International Sugar Journal

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

Annual Subscription: 50s 0d or $8.00 post free
Single Copies: 6s 0d or $1 post free

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Changements de la vitesse de la cristallisation en fonction de la quantité des substances colorées dans la solution. H. Zaorska. p. 99–103

Des substances colorées contenues dans le sucre de basse pureté ont été adsorbées sur le charbon actif et ensuite extraites afin de les ajouter en quantités diverses à des solutions du saccharose pur et à des liqueurs de haute pureté. Les substances colorées a réduit la vitesse de la cristallisation dans les solutions, mais l'effet refrénant a été plus petit à mesure que les additions de la couleur a été augmentées. L'effet des substances colorées a été plus grand avec les liqueurs de plus haute pureté que dans le cas de celles d'une plus basse pureté.

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Le refroidissement de masses cuites dans les cristalliseurs discontinus à refroidissement à eau. H. J. Spoelstra et D. Hoks. p. 103–107

On présente une formule d'approximation simplifiée pour le calcul de la chute de température d'une masse cuite dans un cristalliseur discontinu à refroidissement à eau. Cette formule, en combinaison avec une formule antécédente pour refroidissement à air naturel, donne la chute de température totale. Des essais laboratoires et dans la sucrerie, dans lesquels on a varié l'écoulement de l'eau, ont donné des résultats qui sont présentés sur une seule courbe dans un graphique. Bien que la courbe soit approximative, elle est cependant utile pour l'estimation de la température d'une masse cuite avec une précision acceptable, et on donne un calcul typique comme exemple.

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Des méthodes de l'estimation de l'acide aconitique. S. C. Gupta et U. Chetal. p. 107–110

Une méthode de carboxylation pour l'estimation de la teneur en acide aconitique dans les mélasses, bien que plus simple que la précise méthode polarographique, a donnée des résultats avec une erreur jusqu'à 40–60%. Par l'addition de l'acétate de plomb à pH 11 au lieu de pH 6·5, la précipitation de l'aconitate a été complete et l'erreur a été réduite à 2%.

Geschwindigkeitsänderungen der Saccharosekristallisation in Abhängigkeit von der Farbstoffmenge in der Lösung. H. Zaorska. S. 99–103

Es wurden Farbstoffe aus Zucker von niedriger Reinheit auf Aktivkohle adsorbiert. Nach der Extraktion, wurden die Farbstoffe in verschiedenen Mengen zu reinen Saccharoselösungen und Klären von hoher Reinheit hinzugegeben. Die Farbstoffe verminderten die Kristallisationsgeschwindigkeit in den Lösungen, obgleich der Hemmungseffekt geringer mit steigendern Farbstoffmengen war. Die Einwirkung der Farbstoffe war grösser mit Klären von hoher Reinheit als mit jenen von niedrigerer Reinheit.

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Die Kühlung von Füllmassen in diskontinuierlichen, wassergekühlten Kristallisatoren. H. J. Spoelstra und D. Hoks. S. 103–107

Eine simplifizierte Näherungsformel für die Berechnung von Temperaturabfall in einer Füllmasse in einem diskontinuierlichen, wassergekühlten Kristallisator wird gegeben. Diese Formel, in Verbindung mit einer früheren Formel für die Kühlung mit natürlicher Luft, gibt die Gesamttemperaturabfall. Betriebs- und Laborversuche, in den das Wasserfliessen variiert wurde, haben Ergebnisse gegeben, welche auf einer einzigen Kurve in einem Diagramm dargestellt werden. Obgleich die Kurve nur annähernd ist, ist sie nützlich für die Berechnung von Füllmassetemperatur mit passender Genauigkeit, und man gibt eine typische Berechnung als Beispiel.

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Methoden für die Berechnung von Akonitinsäure. S. C. Gupta and U. Chetal. S. 107–110

Eine Dekarboxylisierungsmethode für die Berechnung von Akonitinsäure in Melassen, obgleich mehr einfach als die genauige, polarographische Methode, hat Ergebnisse mit einem Fehler bis zu 40–60% gegeben. Durch die Hinzufügung des Bleiazatats bei pH 11 statt pH 6·5, war die Akonitatsniederschlagung vollständig, und der Fehler wurde bis zu 2% vermindert.

