid to clarification and observations on liming techniques and mud volumes. G. G. CARTER. *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 171–180.—The laboratory clarification test described by DAVIS was examined and found to be applicable to juices at Tongaat sugar factory. The best sequence of liming was found to be to heat the juice to 160°F, allow to stand for 10 min, lime to pH 7·6 and heat to boiling. Liming after heating —the factory practice—produced a faster settling rate but the supernatant juice was darker and hazy. The darkness may have been due to the use of more lime than in the factory. Addition of 100 p.p.m. of phosphoric acid before hot liming improved clarity and factory trials showed that there was an improvement in the removal of phosphate by 4·5%, of silica by 30% and lime content by 36%, causing an improvement in clarity and increasing the capacity of the clarifiers.

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Entumeni's diffusion plant in operation. ANON. *S. African Sugar J.*, 1966, **50**, 959.—The De Smet continuous diffuser for cane installed by Patrick Murray (Pty.) Ltd. in the Entumeni sugar factory has been commissioned. The diffuser has 11 liquid circulations and residence time for the cane is 45 minutes. Sucrose extraction at Entumeni has reached 97·2%, compared with the South African average of 93·99%, while the unit affords a considerable reduction in power consumption.

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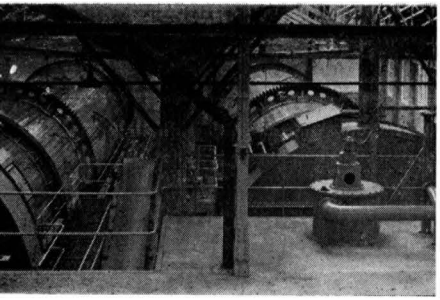
Bogo-Medellin Milling Co. Inc. ANON. *Sugarland*, 1966, **3**, (6), 28–35.—A brief illustrated description is given of the Bogo-Medellin sugar factory, built in 1928, which produced 25,536 piculs (1596 long tons) in its first crop of 1929/30 and 588,746 piculs (36,797 long tons) in 1964/65. The milling capacity has been increased from 1000 to 2250 t.c.d., this latter figure to be obtained with a new 12-roller Honolulu Iron Works milling train with 34 × 66 in rollers.



Beet sugar manufacture

Automation of sample handling and automatic data reduction in a sugar factory tarehouse. M. NOETINGER, *Ind. Alim. Agric.*, 1966, **83**, 883–885.—A description is given of the automatic equipment installed at the Béghin factories in France to meet the new legal requirements as to analysis of beet samples for payment on a pol basis. These are in two parts, the first concerned with washing, drying and topping—the last remaining a manual operation—and the second with determining the sucrose content. The data obtained are recorded on printed cards relating to each sample, with gross weight, net weight, etc., and the printing machines and a control cabinet are illustrated.

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Studies on the respiration of beet after harvesting. P. L. DEVILLERS, M. R. LOILIER and J. C. CHARTIER. *Ind. Alim. Agric.*, 1966, **83**, 901–911.—Respiration of stored beets was measured by displacement by compressed air of the CO_2 released and its determination after trapping in $Ba(OH)_2$ solution. Respiration curves produced indicated three principal phases during storage: the first is a phase of intense activity with great losses during the first three days, particularly if the temperature is a little high. The second phase is of slower activity and commences 6–15 days after harvesting; it can continue almost indefinitely at 3°C, for several weeks at 15°–23°C or some days at 30°C, the losses then doubling for a 10°C increase in temperature. The third phase is one of rapid deterioration, with invasion by moulds and high losses. The effect of root damage is important, increasing respiration losses and helping the introduction of moulds. Topping is of little influence but drying of the roots is very harmful since it favours infection. Sucrose loss in small roots is a little higher than in large roots. But the most important factor is the condition of the beet at the time of entry into the silo and this depends on its growth, on the harvesting, and on the way it has been treated between harvesting and storage.

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Use of electromagnetic flowmeters in sugar manufacture. Analogue and numerical control of liming. M. F. CARRIVE. *Ind. Alim. Agric.*, 1966, **83**, 923–927. The principles of electromagnetic flow measurement and characteristics required for practical meters are described and their application to milk-of-lime and raw juice flow measurement is discussed. The advantages of this form of flow measurement for raw juice over measurement on the basis of pressure difference across a venturi tube are considered in some detail. Two liming schemes are described, using analogue and numerical proportioning. While analogue control is more economical and satisfactory in certain cases, generally numerical proportioning is preferable, for reasons given, particularly where flow conditions are irregular.

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Evaporation in the sugar industry. E. M. DEMARET. *Ind. Alim. Agric.*, 1966, **83**, 929–940.—After restating certain fundamentals of evaporation and establishing a number of basic equations, the author discusses the essential relationships involved in the process and constructs graphs representing these relationships in evaporation, including quintuple-effect evaporation with and without recompression. The graphs, drawn from calculated data, are intended to give a sufficiently clear representation of the process for possibilities of improvement to be evaluated. For values of specific heats, purities and concentrations of sugar solutions, reference is made to an earlier published nomogram[1]. The conditions necessary for vapour recompression are discussed, and two errors which slip easily into heat calculations are corrected; these refer to the temperature of condenser water[2] and the quantity of heat required to raise to a desired temperature.

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Pan vapour recovery by downflow evaporation. J. C. GIORGI. *Ind. Alim. Agric.*, 1966, **83**, 951–954.—Substantial economies in heat consumption may be achieved by re-use of pan vapours, the heat content of which is usually wasted. Details are given of a Fives Lille-Cail vertical tube evaporator for juice or syrup concentration, which is heated by pan vapour using a calandria connected directly to the factory condenser by way of a valve, the position of which is governed by the Brix of the concentrated syrup. Juice or syrup is cooled by heat exchange against a counter-flow of treated syrup and is then fed to the top of the evaporator where it is distributed over the ends of the tubes by a special device. The juice and vapour produced flow down the tubes and out through a lower tube plate into the lower part of the vessel, so overcoming the major problem encountered with conventional evaporators, viz. the considerable effect of pressure head loss. The lower part of the vessel acts as a primary separator for the juice-vapour mixture and a constant syrup level is maintained in it.

[1] *I.S.J.*, 1963, **65**, 245.
[2] See *I.S.J.*, 1947, **49**, 205–208.

The vapour outlet is connected to the factory condenser, the outlet having a special device with a deflector at the entrance to prevent passage of entrained sugar. The evaporator has been tested on a factory scale and is claimed to permit Brix increases without the need for extra steam. Tabulated data from the experiments show a recovery of 80 kg of vapour per ton of beets with a single-effect unit used for syrup concentration and 90 kg/ton for two effects used for juice concentration.

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Desaturation of low-grade products. Massecuite preparation before spinning. J. BLUM. *Ind. Alim. Agric.*, 1966, **83**, 965–968.—Details are given of the "Holo-Flite" diluter which comprises two or more inter-engaging scrolls mounted in a trough. Dilution water is added at one end of the trough through a dispersion device and the scrolls are rotated at 10–18 r.p.m. to give rapid mixing and desaturation of the mother liquor without dissolution of crystals. The advantage of the technique for reducing massecuite viscosity and desaturating the mother liquor before curing in the centrifugals is discussed. Tabulated data demonstrate the drop in apparent Brix of both massecuite and mother liquor; mixture of 100 litres/hr of water at 85°C with 1st massecuite at 60°C treated at the rate of 14 metric tons/hr reduced the massecuite Brix from 95·30° to 94·50°, the mother liquor Brix falling from 92·27° to 90·90° and apparent purity falling from 60·58 to 60·50. A second massecuite at 54°C treated at 12 tons/hr with 150 litres of water/hr at 85°C was reduced from 94·95° to 93·50°Bx; the mother liquor Brix fell from 91·88° to 89·67° while its purity rose from 60·70 to 60·74. The molasses viscosity in these cases was very much reduced, from 70 cp to 27 cp and from 110 cp to 19 cp, respectively.

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Beet pulp pressing. J. RIMBERT and S. TOURLIÈRE. *Ind. Alim. Agric.*, 1966, **83**, 989–996.—The economics of pulp drying and pressing are considered in relation to a number of factors, covering operating costs, quality and value of product, and losses, such as in press water solids, which is largely determined by the quality of exhausted cossettes leaving diffusion. Among the factors relating to pressing proper which are discussed are: feed rate and moisture content of the unpressed pulp, speed of the screw and temperature, while those relating to the wet pulp are: pH, diffusion temperature (which affects the pressing quality of the pulp), the effect of beet quality, and the use of additives such as $CaCl_2$ to coagulate the pectins in the pulp. Reference is made to the results obtained at sugar factories in Ireland, the U.K. and the U.S.A. as well as in pressing of apples for recovery of their juice content.

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Drying and storage of sugar. P. DEVILLERS. *Ind. Alim. Agric.*, 1966, **83**, 971–974.—Three phenomena arising during white sugar storage are briefly described: maturation (in which the sugar becomes slightly sticky as an effect of slow crystallization from the syrup film surrounding the crystals), lumping, and fermentation. It is pointed out that since no dryer is able to provide a white sugar of sufficiently low moisture content that it can be stored without conditioning (to avoid the deterioration mentioned above, the sugar should have an equilibrium relative humidity after 6 days storage of about 60, or at any rate below 70), it is necessary to take steps to ensure that the storage conditions are adequate. These include blowing of air through the sugar (three possible methods of conditioning the air are described), using maturation silos (i.e. small silos where the sugar is stored for some days to adjust its moisture content before it is transferred to permanent storage), and air conditioning of the silos themselves. Air conditioning of bagged sugar is also discussed.

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Amalgamated's Rupert plant goes to 7000 tons of beet/day. ANON. *Sugar y Azúcar*, 1966, **61**, (10), 32–35.—Details are given of equipment installed in the Rupert, Idaho, beet sugar factory of the Amalgamated Sugar Co. to raise its daily slice to 7000 tons of beet, and information is given on the beet sugar industry in Idaho.

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F-2 (Manteca) modernization programme swings into high gear. ANON. *Spreckels Sugar News*, 1966, **18**, (2), 4–6.—A brief illustrated account is given of the expansion programme at the Manteca beet sugar factory of the Spreckels Sugar Co. to increase the slicing capacity from 3000 to 4200 tons of beet per day.

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Arizona progress: the crop is planted. ANON. *Spreckels Sugar News*, 1966, **18**, (2), 12–14.—Information on the new Spreckels beet sugar factory at Chandler, Arizona, is accompanied by a number of illustrations. The factory will have a rated daily slice of 4250 tons of beet and will use a 28-cell Morton diffuser.

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Juice purification with lime and carbon dioxide in the beet sugar industry. J. HENRY. *Zeitsch. Zuckerind.*, 1966, **91**, 571–579.—A survey is presented of beet juice carbonatation schemes, including the classic system and the Dorr, Brieghel-Müller, Wiklund, R.T. (as practised at Oreye sugar factory[1] and as carried out using Grand-Pont filters) and Novi-Sad schemes. Their advantages and disadvantages are discussed. Results obtained at six Belgian factories show that raw and thick juice purities at Oreye were as good as, if not better than, those at the other factories, while the limestone usage at two factories using the R.T. system was up to 20% lower than at factories using the classic process with and without $CaCO_3$ recirculation. While the Novi-Sad system[2] is based on the same principles as the R.T. scheme, the latter is claimed to be less complex and to use less lime.

[1] *I.S.J.*, 1960, **62**, 101; 1961, **63**, 348.
[2] *ibid.*, 1965, **67**, 53; 1966, **68**, 243.

Transportable beet tipping and piling units. G. WICENEC. *Zeitsch. Zuckerind.*, 1966, **91**, 589–591. The units reported previously[1] are illustrated and some modifications described.

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Technological evaluation of beet cossettes according to their deformations. V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 3–22.—Analysis of a formula developed for calculating the permissible cossette thickness in terms of a number of factors including juice flow rate over the cossette, height of cossette bed, the elasticity modulus and coefficients describing deformation in two respective directions, shows that deformation restricts use of thin cossettes, causing them to stick together to form thick cossettes with a resultant considerable drop in permeability. Nevertheless, improvement in knife surface and grinding, correct choice of cossette shape, etc. have permitted thinner cossettes to be used. New recommendations are given which are intended to help improve diffuser design and accelerate diffusion (through such factors as greater rotary speeds, use of square-section cossettes and knife grinding with diamonds). Some of these recommendations have been tested, while others still require investigation under factory conditions.

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Comparative investigations of continuous stone catchers. N. M. DATSENKO and V. N. SHCHEGOLEV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 22–30.—Despite its greater throughput and occupation of less space than a drum-type stone catcher, a bucket elevator-type stone catcher removed a much smaller proportion of stones (35% and 26% of large and small stones, respectively, compared with 98% and 92% removed by a drum type). The elevator type is therefore not recommended except in certain circumstances. An LV-1 stone catcher, comprising a grid at the bottom of the flume for sand and small stones and four chutes at each end of the grid down which the larger stones fall onto a rake conveyor, needs modifications and further testing before conclusions can be given regarding its performance.

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Performance of the diffuser station at Timashevskii sugar factory. N. V. KHEIZE and E. T. KOVAL'. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 30–42.—A BMA tower diffuser of 2500 tons/day throughput handled the beets easily but was less efficient than a Buckau-Wolf tower, a Soviet KDA-25-59 tower and a Silver-DDS trough diffuser. On the other hand, the BMA pre-scalder is better than that of the Buckau-Wolf and is recommended for all Soviet tower diffusers, as is the cossette feed system, using centrifugal pumps, and the BMA fresh water preparation system. Also recommended is the BMA beet slicer used at Timashevskii. The hopper before the beet slicers should have a capacity equivalent to 15 minutes' operation. Advice is also given regarding pulp presses.

Technology of filter powder manufacture from Soviet diatomite deposits. A. K. KARTASHOV, V. E. SKRIPLEV and V. A. CHERNENKO. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 42–64.—In the production of filter aid from diatomite and tripolite, roasting with sodium carbonate gave lower filtration properties than did the use of sodium chloride. Other recommendations given refer to the processing of filter aid from specific Soviet deposits.

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The rôle of dextran in sugar manufacture. S. A. BOGDANOV. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 83–96.—A number of recommendations are made for preventing dextran formation. These include chlorination of beet wash water (5–10 mg of active chlorine per litre of water or 2 g of chloride of lime per 100 litres of water); maintenance of a diffusion temperature no lower than 70°C; and, if bacteria are present during diffusion, sterilization of the diffusion juice with 10 litres of formalin per 100 tons of beet; when deteriorated beet are being processed, chloride of lime (0·05–0·10% on weight of juice) should be added with milk-of-lime to the pre-liming tanks. Tests, details of which are tabulated, demonstrated the poor solubility of dextran and its adverse effect on filtrability, whereby even a very small amount caused a sharp rise in the value of F_k. While formalin and perhydrol (30% hydrogen peroxide), added to combat dextran formation, did not improve juice filtration, sodium hypochlorite and chloride of lime considerably improved filtration. Chloride of lime alone improved 1st carbonatation juice filtration and considerably reduced the colour content.

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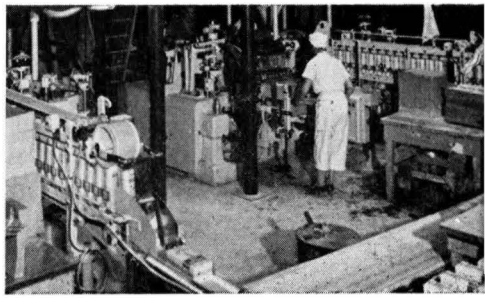
Determination of pressure drop from the thickness of the layer deposited in centrifugal filtration. B. N. TERESHIN. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 134–139.—Laboratory tests using a specially-constructed centrifuge showed that the actual hydrodynamic pressure occurring at the interface between the crystal layer and centrifugal screen was some 800% greater than that calculated for a "clean" screen; this is attributed to the considerable increase in resistance to permeation caused by the crystals caught in the screen perforations. The permeability of the crystal layer was found to fall markedly with even a comparatively small loading, but thereafter changed only slightly with increased loading, and with large crystals (greater than 0·7 mm) remained almost constant. In massecuite curing the screen resistance will be most marked in the initial stages of layer formation, i.e. with considerable pressure drop when the thickness of the screen is commensurate with the thickness of the crystal layer. In view of its small thickness, the screen resistance can be almost ignored after the crystal layer has been formed.

[1] *I.S.J.*, 1965, **67**, 185.

Sugar refining



Economic evaluation of the steam ejector in vacuum pan operation. S. SUZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 55–67.—Recent use in other countries of the steam ejector, in place of the reciprocating air pump, has led to its planned use in some new Japanese sugar refineries. Tests of these ejectors show that air leakage will not cause loss of vacuum if it is lower than 200 mm mercury per hr. Air present in juice or injection is not a problem for refineries in contrast to beet and cane sugar factories. Comparison of an ejector with an air pump for a pan volume of 90 cu.m., boiling 50 tons of massecuite under a boiling pressure of 90 mm mercury, in a boiling time of 18 hours/day with an air leakage of 100 mm/hr, indicated that running costs were the same but the capital investment and installation costs are three times higher for the pump than for the ejector which is therefore to be preferred.

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Thermal regeneration of active granular carbons. M. B. YARMOLINSKII, F. P. ALEKSEENKO and V. N. BONDAREVSKAYA. *Sakhar. Prom.*, 1966, **40**, (8), 15–20. Details are given of tests carried out at Odessa refinery on thermal regeneration of AGS-3 and AGS-5 granular active carbon in a rotary kiln. The carbon was steam dried to 20% moisture content and fed into the kiln where it was roasted by gas at an optimum of 650–800°C. After water-cooling, the carbon was screened and granules smaller than 2 mm removed. The kiln throughput was 300–450 kg/hr, the complete regeneration cycle taking 30–40 min. Losses were about 15% on weight of carbon, although a calculated 5–8% per cycle is considered possible under normal conditions. The regenerated carbon was little different from fresh carbon as regards its physico-chemical properties, and syrup filtration through it was more rapid (up to 15 litres/min/ton) than with fresh carbon (8 litres/min/ton). Decolorizing efficiency was about the same as for fresh carbon.

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Preparation of wash liquor from cane raw sugar. A. P. CHERNOVALYUK. *Sakhar. Prom.*, 1966, **40**, (9), 27–28.—At Odessa refinery wash liquor for massecuite washing is prepared from affined raw sugar melt, which is washed, carbonatated, filtered, sulphited, filtered and then treated twice with active carbon. After being mingled with refined sugar waste from the packaging section, it is subjected to further active carbon treatment and is finally mixed with ultramarine in special tanks. The processes are carried out during the interval between normal refining processes, so that no extra equipment is required.