Cambios en la velocidad de cristalización de sacarosa como función de la cantidad de material colorante en la solución. H. Zaorska. Pág. 99–103

Material colorante de azúcar de bajo grado se adsorba sobre carbón activo y después se extrae para adición en varias proporciones a soluciones de sacarosa pura y a licores de alta pureza. El material colorante disminuó la velocidad de cristalización de las soluciones pero el efecto de reducción estuvó menor para incrementos adicionales de color. El efecto del material colorante estuvó mayor con licores de alta pureza que con estos de más bajo pureza.

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El enfriamiento de masas cocidas en cristalizadores no-continuos enfriado con agua. H. J. Spoelstra y D. Hoks. Pág. 103–107

Una fórmula simplificado de aproximación se presenta para calcular la caída de temperatura de una masa cocida en un cristalizador no-continuo enfriado con agua. Esta fórmula, en combinación con un otra dada previamente, de la caída total de temperatura. Ensayos en una fábrica y pruebos en el laboratorio en que el flujo de agua se variaba dieron resultas que se presentan en la misma curva de un gráfico. Mientras la curva es aproximativa, sin embargo es útil para predecir la temperature de una masa cocida con exactitud aceptable, y un cálculo típico se presenta como ejemplo.

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Métodos para estimación de ácido aconitico. S. C. Gupta y U. Chetal. Pág. 107–110

Un método de descarboxilación para estimación de ácido aconitico en melaza, mientras más sencillo que el exacto método polarográfico, dió resultas con error tan grande como 40–60%. Por adición del acetato de plomo a pH 11 en lugar de pH 6·5, precipitación del aconitato estuvó completa y el error se reduzca al 2%.

THE
INTERNATIONAL
SUGAR JOURNAL

VOL. LXX APRIL 1968 No. 832

Notes & Comments

British Sugar Corporation Ltd., 1967 Report

6,496,229 tons of beet was delivered to the factories from the 1966 crop. The average yield per acre at 15·12 tons was the third highest in the Corporation's history. However, the sugar content at 15·78% was relatively low.

The output in terms of white sugar was 847,558 tons. The total quantity of molasses produced was 283,459 tons. Dried molassed pulp production at 548,383 tons narrowly exceeded the record figure of 1965. One-third of this was in the form of nuts and additional plant has been installed to increase production of this increasingly popular feed for cattle and sheep.

Genetic monogerm seed was sown in commercial quantities for the first time in Britain. After many years of intensive work by the seed producers the performance of several varieties of this seed now approaches that of the best well-established multigerm varieties, and further progress in this direction is confidently anticipated. Pelleted seed of both multigerm and monogerm varieties was sown on an increasing commercial scale.

For the second year in succession, abnormally heavy rain in the late Autumn made harvesting difficult and the growers are to be congratulated on keeping the factories fully supplied with beet and completing the harvest with negligible loss of crop.

Precision drilling has increased from 10% to 85% of the total acreage sown. In association with the application of chemicals for weed control, now used on over half the crop, these modern drills significantly reduce the amount of hand labour required to single the beet, particularly when pelleted monogerm seed is sown, and at the same time contribute to higher plant populations and, in consequence, higher yield.

Whereas in 1957 approximately half the crop was harvested by hand, 95% is now harvested mechanically; this represents a further substantial reduction in the labour demand. The use of cleaner-loaders, introduced in 1961, now extends to 58% of the beet delivered, with substantial savings to growers in haulage costs and to the Corporation in soil disposal.

With regard to disease control, it has been calculated that virus yellows was responsible for a loss equivalent to one million tons of beet in 1957, and there is every reason to believe that similar heavy losses were incurred in earlier seasons. Thanks to the untiring efforts over the years of Dr. RAYMOND HULL and his staff, of Broom's Barn Experimental Station, systemic insecticides are most effectively used to kill aphids which transmit the disease. As a result, based upon daily inspection by BSC field staff, growers are now advised when to spray their crops and the ready adoption of this service has provided effective control of the disease.

Indications are that the 1967 crop yield will be similar to that of 1966, with a slightly higher sugar content.

In the last financial year much obsolete plant has been replaced by modern equipment and new machinery installed with the joint object of increasing capacity and efficiency.