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Automatic line for pressing, drying, cutting and packaging of refined sugar. G. A. RASHKOVAN and N. B. GERZHOI. *Sakhar. Prom.*, 1966, **40**, (9), 34–36. Details are given of the PSA-M automatic pressing and drying line which has a throughput of 30 tons per day in the form of slabs measuring $18 \times 24 \times 150$ mm (another version produces slabs measuring $23 \times 23 \times 184$ mm). One pressing plus feeding of the slab onto the steel band conveyor takes 1·04 sec and the output of the four-matrix rotary press is 24 pressings/min. Drying takes place in an 85°C counter-current stream of air. The line can be operated in conjunction with a semi-automatic PLR line which cuts the slabs and packs the tablets in 1-kg packets. The PSA-M is claimed to pay for itself within no more than 2½ years, three operators being required in place of 109 originally and power and steam consumption being reduced.

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An approach to loss control. T. KACZOREK and A. ANCONA. *Sugar J.* (La.), 1966, **29**, (4), 28–31.—At the Sucrest Corporation refinery, a new loss programme was introduced in 1962, covering the warehouse, packing department and the refinery proper. The total loss figure of 0·35% on total melt at the start of the programme has been reduced to the present 0·25%. The losses in the packing department have proved to be very small. In the warehouse, on the other hand, bag breakage in 1965 was 0·83% of the annual production (0·90% of the annual shipment). Nails in pallets and in the "Hilo" plus breakages in the refinery made up 95% of the total breakages. The refinery losses are checked by various means, according to the process. The sweet-water from the fine and coarse melt strainers is analysed by the α-naphthol test, sugar lost in carbon regeneration is determined by complete sugar analysis of a carbon sample before regeneration, and "Auto-analyzers" are used for determining losses in the main sewer and in the evaporator condensate and also for monitoring influent salt water and refinery hot water. Decolorizing and ion exchange columns and press-cake tanks are also monitored by automatic systems which are described. Losses at the "Roto-Clones" are determined by analysing air samples using the α-naphthol method.

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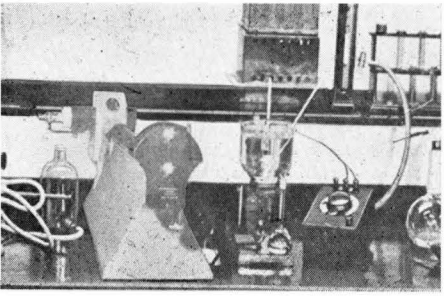
Methods of decolorizing sugar solutions with active carbon. H. ZAORSKA. *Gaz. Cukr.*, 1966, **74**, 209–214. See *I.S.J.*, 1966, **68**, 85.



Laboratory methods & Chemical reports

New method of detection of sugars and sugar derivatives on paper chromatograms. K. HORITSU. *Bull. Facult. Agric. Hirosaki Univ.*, 1965, (11), 51–54; through *S.I.A.*, 1966, **28**, Abs. 602.—H_2SO_4 (2·5% or 5%), $HClO_4$ (2·5% or 5%), or H_3PO_4 (5%) were found to be good spraying reagents for revealing eight sugars (including sucrose) on chromatograms developed with 6:4:3 *n*-butanol-pyridine:water or 4:1:5 *n*-butanol:acetic acid:water.

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New cupri-argentimetric method for determination of reducing sugar. S. A. CELSI and P. O. SARRAILH. *Ann. Pharm. Franç.*, 1965, **23**, 775–780; through *S.I.A.*, 1966, **28**, Abs. 603.—The sugars are determined by reduction (in 5 ml of solution) with 10 ml of a modified Bang's reagent containing 18 g of $CuSO_4.5H_2O$, 250 g of K_2CO_3, 100 g of $KHCO_3$ and 50 g of KNCS in 1 litre. A precipitate of CuNCS is obtained by heating at 100°C for 20 min, adding 2 ml of 0·3% $KAl(SO_4)_2.12\ H_2O$ and centrifuging. The precipitate is washed and re-centrifuged twice: the washing is carried out with 11 ml of 2·5% K_2CO_3-1% $KHCO_3$ followed by 2 ml of the Al reagent. The precipitate is re-dissolved with 11 ml of ferric reagent [20% $FeNH_4(SO_4)_2.12\ H_2O$-20% H_2SO_4 (all w/v)]. The equivalent NCS is determined by re-precipitating with 25 ml of 0·05N $AgNO_3$ and back-titrating with 0·05N KNCS. Results for a solution containing 4–10 mg of invert sugar (as sucrose) showed a strongly linear proportionality between titre and sugar concentration.

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Determination of 3-amino-1,2,4-triazole ("Amitrole") residues in sugar cane. H. W. HILTON and G. K. UYEHARA. *J. Agric. Food Chem.*, 1966, **14**, 90–94; through *J. Sci. Food Agric. Abs.*, 1966, **17**, ii-137. The herbicide applied as a spray at 40 lb per acre caused a little temporary yellowing of the cane leaves but did not affect cane yields. Residues after 2 years were <0·002 p.p.m. Some improvements were made in the spectrophotometric determination that increased the sensitivity of the method to <0·1 μg of "Amitrole" in sugar cane or concentrated cane juice.

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Study of massecuite viscosity and shear limit. A. I. GROMKOVSKII. *Sakhar. Prom.*, 1966, **40**, (10), 12–17. The true viscosities of artificial massecuites, η_m, [expressed as viscometer readings $\times (1 + \frac{\Delta\alpha}{\alpha})$, where $\frac{\Delta\alpha}{\alpha}$ is a function of the degree of slip] were measured with a rotary viscometer. The measurements were made at varying crystal contents, crystal sizes and mother liquor viscosities (η_o), the last being determined with a capillary viscometer after separation from the crystals by centrifuging. The values of η_m were approximately the same as, but always lower than, the viscosities measured after one revolution. The measured viscosity was greater because of the effect of inertial forces on the time of rotation. Crystal size proved to have no effect on massecuite viscosity. Measurements made with a Höppler falling sphere viscometer, a capillary instrument and a conventional rotary viscometer were found to be distorted by slip. A co-axial rotary viscometer[1], in which the massecuite was subjected to two absolute shearing stresses, gave measurements of specific viscosity (η_m/η_o) in good agreement with values obtained from the empirical formula (obtained by the least squares method):

$$\eta_m = \frac{\eta_o}{1 - 3{\cdot}7855\,\phi + 3{\cdot}6614\,\phi^2}$$

where ϕ = relative crystal volume. While earlier investigations[2] showed that massecuite flow is approximately that of a Newtonian fluid, experiments with a special viscometer having a ribbed mixer blade showed that, while at up to 51% crystal content the massecuite behaves according to the equation, at crystal contents above 51% it develops a shear limit and apparently behaves as a Bingham fluid. However, such massecuites break up during flow and may take in air to form a three-phase system.

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Flame photometer for detection of sugar in boiler feed water. M. L. A. VERHAART and N. H. M. DE VISSER. *Zucker*, 1966, **19**, 509–510.—A flame photometer used to determine K and Na in beet has been applied to sugar detection in condensate. The technique is based on the fact that K is always present with sugar, from which it is separable only by crystallization. Since the amount of K in thin or thick juice is 1% on sugar, a value of 0·1 p.p.m. of K in condensate will correspond to 10 p.p.m. of sugar. The condensate is continuously atomized with compressed air and the mist then mixed with propane gas which is ignited. The wavelength emitted by the K (768 mμ) is isolated with an interference filter and measured with a photoresistance. The electrical conductivity proportional to the light intensity is then proportional to the K concentration and so to

[1] *ibid.*, 1965, **67**, 348.
[2] *ibid.*, 1966, **68**, 376.

the sucrose content. The method has been used at Breda sugar factory in Holland; daily calibrations with a standard solution required only slight corrections and these were not in any one direction. While the minimum sugar content detectable is 20 p.p.m., the instrument could be adapted to measure down to 10 p.p.m., but this is not considered necessary.

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Determination of sucrose in sugar solutions containing sucrose, glucose and fructose by a modified Somogyi method. N. EJIMA and Y. HIRATA. *Nippon Shokuhin Kogyogakaishi*, 1963, **10**, 413–417; through *S.I.A.*, 1966, **28**, Abs. 691.—The modified Somogyi method[1] (in which sufficient Na_3PO_4 is added to protect the Cu_2O from re-oxidation by atmospheric oxygen) was applied to sucrose determination. The optimum heating time was 5 min; 1 ml of 0·05N $Na_2S_2O_3$ corresponded to 1·41 mg of sucrose. In the case of mixed sugars, the results obtained were too low. It was shown by paper chromatography that some glucose and fructose (especially the latter) was decomposed during the determination into 5-hydroxymethylfurfural and an unidentified compound of similar R_f to glucose and fructose.

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Thin-layer chromatography of carbohydrates. A. PASTUSZYN and H. MICHL. *Mitt. Versuchs. Gärungsgewerbe*, 1966, **20**, 1–4; through *S.I.A.*, 1966, **28**, Abs. 692.—Sugars were separated by two-dimensional chromatography on "Kieselgel G", using as solvents 5:1:4 *n*-butanol:ethanol:water and 9:6:3:1 *n*-butanol: glacial acetic acid: ether: water. The spots were revealed with aniline phosphate and orcinol- and naphthoresorcinol phosphoric acid. Chromatographs obtained with two artificial mixtures of mono- and oligosaccharides, with a mixture of formaldehyde condensation products and with two wines are shown.

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Thin-layer chromatography of carbohydrates. Part III. H. SCHERZ, W. RÜCKER and E. BANCHER. *Mikrochim. Ichnoanal. Acta*, 1965, 876–879; through *S.I.A.*, 1966, **28**, Abs. 693.—A simple method for the quantitative separation and determination of hexoses and oligosaccharides is described. The sugars are separated on plates of silica gel G or H. The greatest mobility and separation of oligosaccharides (e.g. sucrose, melibiose and raffinose) is obtained on plates impregnated with 0·5% polyvinyl alcohol solution, using 60:30:5 ethyl acetate:dimethylformamide:water. The spots are located on the dried plate by spraying with alkaline $KMnO_4$ solution. The corresponding areas are scraped off, transferred to graduated tubes and heated with a mixture of 10 parts of conc. HCl, 8 parts of acetic acid, and 2 parts of 2% diphenylamine in ethanol at 100°C for up to 30 min (aldoses) or 5–10 min (ketoses). The blue colour is measured at 640 mμ.

Thermophysical properties of the sucrose crystal. V. D. POPOV, YU. A. TERENT'EV and B. N. GONCHARENKO. *Izvest. Vysshikh Ucheb. Zaved., Pisch. Tekhnol.*, 1966, (1), 127–129; through *S.I.A.*, 1966, **28**, Abs. 702. Fundamental measurements of thermal diffusivity a were carried out by suspending a large sucrose monocrystal containing an imbedded thermocouple in a stirred solution of mercury at 25°—95°C, after establishing an initial temperature difference between crystal and liquid. The value of a (m²/hr) at t°C is given by the empirical equation $a = 0{\cdot}001025 - (0{\cdot}0492 \times 10^{-5})t$, within the estimated experimental error of 5%. Hence, the thermal conductivity λ (kcal/m/°C/hr) is given by $\lambda = 0{\cdot}474 - 0{\cdot}00153t$. These values do not agree with those extrapolated from data for sugar solutions.

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Influence of temperature on the kinetics of crystallization of sucrose. A. V. ZUBCHENKO. *Izvest. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1966, (1), 97–99; through *S.I.A.*, 1966, **28**, Abs. 706.—Sucrose solutions all of 1·3 supersaturation were prepared at five temperatures between 30° and 70°C. Nucleation and crystallization rates were measured[2] at stirring rates of 400 or 800 r.p.m. The first-order rate constant of crystallization (7×10^{-4}/min at 30°C and 400 r.p.m.) was increased 2–3 times per 10°C rise in temperature, or by doubling the stirring rate; the rate constant was thus increased to 560×10^{-4}/min at 70°C and 800 r.p.m. Stirring had no effect on the activation energy. In all cases, the nucleation time varied inversely with the crystallization rate.

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Use of thionine (resazurine) for the detection of microbial infections in the sugar factory. P. BIDAN, J. GENOTELLE, G. ROUSSEAU and J. STAMBUL. *Ind. Alim. Agric.*, 1966, **83**, 915–919.—Thionine was introduced by ANDERSEN[3] as a colorimetric reagent, capable of being used by relatively unskilled seasonal workers to determine the extent of microbiological infection in sugar factory products. The colour changes with time from blue to violet to red to colourless in the presence of microorganisms and this has permitted its successful use by factories of the Groupement Technique de Sucrerie since 1960, especially for control of infection in the diffusers. A 1-ml sample of juice is added to a tube containing 9 ml of dilute NaCl solution (9 g NaCl in 1000 ml distilled water) at 55°C. To this is added 1 ml of thionine solution (5 p.p.m. in sterile water) and the tube closed and placed in a thermostat at 55°C. The colour is noted at half-hour intervals and depends on the initial population; with 10^4 organisms/ml the colour stays blue for 3½ hours then turning violet. With 10^5 organisms/ml it changes to violet after 2½ hours and then to red after a further ½-hour, with 10^6 the change from blue to violet occurs after 2 hours

[1] KOBAYASHI & TABUCHI: *J. Agric. Chem. Soc. Japan*, 1954, **28**, 171–174.
[2] ZUBCHENKO *et al.*: *I.S.J.*, 1965, **67**, 249.
[3] *I.S.J.*, 1955, **57**, 112.

and to red after 3½ hours, and with 10^7 the blue becomes violet after ½-1 hour, red after 2–2½ hours and colourless after 4–4½ hours. With 10^8 organisms/ml the colour changes from blue to violet after ½ hour, to red after 2 hours and to colourless after 3½ hours, while with 10^9 per ml the colour becomes violet after ½ hour, red after 2 hours and colourless after 3 hours.

* * *

Progress made in the construction of automatic saccharimeters. M. DEMAUX and S. TOURLIÈRE. *Ind. Alim. Agric.*, 1966, **83**, 889–898.—The International and Ventzke Sugar Scales for sugar polarization are described, as is the scale used only in France where 100 degrees corresponds to a solution of 20 g sucrose per 100 c.c., measured in vacuum (as against 26 g for the I.S.S.). The authors consider the French scale "infinitely more useful because of its analogy with the decimal system". The scale is not linear, however, and is expressed by a binary equation involving the concentration. Saccharimeters may thus be engraved with non-linear scales to allow for this correction or can be engraved linearly but over smaller range (25–30°S) instead of 0–100°S. The latter course has been adopted by French manufacturers making automatic instruments. Such instruments, for commercial use, must be secure against unauthorized adjustment to gain dishonest ends, and must be of a guaranteed accuracy, the latter confirmed by regular inspection by the Service des Instruments de Mesure. Descriptions are given of a number of makes of automatic saccharimeter.

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Influence of a sonic field on crystal formation in supersaturated sucrose solutions. S. ZAGRODZKI and Z. NIEDZIELSKI. *Ind. Alim. Agric.*, 1966, **83**, 957–961. See *I.S.J.*, 1963, **65**, 29.

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Measurement of water in powdery solids and possibilities of application in the sugar industry. M. MOREUIL. *Ind. Alim. Agric.*, 1966, **83**, 977–981.—Of two possible methods of measuring the moisture content of materials, the one which could find application in the sugar industry is a technique based on the measurement of dielectric parameters. This uses the fact that the assymetric molecules of water act in electromagnetic fields as dipoles vibrating at the field frequency. If a capacitor of capacitance *Co* is charged with the material, its impedance will vary. This impedance can then be assimilated at a capacitance *C* in series with a resistance *R*. The two parameters which can then be measured are the permittivity (here given by *C*/*Co*) and the dielectric loss (here represented as the ratio between the moduli of the true and imaginary parts of the impedance). Laboratory determination of the moisture content of crystal sugar using a device based on the above principle gave graphs relating moisture and (i) permittivity and (ii) dielectric loss. The relationships were linear up to 4% moisture by weight, although neither straight line passed through the origin. The scatter is claimed to be similar to that experienced with oven-determined moisture. The method is claimed to be applicable to agglomerates, to beet pulp and in general where moisture content exceeds 1–2%.

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pH measurement in sugar manufacture. M. RHYN. *Ind. Alim. Agric.*, 1966, **83**, 983–987.—Modern apparatus for pH measurement is described and illustrated. It includes glass electrodes and silver/silver chloride reference electrodes, electrodes sensitive to specific cations, such as Na^+, K^+, Ca^{++} and Mg^{++}, immersion and flow-through probes, and a fully-transistorized pH meter. Flow diagrams are given of a diffusion and a carbonatation scheme with suggested location of pH meters.

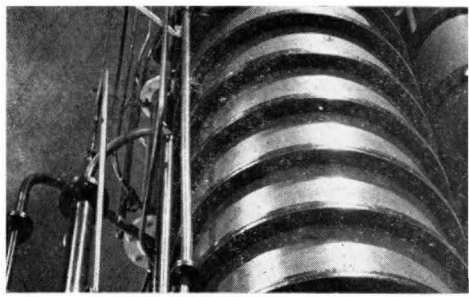
* * *

White sugar sieve analysis methods. A. F. ZABORSIN. *Trudy Vsesoyuz. Nauch.-Issled. Inst. Sakhar. Prom.*, 1966, **13**, 193–205.—An electrically-driven unit in which sugar is allowed to fall from the top of a number of screens of geometrically diminishing mesh size (from 1·5 to 0·2 mm) while these are being vibrated (through an eccentric drive) was used to determine the sieve analysis of white sugar. (The central rotary shaft takes three sets of seven screens.) The results were plotted on log-probability paper. The straight line obtained permits the following parameters to be determined: the screen size through which 50% of a particular sugar sample passes; the standard deviation; the screen size characterizing the dominant crystal size in the sample; and the mean crystal size. The processing of results takes 3–5 min. The machine should have a frequency of vibrations such that the sugar takes no more than 20 min to pass through all the screens.

* * *

Determination of insolubles in refined sugar. M. FRIML and J. BUREŠ. *Listy Cukr.*, 1966, **82**, 252–256. The insoluble matter in refined sugar was determined qualitatively by passing an aqueous solution of the sugar through a filter screen of 1·8 sq.cm. surface incorporated in a special funnel device, and quantitatively by means of membrane filters. The insolubles were classified under three groups: (i) those entering the sugar from machinery (e.g. ferromagnetic particles) or as a result of inefficient operation of particular equipment or processes (e.g. particles of decolorizing medium); (ii) those added to improve the appearance of the sugar (e.g. ultramarine); and (iii) those adhering to the sugar during storage and transport (dust and jute fibres). There were considerable differences between the insolubles contents, the average being 2·29 mg/100 g. It was found that the greatest effect on the insolubles content is exerted by liquor filtration. It is considered that insufficient attention is paid to filtration and to decolorization. More care should also be taken in the use of ultramarine, which in some cases constituted a considerable insoluble impurity, occasionally being well above the average insoluble content.