At the Bardney factory a target capacity increase of 40% was aimed at following the installation of automatic continuous filtration, increased evaporating and sugar boiling capacity and additional washing water settling plant. This target has in fact been exceeded in the 1967/68 campaign. New installations at other factories include boilers, turbo-generators, pulp presses, automatic centrifugals and other ancillary plant. In addition extensive work has been carried out on water treatment plant for the prevention of river pollution.

Since 1957 the slicing capacity of the 18 factories has been raised from 47,000 to 56,500 tons per day—equivalent to the addition of three average-sized factories, but at much less cost and with the avoidance of increased overheads. Beet reception facilities have had to be enlarged to cater for this increased capacity. In the largest factory this means handling from lorries up to 1,000 tons of unwashed beet per hour at peak periods. All weights and sugar contents are now determined automatically and can be transmitted directly into the computer at Central Offices.

The policy of replacing a proportion of the fuel for boilers and dryers by oil has raised overall efficiency and reduced labour. In the next few years there will have to be the costly replacement of aged boiler and power plant at several factories.

The first experimental automated extraction, filtration, centrifugals, and lime-producing plants were installed rather more than ten years ago and, following satisfactory results, these are now in operation at those factories where they are an economic proposition. These installations have improved working conditions.

Pulp drying has been considerably extended and made more economical by plant for more efficient pressing of wet pulp.

In 1958 there were only two bulk white sugar storage installations. This system has now been extended to ten factories with a total bulk storage capacity for the 1967 campaign of 230,000 tons. All old packeting plants have been replaced by modern installations for packing granulated, caster, icing and other sugars.

New methods for improving processs control and efficiency continue to be investigated including the use of data logging and the computer.

The exchange of visits with sugar technologists from Europe and America continued and the unrestricted exchange of information has proved to be of inestimable mutual benefit.

The Corporation has made a contribution to exports by assisting British manufacturers of sugar machinery in the design of complete factories abroad, and by supplying teams of experienced technologists and operators to commission these plants.

* * *

Jamaica Sugar Commission report[1].

One of the principal recommendations made in the report of the Commission, set up in 1966 under the chairmanship of Sir John Mordecai to investigate all problems and prospects of the sugar industry, is gradual mechanization of the sugar industry to "reduce production costs". The report, which is now being studied by the Government, also contains the following recommendations:

1. Rationalization of factories on the basis of production costs, cane transport and cane supply. The present 18 factories should be reduced by amalgamation of estates in St. Thomas, St. Catherine and on the north coast.

2. Creation of a Sugar Industry Advisory Council, a Sugar Industry Countrol Authority, a Statutory Cane Prices Board, a Statutory Sugar Board and a Statutory Research Institute Board.

3. No reduction in area of land under cane. No evidence was found by the Commission of non-productive use of appreciable areas of land suitable for cane growing. It would not be in Jamaica's interest to reduce production of a crop which creates a high degree of employment and contributes so richly to foreign exchange and Government taxes.

4. Shipping of sugar should be discontinued at the ports of Black River, Montego Bay and Falmouth because of "the excessive costs to the industry of the present antiquated operations, and . . . . the need to make a start with rationalizing shipping ports for sugar."

5. The Rocky Point proposal for the bulk loading of sugar (one of the issues which led to the appointment of the Commission) should be accepted by the Government, provided the West Indies Sugar Company, proposers of the project, satisfy certain conditions.

* * *

EEC sugar surpluses.

Sugar statistics for the EEC seem to indicate substantial surpluses of sugar in some member-countries. The Italian Government has asked for special permission to export some 200,000 tons (surplus from the 1967 crop of 1·52 million tons against an EEC guaranteed price quota of 1·23 million tons) over a period of 1½–2 years starting from 1st July. It is reported[2] that the Administrative Committee for Sugar of the EEC has turned down the request, but the Italians are expected to take the matter up "at a more political level at a special Committee for Agriculture meeting to be held on 7th March". While it is believed that permission will then be granted to avoid the sugar becoming a charge upon the Community as a whole, it is pointed out[3] that any exports would result in heavy financial losses because of the current low world prices. On the other hand, a carryover into 1968 would mean restrictions on the 1968 beet area, which in turn would seriously affect both beet growers and sugar industry workers. As C. Czarnikow Ltd. point out[4], "In many ways the EEC regulations are still unclear; in other respects, where intentions seem to be plainly stated, it appears that exemptions and exceptions may be made, or at least requested. Little wonder that the market remains confused and rumours flourish".