By-products



New efficient aeration system for yeast culture. M. SKIBA. *Abs. of papers presented to 2nd Intern. Congr. Food Sci. Technol.* (Warsaw), 1966, 53.—The commercial yield of yeast with regard to raw material and yield per unit volume of fermentation tank as well as the admissible culture medium concentration are limited by the low aeration efficiency of present systems. A new type of aerating device, incorporating a horizontal rotor, has been designed; in laboratory experiments this gave a K_L value of 1100–1700 hr^{-1}, while in pilot-plant tests normal yeast yields were obtained even at final molasses dilutions as high as 1:5. The consumption of air, electricity and anti-foaming agent was lower than usual in the industry. The yield of yeast (with a 27% total solids content) increased to 140 kg/cu.m./day. The device is being tested on an industrial scale.

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Oxidation of sucrose by nitric acid. I. Introduction and reaction conditions. R. BRETSCHNEIDER and B. KOPŘIVA. *Listy Cukr.*, 1966, **82**, 215–220.—Utilization of sucrose as a chemical raw material, where sugar demand falls below production levels, is discussed and the various classes of derivatives obtainable are listed. The mechanism and reaction conditions of sucrose oxidation with nitric acid to tartaric acid and oxalic acid are described. In tests on the oxidation of glucose, fructose and sucrose with nitric acid, using molar ratios of 5:1–8:1, and reaction times of 410–565 minutes, the best results were obtained with sucrose, 95 g of which yielded 25·9 and 47·8 g of (i) tartaric acid and (ii) oxalic acid dihydrate after 490 minutes, using a molar ratio of 7:1. Glucose yielded a maximum of 25·0 and 26·9 g of (i) and (ii), respectively, after 450 min at a molar ratio of 5:1. Fructose yielded only very small quantities of tartaric acid. In recycling tests 400 g of glucose yielded 136·5 g of (i) and 155 g of (ii), while 380 g of sucrose yielded 107·3 g and 168·1 g of (i) and (ii), respectively.

* * *

A valuable feed for dairy cattle. J. B. FRYE. *Sugar J.* (La.), 1966, **29**, (4), 9–10.—The total digestible nutrient content of molasses is equivalent to about 66% of that in corn. However, while molasses is rich in niacin and pantothenic acid, it has low thiamine, riboflavine and phosphorus contents and little or no vitamins A and D. Nevertheless, since in many tropical and sub-tropical areas of the world an insufficiency of energy is a limiting factor in milk production, molasses is of value in rations fed to dairy cattle since it does supply much readily-available energy. Reference is made to research work conducted on molasses feeds; the experiments have shown that, while molasses (or ground snapped corn or citrus pulp) can replace one-third of the corn silage in dairy cattle rations, it can satisfactorily and economically replace about half of the concentrate mixture when hay is the primary roughage. Molasses fed at the rate of 2·5% was found to be the optimum level for increasing grain consumption and milk production, which it raised by 10% and 5–10%, respectively.

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Research on beet pulp ammoniation. I. Technology of ammoniation. T. STOBIECKI and S. SZYBALSKI. *Gaz. Cukr.*, 1966, **74**, 219–221. Reference is made to the work of MILLAR[1] whose results from experiments on beet pulp ammoniation were confirmed by laboratory and pilot-plant tests. Details are given of a full-scale tower unit installed at Strzelin sugar factory in Poland. Results from the 1963/64, 1964/65 and 1965/66 campaigns are tabulated. These show that the beet pulp nitrogen content was increased from 1·40–1·45% to 2·78–3·17% on solids. The sugar content fell from 2·23–5·00% to 1·95–3·40% and the water content from 8·28–8·68% to 4·50–6·50%. The unit handled 411–468 tons during the three campaigns, at a throughput of 6 tons/day, with an hourly ammonia usage of 5·5 kg. The economics are discussed, and it is considered that the scheme will find general acceptance throughout the industry.

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High-quality paper products from bagasse pulp. M. F. GLORIA. *Sugar y Azúcar*, 1966, **61**, (10), 41–43. Full details are given of the processes used at the paper mill attached to Central Azucarera de Bais, in the Philippines. The mill produces 28–30 metric tons of bagasse pulp and 35–40 metric tons of paper per day; the paper produced includes white and coloured writing paper, mimeo stock and kraft types. The sugar factory operates only 6 months of the year so that storage of the bagasse is necessary. While depithing of dry bagasse that has been stored consumes less power than wet depithing (fermentation processes during storage help loosed the pith), the latter process is more efficient. A converted pulp dryer at the paper mill is used to produce chipboard from scrap paper. Wood pulp, generally imported, is blended with the bagasse pulp. The chemicals used in the paper making process are produced in the company's own diaphragm electrolytic plant, excess chlorine plus hydrogen being used to produce hydrochloric acid for acidifying the feed brine and for sale outside.

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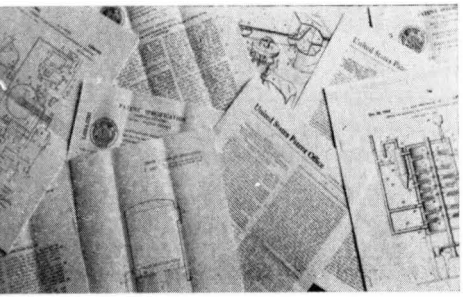
[1] *I.S.J.*, 1941, **43**, 216.

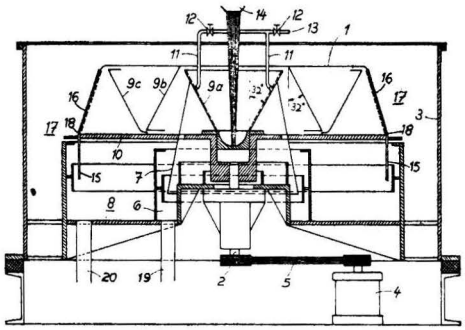


Patents

UNITED KINGDOM

Continuous centrifugals. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,054,884.** 22nd May 1965; 11th January 1967.

The centrifugal is similar to the design covered by U.K. Patent 990,490[1] in which it has been found, however, that rapid separation of wash water through the screens produces a drier sugar which does not move easily over the screen surface because of the higher frictional forces; the crystals roll over each other irregularly, forming a cake of variable thickness and speeds of transport over the screen surface. This results in out-of-balance operation and consequent undesirable vibration.



This is remedied by mounting the concentric screens 9a, 9b, 9c such that their angle of slope to the vertical is 30°–35° and the path to be traversed on each by the sugar is between 7 and 10 inches, preferable values being 32° and 8 inches. Further, the nozzles 11 by which "covering" or wash water is admitted are mounted so as to discharge in the vicinity of the position where the sugar passes from one basket to the next.

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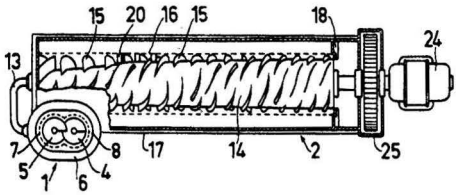
Beet pulp press. AB. LANDSVERK, of Landskrona, Sweden. **1,056,965.** 12th March 1965; 1st February 1967.

The press is in two parts, the first of these being a pre-press 1 in which contra-rotating vertical scrolls 4, 5, driven through gearing from the same motor, subject beet pulp supplied from above to a moderate pressure, achieved rapidly after the entrance of the pulp into the press casing 8. Press water squeezed out through the screen 7 surrounding the scrolls into gutter 6 drains through the pipe 13 into the casing of the main press 2.



This is a horizontal press in which the paraboloidal shaft 14 is provided with flight sections 15 and is rotated by motor 24 so that the flight sections turn, interrupter bars 20 preventing rotation of the pulp with the shaft. The pulp is therefore carried along from the pre-press end of the main press to the motor end and out through the valve 18. Press water passes through screen 16 into the casing 17 from which it is drained, together with the water from pipe 13.

The pre-press may be horizontal and the main press vertical, there may be more than two scrolls forming the pre-press conveyor-press device, and there may be twin vertical presses fed separately from a large common pre-press mounted directed directly above, in which the scrolls 4, 5 are extensions of the main press shafts 14.

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Beet harvester. FELLA-WERKE G.M.B.H. of Feucht/Bayern, Germany. **1,054,886.** 4th June 1965; 11th January 1967.

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Method of purifying molasses. KYOWA HAKKO KOGYO CO. LTD., of Tokyo, Japan. **1,056,996.** 28th February 1964; 1st February 1967.—Molasses is mixed with a water-soluble organic solvent (methanol, ethanol or acetone) and precipitated impurities are filtered off. The solvent is removed and the molasses treated at least once with active carbon for decolorization and at least once with cation and anion exchange resins for deionization. The purified molasses is suitable as a source of sugar for the chemical industry.

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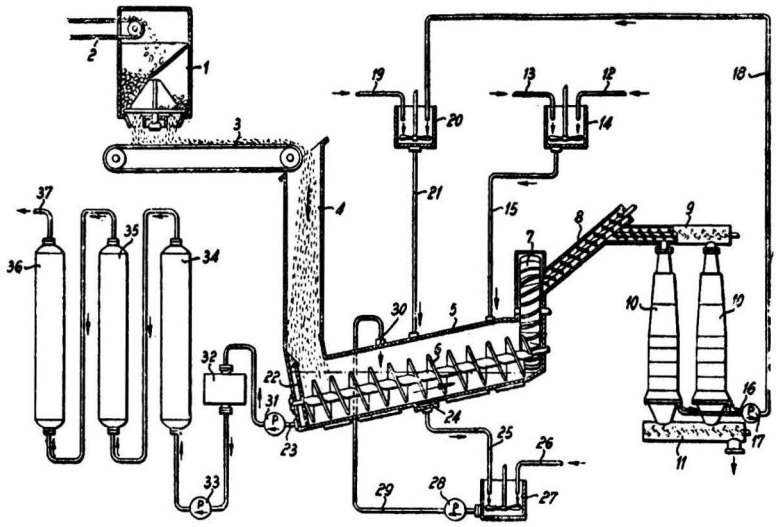
[1] *I.S.J.*, 1966, **68**, 186.

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).

Beet juice extraction. KNAPSACK A.G., of Knapsack bei Köln, Germany. **1,056,170.** 12th October 1964; 25th January 1967.

Beet is delivered by conveyor 2 to slicing machine 1 which converts it into cossettes carried by conveyor 3 to the supply conduit 4 of extractor 5, transported by screw 6 in counter-current to extraction liquid, removed by bucket wheel 7 and carried by screw 8 to the feed screws 9 of two vertical screw presses 10 in which it is dewatered to give pressed pulp discharged into a screw conveyor 11 and press water discharged through pipe 16 to pump 17. The press water is pumped through pipe 18 to a mixing vessel 20 in which it is mixed with an aqueous solution of



(0·001–0·100%) polyphosphoric acid (containing at least 72·4% P_2O_5 by weight) and/or (0·005–0·040%) itaconic acid before being sent through pipe 21 to extractor 5.

Make-up water is admitted from pipe 12 to a mixing vessel 14 where it is brought to pH 5·8 by means of sulphuric, sulphurous or phosphoric acid admitted through pipe 13. From vessel 14 this make-up water travels along pipe 15 to the higher end of the extractor 5. A suitable amount of extracting liquid is withdrawn from about the centre of the extractor, passing through screen 24 and pipe 25 to mixing vessel 27 where it is stirred while lime [0·0005–0·05% $Ca(OH)_2$] is added from pipe 26 to neutralize the acid content. The neutralized liquid is then returned by pump 28 via pipe 29 and connector 30 into the extractor.

Raw juice is withdrawn through screen 22 into pipe 23 and conveyed by pump 31 to a filter 32 and further pump 33 and then to columns 34, 35 and 36 containing respectively a decolorizing material, cation exchanger and anion exchanger, so that the thin juice leaving through pipe 37 can be sent direct to the evaporator.

The polyphosphoric acid or itaconic acid in the extraction water preserves the initial stiffness of the cossettes and gives a juice low in pectins, proteins and soluble nitrogen compounds so that it can be treated with resins and evaporated without the usual purifying treatment.

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UNITED STATES

Drying and simultaneously cooling white sugar coming from a centrifugal station. H. KAMP, of Krefeld-Bockum, Germany, assr. BÜTTNER-WERKE A.G. **3,229,383.** 21st January 1963; 18th January 1966. See U.K.P. 1,023,700.[1]

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Method of separating solids in liquid suspension. D. S. CUSI, of Mexico City 6, Mexico. **3,231,087.** 23rd February 1962; 25th January 1966. — Underwater separation into two fractions of a heterogeneous suspension of two groups of particles (bagasse fibre and pith) involves submerging in the suspension a perforated screen plate (e.g. in the form of a drum, having holes which are uniformly substantially larger than any dimension of the one group and uniformly substantially smaller than the longest dimension of the other. The screen presents a substantially plane surface from one hole to each of the next adjacent holes. A hydrostatic head pressure is applied to move the suspension toward the holes and the screen moved relative to the suspension in a direction parallel to the screen whereby the longer-dimensioned fibre particles are deflected into a rejected fraction while the smaller pith particles pass through.

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Fatty acid sugar esters and fatty acid sugar boron esters. T. E. BRUNELLE, L. M. RUE and S. B. CRECELIUS, *assrs.* ECONOMICS LABORATORY INC., of St. Paul, Minn., U.S.A. **3,231,561.** 3rd January 1962; 25th January 1966.—Surface active and emulsifying esters are prepared by reacting a saccharide (glucose, sucrose) in glacial acetic acid with a reactable boron compound (orthoboric acid) to form a reaction product soluble in acetic acid, reacting this product with an acyl halide (of 8–18 carbon atoms) to form an ester and removing the solvent. The product may then be heated with an alcohol to form an alkyl ester.

[1] *I.S.J.*, 1966, **68**, 316.

Process for recovering unreacted sucrose from the reaction solution of fatty acid sucrose ester. S. MORI, of Tokyo, Japan, *assr.* DAINIPPON SEITO K.K. **3,231,562.** 22nd August 1962; 25th January 1966. An inter-estification reaction is carried out between a methyl ester of a C_6–C_{30} fatty acid and sucrose in dimethylformamide as solvent and in the presence of an alkaline catalyst, at 60°–120°C in a vacuum, the methyl alcohol and some solvent being distilled off. The reaction product is mixed with sufficient toluene ($\frac{1}{4}$–19 volumes; $\frac{2}{3}$ volume; 3–4 volumes) so that the unreacted sucrose is rendered insoluble at 80–85°C while the sucrose ester remains in solution. The mixture is cooled to 30°C and the sucrose separated.

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Raw cane sugar recovery process. B. A. BOURNE and P. S. FRANCIS, of Clewiston, Fla., U.S.A., *assrs.* U.S. SUGAR CORPORATION. **3,232,795.** 30th April 1963; 1st February 1966.—Raw cane juice is treated with 50–120 p.p.m. (100 p.p.m.) of sodium aluminate and 6·25–15 p.p.m. (12·5 p.p.m.) of NaOH, thereafter adding substantially non-calcined $Mg(OH)_2$ to adjust the pH (to 7·1–7·2). The juice is then heated to boiling point and (1·5 p.p.m. of a) carboxyl-containing anionic water-soluble polyelectrolyte (a copolymer of acrylamide and acrylic acid) added, to produce a primary juice and a first precipitate. The latter is treated with 80–120 p.p.m. (90–100 p.p.m.) of 80% phosphoric acid and the pH adjusted to 7·0–7·1 with lime and 6–10 p.p.m. (8 p.p.m.) of a polyelectrolyte consisting essentially of a copolymer of acrylamide and acrylic acid. This produces a second precipitate and a clarified sugar solution which, with the primary clarified juice, is evaporated to 60–62°Bx and boiled under a vacuum of 25–77 inches Hg to a 94°Bx massecuite containing molasses and raw sugar, which are separated.

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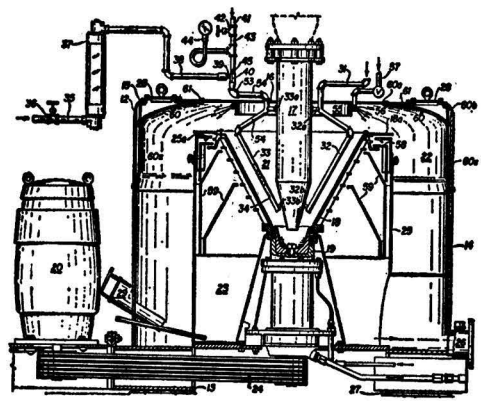
Beet or cane diffusion. D. D. SIBBERSEN, of Bistrup, Denmark. **3,235,338.** 27th June 1962; 15th February 1966.—The twin-scroll type of conveyor unit in a sloping trough diffuser avoids the necessity for breakers to prevent rotation of the beet or cane, but variation in the throughput of the unit is limited by the need to keep the trough almost completely full, so restricting the possible variation in speed of rotation of the scrolls, and by the increased friction and power requirements which result when greater diameter scrolls are used in an effort to increase throughput. A second pair of scrolls is therefore mounted above the first and can be used when the trough is full to double the throughput achieved by a single pair, while the upper pair may be run at minimum speed and only the lower pair used fully when lower throughput is required. The hollow space formed between the peripheries of the upper and lower pairs of scrolls can be occupied by a prismatic-sectioned body through which a heating or cooling medium can be introduced.

Continuous centrifugal. C. R. STEELE, *assr.* AMERICAN FACTORS ASSOCIATES LTD., of Honolulu, Hawaii, U.S.A. **3,238,063.** 3rd August 1962; 1st March 1966.

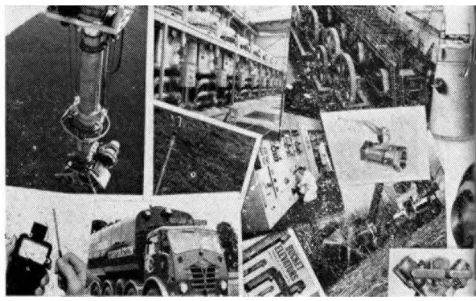
The continuous conical centrifugal embodies a screen 18 mounted in a cone carried by hub 19 driven by motor 20 by means of belts 24. The cone is within a housing 14 provided with a molasses compartment 23 and a sugar compartment 22 separated by a vertical partition 25. Sugar leaves the compartment 22 through duct 27, while molasses passes by way of a sealed duct through compartment 22 into exit pipe 26. Massecuite is supplied through feed pipe 17 which passes through the central part 16 of cover 15. It is separated into sugar and molasses as it rises over screen 18, the molasses passing through into compartment 23 and the sugar being discharged over the edge 18*a* into compartment 22.