* * *

European sugar production 1967/68.

Estimates issued by the International Association for Sugar Statistics as a result of an inquiry held in January into sugar production in twelve West European countries show that the 2nd estimates provided by F. O. Licht KG[5] were somewhat on the low side. Coupled with the latest available Licht estimates for non-IASS countries (Italy, Ireland, Greece and Yugoslavia), the IASS figures show an increase of 162,000 metric tons, raw value, over the earlier estimates. According to Licht[6], the most important revisions apply to the production figures for West Germany and Turkey, the correction being +104,000 tons for the former country (including molasses desugaring) and +44,000 tons for the latter. Although East European countries are not members of IASS and are therefore not covered by the survey, C. Czarnikow Ltd[7]. expect that several of the earlier forecasts will eventually have to be raised, particularly the figures for the USSR and Poland.

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[1] *W. Indies Chron.*, 1968, **83**, 70.
[2] *Public Ledger*, 2nd March 1968.
[3] *Reuters Sugar Rpt.*, 15th January 1968.
[4] *Sugar Review*, 1968, (855), 47.
[5] *I.S.J.*, 1967, **69**, 34, 63.
[6] *International Sugar Rpt.*, 1968, **100**, (4), 1–4.
[7] *Sugar Review*, 1968, (852), 34.

Changes in Sucrose Crystallization Rate as a Function of the Quantity of Colouring Matter in the Solution

By Dr. H. ZAORSKA

Paper presented to the 13th General Assembly of the Commission Internationale Technique de Sucrerie (CITS), 1967

THE effect of crystallization conditions on sucrose crystal growth has usually been investigated by measuring the growth rate of single crystals or of a small number of crystals[1–4]. In many cases the effect of individual components in the solution on the crystallization rate has been studied[5–12], most tests being carried out with model solutions. In most cases the temperature range over which the crystallization rate has been measured has been limited[8–10], higher temperatures being used in only certain cases[13–16].

Tests over a number of years at the Sugar Technology Dept. of Lodz University have involved measurement of the crystallization rate in solutions of varying purity and over wide temperature ranges[17]. The influence of mother liquor circulation has been considered in these tests[18].

In recent work the effect of colouring matter on the crystallization rate of sugar in solutions of varying purity has been determined under conditions identical to those in a factory[19]. The reproducibility of the results led to further investigations.

The aim of the present work is to determine the effect of the colouring matter content on the sugar crystallization rate in solutions of relatively high purity, since it is under these conditions that the effect is most evident.

EXPERIMENTAL

Methods used

1. Extraction of colouring matter

Liquor was prepared from 2nd-product sugar and from thick juice having the same colour content. These solutions were decolorized by active carbon using the column method[20]. The carbon was then washed with distilled water, dried under reduced pressure and extracted with pyridine aqueous azeotrope. Most of the adsorbed colouring matter and colloids passed from the carbon into the aqueous pyridine solution. While the pyridine was being distilled-off, a quantity of sucrose was introduced into the isolated colouring matter solution. Thus we obtained colouring matter solutions of high sugar purity.

2. Preparation of solutions for crystallization

The following solutions were used for crystallization:

(i) Syrup from refined sugar.
(ii) Partially decolorized liquor.
(iii) Standard liquor.
(iv) Syrups to which varying quantities of colouring matter isolated from liquor were added.
(v) Syrups to which varying quantities of colouring matter isolated from thick juice were added.

The colouring matter was added to refined sugar solution in sufficient quantities to give approximately the same colour as second-product liquor. The next two syrups were prepared by adding smaller quantities of colouring matter, i.e. two-thirds and one-third of the original quantity.

A sugar solution was prepared separately by adding colouring matter obtained from thick juice. This solution then had a colour about the same as the thick juice. Two brighter syrups were prepared by adding two-thirds and one-third of the original colouring matter fraction. Hence, apart from the refined sugar solution, we had available eight solutions of varying purity and colour content. The purities and colour of the individual solutions are given in Table I.