Water, at a flow rate regulated by valve 36 in accordance with a meter 37, is mixed with steam, the flow of which is governed by valve 42 in accordance with pressure gauge 44. The mixing occurs in an ejector type unit 40 and gives an atomized mixture delivered onto the massecuite surface from manifold 34 through a series of holes of narrow diameter having countersunk external ends to eliminate blocking. The mixture aids the removal of the molasses film from the crystal surfaces, as does the heating effect of steam supplied through holes in another manifold 32 supplied from pipe 31. A further annular manifold 56 is provided for supply of hot water for washing down the centrifugal during cleaning.

To avoid crystal breakage a baffle 60 is provided against which the discharged sugar is thrown. The baffle is of flexible material such as rubber and is supported by the end 60a and an appended portion 60b. At the normal discharge rate the baffle pulsates under the action of the sugar; alternatively, between it and the outer wall 14 of the casing may be arranged a series of compartments with connexions to a source of pneumatic pressure so varied as to cause pulsations in the baffle.

Trade notices



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"Zuclar 106". Fabcon Inc., 314 Public Square Building, Cleveland, Ohio, 44113 U.S.A.

"Zuclar 106" is an improved polyacrylamide coagulant for use in sugar juice up to 5 p.p.m. for improving clarification and improving filtration of muds and clarity of filtrate. It is used as a dilute (0·50%) solution, prepared by adding the dry powder slowly to water and stirring until completely dissolved. Sufficient of this solution is added to the juice entering the clarifier to give the required proportion—normally 0·5–2 p.p.m., although factories in Louisiana and Mexico are obtaining satisfactory clarification of very refractory juices using 3–5 p.p.m. Best results are obtained when the "Zuclar" solution is completely dispersed in the juice from the flash tank, with minimum stirring to disturb the flocs. The solution may be added, with additional water dilution of 4:1, by means of a T-feed connexion, 5 to 15 ft before the clarifier.

For improved filtration the 0·50% "Zuclar" solution is fed at 2–10 p.p.m. on mud weight through a conventional feeder or distributed along the length of the bagacillo-mud mixer by dripping through a 1-inch plate drilled on 6-inch centres. Raising the mud pH to 7·5–8·0 with lime will normally further improve the filtrability of the mud and the clarity of filtrate.

* * *

Silos. Edenhall Concrete Products Ltd., Penrith, Cumberland, England.

A new form of low-cost silo, ideal for, *inter alia*, sugar and chemicals, is announced. The silo is based on pre-cast concrete staves and post-stressing techniques in imitation of the method used in barrel construction, being reinforced with galvanized steel hoops. These are set at more frequent intervals near the base of the silo. The pressures and point loads are distributed evenly through the hoops, which are joined by lugs to form a clearly visible zig-zag pattern. The silo is available in sizes ranging from 12 ft dia. × 16 ft high up to 26 ft dia. × 80 ft high. Advantages include quick erection (10–12 days), little maintenance and resistance of the staves to acid, fire and moisture. Additional protection in the form of epoxy resins, chemical paints and waterproofing compounds can be applied to the interior.

PUBLICATIONS RECEIVED

THE QUENTIN PROCESS OF MOLASSES PURIFICATION. Industrieele Mij. Activit N.V., Postbox 240-C, Amsterdam, Holland.

Details are given of this process[1], of which IMACTI are the licensees, which involves ion exchange treatment of intermediate molasses to replace inorganic cations, such as K^+, with magnesium ions, whereby a further 0·5% of sugar on beet may be crystallized and the final molasses purity reduced by 4–6 units.

* * *

CATENARY IDLERS. Rex Chainbelt Inc., P.O. Box 2022, Milwaukee, Wisconsin, 53201 U.S.A.

Bulletin 6651 contains details of a new line of Rex catenary idlers which has been designed for the movement of hot, sticky, wet or abrasive materials. They feature double contact seals and non-regreasable bearings which prevent belt contamination with grease. The idler rollers have a rubber surface which will not cut into the belt and are corrosion-resistant. The idler has a mounting hook, which permits adaptation to various load conditions as well as easy roller installation. The oval base pipe is self-cleaning and the base end stands are designed to give added strength where the loads approach the maximum. The idlers are available for 18-, 24-, 30- and 36-inch belt widths.

* * *

PORTABLE MIXERS. Mitchell Craig Pumps Ltd., Glenburn Road, College Milton, East Kilbride, Glasgow, Scotland.

A two-colour 12-page brochure, No. PM.1, describes the complete range of portable mixers manufactured by Mitchell Craig Pumps Ltd. and contains information on their design, selection and construction materials, etc.

* * *

HYMATIC CONTROL VALVES. Control Valve Division, The Hymatic Engineering Co. Ltd., Glover St., Redditch, Worcs., England.

Publication HY 900 gives details of the range of valve body types of Hymatic automatic process control valves. A wide range of inner valves and of actuators is complemented by a complete range of accessories and a selection of pressure, level and temperature controllers, to cover fluid control problems.

Silver ring diffusers.—The third Silver ring cane diffusion-clarification-filtration system has started operations at Ingenio Eldorado, in Mexico. The system used incorporates a "Fiberizer" for cane preparation but uses two sets of cane knives instead of the "Buster" used in the systems at Pioneer (Hawaii) and Naha (Ryukyu Islands). The Ingenio Eldorado plant has a throughput of 3600 t.c.d. A fourth Silver diffuser, also of 3600 t.c.d. capacity, is to become operational this year at a factory in Venezuela, and a contract has been signed for the supply of a 6400 t.c.d. unit to Hacienda Casa Grande in Peru. A second 6400 t.c.d. unit is also planned for the factory but it has not yet been ordered. The two diffusers are intended to replace all the mills presently in use.

[1] *I.S.J.*, 1958, **60**, 174.

United States Sugar Supply Quotas 1967

	Deficits and prorations	*Revised quotas*
	(*short tons, raw value*)	
Domestic Beet	—	3,025,000
Mainland Cane	—	1,100,000
Hawaii	—	1,252,543
Puerto Rico	—415,000	725,000
Virgin Islands	—15,000	0
Total domestic	—430,000	6,102,543
Argentina	7,520	59,684
Australia	—	185,499
B livia	728	5,776
Brazil	61,134	485,176
British Honduras	1,639	13,009
British West Indies	22,502	178,580
Colombia	6,469	51,341
Costa Rica	7,198	57,123
Dominican Republic	166,134	590,176
Ecuador	8,895	70,594
Fiji	—	40,707
French West Indies	7,078	56,175
Guatemala	6,065	48,137
Haiti	3,396	26,954
Honduras	726	5,759
India	—	74,200
Ireland	—	5,351
Malagasy	—	8,759
Mauritius	—	17,004
Mexico	62,508	496,086
Nicaragua	7,198	57,123
Panama	4,528	35,938
Peru	48,761	386,986
Philippines	—	1,126,020
Salvador	4,448	35,301
South Africa	—	54,619
Swaziland	—	6,699
Taiwan	—	77,291
Thailand	—	17,004
Venezuela	3,073	24,386
Total	—	10,400,000

Brevities

Antigua sugar industry[1].—The assets of the Antigua Sugar Factory Ltd. have been purchased by the Government and a board appointed to revitalize and run the sugar industry. Some former employees have been re-engaged and the factory is preparing to take off a crop estimated at 5000 tons of sugar.

* * *

U.K. beet price 1967.—The guaranteed price to be paid for sugar beet in 1967, according to the annual agricultural review, will be £6 13s 0d per ton, basis 16% sugar content, with an increase or decrease of 10s 0d per 1% above or below 16%. This price is 2s 6d higher than that paid for beet in 1966. A White Paper issued simultaneously with the Government announcement states that the contract acreage will be the same as in 1966, i.e. 427,000 acres in England and Wales and 15,600 acres in Scotland. The Government expects a sugar production of 900,000 tons from U.K. beet this year, while 2,200,000 tons will be imported.

* * *

Polish sugar production, 1966[2].—A total of 13,600,000 metric tons of sugar beet was harvested in Poland during 1966, or 10·4% more than in 1965. This was despite a reduction in area since yield of beets per hectare amounted to 32 tons or 20·5% higher than in 1965 while the sugar content of the beets was only slightly lower at 11·4% *vs.* 11·5% in 1965. Sugar production was some 1,722,000 metric tons, raw value, or about 25,000 tons higher than in 1965.

Finland sugar imports, 1966[3].—Imports of sugar into Finland in 1966 totalled 162,372 metric tons, raw value, as against 138,760 tons in 1965. Principal suppliers were Cuba (76,241 tons), the U.S.S.R. (56,449 tons), Poland (19,317 tons) and South Africa (10,320 tons).

* * *

Rumania sugar beet production 1966/67[4].—A record sugar beet crop was harvested in Rumania in 1966/67, amounting to 4,277,000 metric tons, compared with 3,270,000 tons in 1965 and 3,670,000 tons in 1964. Sugar production in the calendar year 1966 reached 442,000 metric tons, compared with 402,000 tons in 1965 and 349,000 tons in 1964; these figures comprising production from different campaigns are thus not comparable on a campaign basis.

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Austrian beet crop, 1966/67[5].—In the 1966/67 campaign, a record crop of 2,308,000 metric tons of beet were sliced; the previous record of 2,200,000 tons was sliced in 1964/65.

* * *

Japanese sugar imports 1966[6].—Imports of sugar into Japan during 1966 totalled 1,738,307 metric tons, tel quel, as against 1,722,956 tons in 1965. Of this total, Australia supplied 582,567 tons, Cuba 361,006 tons, Taiwan 359,433 tons, Ryukyu Islands 219,647 tons, South Africa 166,935 tons, Indonesia 39,246 tons, Mainland China 8297 tons, Thailand 974 tons, the U.S.A. 201 tons and Philippines 1 ton. Taiwan has been a major supplier of sugar to Japan for some years but this supply is to be broken in 1967 because of a lower cane crop in Taiwan which will reduce the quantity of sugar available for export.

* * *

Argentina 1966/67 sugar crop[7].—A total of 10,241,850 metric tons of cane were crushed in the 1966/67 season, to yield 963,222 tons of sugar, raw value, representing a yield of 9·405% on cane. The crop was a reduction from the 1,211,480 tons of sugar produced in the previous campaign from 13,112,317 tons of cane, which represented a recovery of 9·239%.

* * *

Sugar beet experiments in India[8].—The Central Government has selected the Janata Cooperative Sugar Mill, at Bhogpur in Jullundur district, for a new experiment in the production of sugar from sugar beet. The necessary machinery will be provided by the Government.

* * *

Japanese beet factory closure[9].—Fuji Seito Co. Ltd. have notified the Japanese Government of their intention to close down their beet sugar factory in Aomori Prefecture in the northern part of the main island after the next crop unless they receive financial help. The factory has run at a loss since its launching in 1962, owing to the high cost and insufficient supply of sugar beets.

* * *

Morocco sugar expansion[10].—In addition to the two existing factories and the third planned to start in May 1968[11], a fourth factory is to be erected in Sidi Alal Tazi, an agreement concerning the construction of this plant having been signed recently between the Moroccan Ministry of Trade and Industry and representatives of three West German firms.

* * *

Guinea sugar factory[12].—Plans have been laid for the construction of Guinea's first cane sugar mill at Madina-Oula. It is hoped that the factory, which will have an annual production capacity of 30,000 tons of sugar, will be completed in 1968.

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[1] *Overseas Review* (Barclays D.C.O.), May 1967, 74.
[2] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (5), 11; (6), 11.
[3] C. Czarnikow Ltd., *Sugar Review*, 1967, (802), 41.
[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (5), 12.
[5] *Zeitsch. Zuckerind.*, 1967, **92**, 97–98.
[6] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (5), 12.zfi
[7] *La Ind. Azuc.*, 1967, **72**, 52–55.
[8] *Indian Sugar*, 1967, **16**, 811.
[9] *Willett & Gray*, 1967, **91**, 170.
[10] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (9), 16.
[11] *I.S.J.*, 1967, **69**, 128.
[12] C. Czarnikow Ltd., *Sugar Review*, 1967, (811), 81.

Brevities

Israel sugar production[1].—The Israel Ministry of Agriculture has decided not to permit an increase in Israeli sugar beet production this year and has set a target of 300,000 metric tons, which should yield about 37,500 tons of white sugar. Beets processed from the 1966 crop totalled 282,000 tons and produced 36,250 tons of white sugar, sufficient to cover about one-third of local requirements. The average yield per irrigated acre rose from 2·772 tons in 1965 to 3·260 tons in 1966. This reflected favourable weather and more effective sowing, thinning and spraying methods. However, the yield from unirrigated fields was only about half this figure.

* * *

Spanish production plans[2].—A total sugar output of 655,000 metric tons (620,000 tons from beet and 35,000 tons from cane) is the target set by the Spanish Government for the 1967/68 season. The beet sugar target for 1966/67 was 600,000 tons. Basic beet prices in 1967/68 will remain unchanged at 1345 pesetas per ton, but a scale of premiums and discounts will apply for the first time in accordance with the sugar contents. The same practices will be applied to the cane crop as from the 1968/69 season. A total subsidy of 1100 pesetas per metric ton of sugar produced will be paid by the Government to sugar factories. At the same time, 60 million pesetas will be put at the disposal f the Ministry of Agriculture to rationalize beet cultivation, of which 10 million will be used to improve seeds and 50 million on mechanization.

* * *

Portuguese East Africa sugar project[3].—Development of a 15,000-hectare concession at Mafambisse (in the Manica and Sofala district) on the Púngue River is taking place. Preliminary works on the agricultural and industrial side have commenced. It is initially proposed to install 73 smallholders with a quota allotment of 3000 tons of cane each. The new concern, whose 600 shares have been fully subscribed, is receiving the technical assistance of French firms. It is anticipated that the venture should be in full operation in a year's time.

* * *

Japan beet sugar crop, 1966/67[4].—The 1966/67 beet sugar campaign in Hokkaido and the Northern province of Japan reached 221,330 metric tons.

* * *

Indonesia return of British Company[5].—Indonesia has returned to its British owners the United Molasses Company which was taken over in 1964 by the Sukarno régime. Documents reversing the take-over were signed in Djakarta at the end of April at the Ministry of Plantations. An official of the Government Management Board said that the annual export of molasses by the Company had been increased from the 1964 figure of 80,000 tons to 248,000 tons last year while under Government control, and it was now hoped that the owners would invest fresh capital in the Company.

* * *

Burma sugar plans.—Provisional estimates published in the Burmese Budget Report put the area to be cultivated with cane during the 1966/67 season at 133,000 acres; it is forecast that this will yield 1,960,000 tons of cane as against 1,430,000 tons harvested during 1965/66. Meanwhile, following improvements to the existing sugar factories and the construction with a Chinese loan of a new mill at Bilin with a daily sugar output of 100 tons, the annual Burmese sugar production capacity is now in the region of 77,000 tons. This should be enough, according to the *Yearbook* of the Far Eastern Economic Review Ltd[6]. to ensure that Burma is self-sufficient in sugar.

* * *

Czechoslovakia beet area reduction[7].—The area to be planted to sugar beet in Czechoslovakia is to be restricted to 200,000 hectares in 1967, which compares with about 220,000 hectares in each of the previous two years.

Indian Sugar Exports[8]

	1966	1965	1964
	(*metric tons, tel quel*)		
Canada	51,074	52,762	—
Ceylon	—	—	2
France	20,898	—	—
Hong Kong	10,140	—	10,469
Iran	40,557	—	—
Iraq	15,402	—	—
Italy	—	—	19,153
Japan	—	—	60,866
Korea, South	—	9,519	—
Lebanon	10,091	—	—
Malaysia/Singapore	99,214	35,900	14,509
Persian Gulf	—	1,000	—
U.K.	98,628	75,716	10,525
U.S.A.	65,440	91,896	99,431
Vietnam, South	9,645	9,725	19,346
Zambia	10,308	—	—
Total	431,397	276,518	234,301

New Japanese refining Company[9].—Creditors of Kyowa Seito Co. Ltd. and its affiliated companies have decided to set up a new company, Daiichi Togyo Co. Ltd. to lease Kyowa's Miyazaki sugar refinery and Chiba glucose factory on a rental basis. This follows public awareness of the Kyowa company in a political scandal and prosecution of the management for alleged fraud, illegal disposition of bank loans, etc.

* * *

U.S. mainland cane sugar production[10].—The 1966/67 season in Florida closed at the end of March with a record quantity of 652,261 short tons, raw value, of sugar produced. This exceeds earlier estimates by approximately 50,000 tons and is over 100,000 tons above the 1965/66 production figure of 546,977 short tons. Overall sugar output during 1966/67 from U.S. mainland cane areas totalled 1,219,000 short tons, according to the U.S. Dept. of Agriculture, as compared with 1,104,000 tons produced in the previous season.

* * *

Ivory Coast sugar projects[11].—Three sugar projects are soon to be undertaken in the Ivory Coast. The first of these was proposed by a Hawaiian Company and involves the planting of cane this year on a preliminary area of 8000 hectares in the Marahoue valley, approximately 160 miles northwest of Abidjan. It has also been recommended, according to Agence France-Presse, that three sugar factories should be constructed in this area between 1970 and 1972. Furthermore, a second area of 9500 hectares in the region of Ferkessedouglou, in the extreme north of the country, has been pronounced favourable for cane growth by SESUAM and it is expected that planting will commence before 1970.

* * *

Kenya sugar proposal[12].—Negotiations for the establishment of a £7,000,000 sugar estate and factory at Mumias are being held between the Kenya Government and a number of interested organizations. If established, this scheme would be the third major sugar estate in Kenya and should enable the country to become self-sufficient in sugar by 1973.

* * *

Canadian beet sugar crop, 1966/67[13].—From an area of 81,272 acres harvested in 1966/67 a total of 1,013,009 long tons of beet were delivered and processed to give 134,248 tons of sugar. This compares with 1,014,547 tons of beet produced from 85,101 acres in 1965/66 and processed to give 119,310 tons of sugar.

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[1] *Reuter's Sugar Rpt.*, 21st February 1967.
[2] *Public Ledger*, 28th February 1967.
[3] *Overseas Review* (Barclays D.C.O.), April 1967, 30.
[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (9), 17.
[5] *Public Ledger*, 29th April 1967.
[6] Through C. Czarnikow Ltd., *Sugar Review*, 1967, (812), 85.
[7] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (12), 6.
[8] C. Czarnikow Ltd., *Sugar Review*, 1967, (811), 80.
[9] *Willett & Gray*, 1967, **91**, 170.
[10] C. Czarnikow Ltd., *Sugar Review*, 1967, (814), 94.
[11] C. Czarnikow Ltd., *Sugar Review*, 1967, (813), 88.
[12] *Overseas Review* (Barclays D.C.O.), April 1967, p. 48.
[13] C. Czarnikow Ltd., *Sugar Review*, 1967, (814), 93.