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[1] SMOLENSKI and ZELAZNY: *Gaz. Cukr.*, 1934, **74**, 303; *I.S.J.*, 1935, **37**, 318.
[2] KUKHARENKO: *Proc. III Congr. Intern. Tech. Chem. Ind. Agric.*, 1934, Q IV.
[3] VANHOOK: *Ind. Eng. Chem.*, 1946, **38**, 50, **40**, 85.
[4] *idem: Ind. Sacc. Ital.*, 1966, **59**, 201.
[5] SANDERA: *Z. Tschsl. Zuckerind.*, 1927, **8**, 401.
[6] DĚDEK: *Listy Cukr.*, 1932, **51**, 125.
[7] MIRČEV and SANDERA: *ibid.*, 1955, **71**, 37.
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[17] ZAGRODZKI: *Wiad. Chem.*, 1959, **13**, 185.
[18] ZAGRODZKI and MARCZYNSKI: *Kristall Technik*, 1966, **1**, 299.
[19] ZAGRODZKI and ZAORSKA: *I.S.J.*, 1965, **67**, 300, 337; *Gaz. Cukr.*, 1967, **75**, 209–214.
[20] ZAORSKA: *I.S.J.*, 1964, **66**, 260, 285; *Gaz. Cukr.*, 1966, **74**, 157.

Table I. Analysis of solutions prepared for crystallization

Solution	*Purity*	*pH*	*Extinction coefficient* 420 nm	500 nm	560 nm	650 nm	740 nm
Refined sugar	99·98	7·3	0·032	0·019	0·012	0·006	0·003
Decolorized liquor	96·5	8·3	0·855	0·382	0·186	0·077	0·029
Non-decolorized liquor	95·0	8·3	3·780	1·555	0·810	0·327	0·105
Raffinade with colouring matter from liquor	99·5	7·9	1·510	0·592	0·283	0·104	0·034
ditto	99·1	7·9	2·240	0·880	0·420	0·154	0·050
ditto	98·55	7·9	4·080	1·600	0·762	0·279	0·091
Raffinade with colouring matter from thick juice	99·55	8·0	0·925	0·438	0·253	0·094	0·031
ditto	99·2	8·0	1·440	0·682	0·394	0·146	0·048
ditto	98·7	8·0	2·500	1·180	0·683	0·254	0·084

3. Crystallization

For crystallization we used the same apparatus as in previous work[19]. The process was conducted at 60°C in Dewar vessels placed in a thermostat. To ensure even circulation the sugar seed was placed in cylindrical wire cages. The seed was of uniform size, the average weight being 0·26 mg. The linear velocity of the crystals relative to the mother liquor was 290 cm/min. The solutions were brought at 60°C to 1·1 supersaturation, and the pH was maintained at about 8·3 throughout crystallization.

SUMMARY OF RESULTS

Crystallization was carried out twice in one and the same solution, each experiment comprising two parallel tests, so that each result, which was used for further calculations, was the average of four crystallizations.

The crystallization rate was calculated from the increase in weight of fractions containing sucrose crystals of the same size and of uniform total weight at the same temperature and after the same period of time. As standard for comparison we used the crystallization rate in the syrup prepared from refined sugar, in which the crystallization rate coefficient $\eta = 1$.

Table II gives the mean crystallization rates in various solutions calculated from successive tests. As the data show, sugar crystallization was slowest in the solutions from non-decolorized liquor.

Table II. Change in crystallization rate as a function of the quantity of added colouring matter

Crystallization syrup	*Purity*	*Extinction coefficient* (560 nm)	*Crystallization rate* mg/sq.m./min	*Coefficient* η
Refined sugar	99·98	0·012	3266	1·000
Decolorized liquor	96·5	0·186	1688	0·516
Non-decolorized liquor	95·0	0·810	1056	0·324
Raffinade with colouring matter from liquor	99·5	0·283	1730	0·530
ditto	99·1	0·420	1477	0·452
ditto	98·55	0·762	1320	0·404
Raffinade with colouring matter from thick juice	99·55	0·253	1772	0·543
ditto	99·2	0·394	1543	0·472
ditto	98·7	0·683	1375	0·421

The crystallization rate in impure solutions can be expressed by the following formulae[17]:

$$\frac{dS}{dt} = - DF \frac{(c - c_s)}{l} \eta$$

or

$$\frac{dS}{dt} = kMF(c - c_s)\eta \quad \ldots\ldots\ldots\ldots (1)$$

where dS/dt = crystallization rate, D = diffusion coefficient, F = crystal surface area, c = sucrose concentration in supersaturated solution subjected to crystallization, c_s = sucrose concentration in saturated solution at given temperature and purity; l = thickness of diffusion layer, k = proportionality coefficient, M = coefficient of mixing, and η = coefficient expressing the reduction in crystallization rate in the test solution relative to that in a pure sucrose solution (i.e. the inhibiting effect of non-sugars).

In aqueous solutions of pure sucrose it is assumed that η equals unity. According to earlier experiments[19] η can be expressed as the product of the effect of non-sugars in the solution, η_1, and the effect of the colouring matter, η_2:

$$\eta = \eta_1 . \eta_2 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where η_1 expresses the reduction in crystallization rate due to non-sugars not adsorbed by the active carbon, and η_2 expresses the reduction in crystallization rate due to the colouring matter and other compounds, particularly colloids, adsorbed by the active carbon during column decolorization.

On the basis of earlier investigations, we determined the value of η_1 from the quantity of non-sugars[19] in solution for all 8 solutions:

$$\eta_1 = e^{--0.1015\ \textit{non-sugars}} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

We calculated values of η_2 from measured values of η (see Table II) using the formula

$$\eta_2 = \eta/\eta_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

In this way we found values of η, η_1 and η_2 for each solution in which the crystallization rate was investigated (Table III).

Fig. 1 shows a graph of the relationship between the values of the coefficients and the solution colour, expressed as specific extinction. Curve 1 shows values of η_1 calculated from equation (3). Curve 2 represents values of η_2 calculated from equation (4).

Table III. Inhibiting effect of non-sugars ($\eta_1 = e^{1-0.1015\ non\text{-}sugars}$) and of colouring matter ($\eta_2 = \eta_1$) on sugar crystallization rate.

Crystallization syrup	*Purity*	*Non-sugars, %*	η_1 *(calculated)*	*Extinction coefficient at 560 nm*	η *(measured)*	η_2 *(calculated)*
Refined sugar	99·98	—	1	0·012	1	1
Decolorized liquor	96·5	3·5	0·700	0·186	0·516	0·738
Non-decolorized liquor	95·0	5·0	0·602	0·810	0·324	0·538
Raffinade with colouring matter						
from liquor	99·5	0·5	0·950	0·283	0·530	0·559
ditto	99·1	0·9	0·913	0·420	0·452	0·497
ditto	98·55	1·45	0·863	0·762	0·404	0·468
Raffinade with colouring matter						
from thick juice	99·55	0·45	0·955	0·253	0·542	0·567
ditto	99·2	0·8	0·922	0·394	0·472	0·514
ditto	98·7	1·3	0·877	0·683	0·421	0·480

Curve 3 represents measured values of η for solutions prepared by adding varying quantities of colouring matter from thick juice (×) and liquor (O). Curve 4 shows values of η_2 calculated from equation (4) for decolorized and non-decolorized liquor. Curve 5 shows measured values of η for decolorized and non-decolorized liquor.

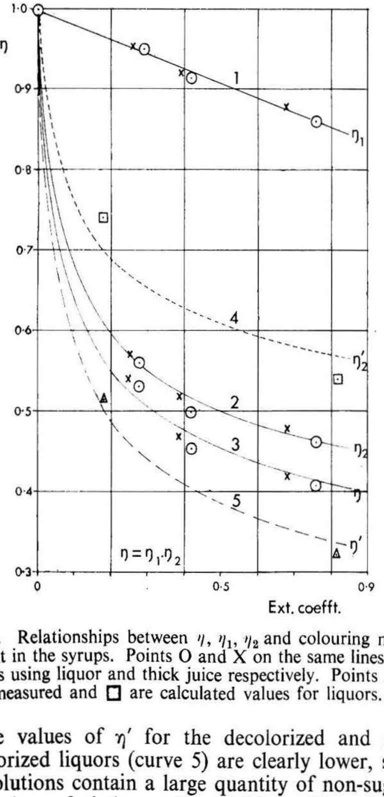

Fig. 1. Relationships between η, η_1, η_2 and colouring matter content in the syrups. Points O and X on the same lines refer to tests using liquor and thick juice respectively. Points Δ are measured and □ are calculated values for liquors.

The values of η' for the decolorized and non-decolorized liquors (curve 5) are clearly lower, since the solutions contain a large quantity of non-sugars. The values of η'_2 (curve 4) are higher. The relationships agree completely with the finding of previous experiments[19], in which it was found that the lower the purity of a solution, the smaller will be the effect of colouring matter on the sugar crystallization rate.

The relationships can be much more clearly expressed by a log-log graph (Fig. 2). The values of coefficients η and η_2 lie almost along a straight line. The crystallization rate of sugar η' in decolorized and non-decolorized liquors is lower than in syrups to which colouring matter has been added (η). The coefficient η'_2 for decolorized liquor are, on the other hand, higher than those for liquor to which colouring matter has been added (η_2), a point which has already been clarified.

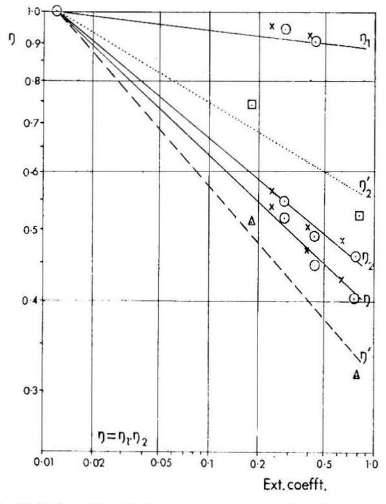

Fig. 2. Relationships between η, η_1, η_2 and colouring matter content in the syrups. Points O and X on the same lines refer to tests using liquor and thick juice respectively. Points Δ are measured and □ are calculated values for liquors.

Mathematical consideration of the relationships

If the straight line for η_2 in Fig. 2 is plotted for pure sucrose to which colouring matter has been added, we will see that the increase in extinction of the solution, the logarithmic difference of which, $\Delta \log E = 1{\cdot}400$ (e.g. from $E_1 = 0{\cdot}02$ to $E_2 = 0{\cdot}5$), will cause a reduction $\Delta \log \eta_2 = -0{\cdot}262$ (e.g. from $\eta_2 = 0{\cdot}91$ to $\eta_2 = 0{\cdot}50$). Thus the crystallization rate will fall by 45%, hence

$$\Delta \log \eta_2 = \Delta \log E\left(-\frac{0{\cdot}262}{1{\cdot}400}\right) = -0{\cdot}187\ \Delta \log E.$$

On the basis of this we can see that a ten-fold change in the coefficient of specific extinction $\Delta \log E = 1{\cdot}00$ will result in a change in the inhibiting coefficient $\Delta \log \eta_2 = -0{\cdot}187$ which will cause a change in the crystallization rate.

The results alter with reducing purity. In the case of a purity drop to 95, a ten-fold change in the extinction coefficient ($\Delta \log E = 1{\cdot}00$) will cause a smaller change in the inhibition coefficient ($\Delta \log \eta_2 = -0{\cdot}157$), while the crystallization rate will change by only about 30% ($\Delta \log \eta_2 = -0{\cdot}157 \, \Delta \log E$).

From the results obtained we see that a higher colouring matter content in the solutions causes a greater reduction in the crystallization rate. For almost pure sucrose solutions this relationship is of the following magnitudes:

$E_{560} = 0{\cdot}04$ restricts crystallization to $\eta_2 = 0{\cdot}80$
$E_{560} = 0{\cdot}20$,, ,, ,, $\eta_2 = 0{\cdot}60$
$E_{560} = 1{\cdot}00$,, ,, ,, $\eta_2 = 0{\cdot}45$

On the other hand, with reduction in solution purity the differences between the values of η_2 become correspondingly smaller, which can be represented by a semi-log graph. In Fig. 3 the calculated results are given in the form of a bunch of three straight lines, demonstrating the relationship between η_2 and solution purity at different specific extinctions (0·04, 0·02 and 1·00 at 560 nm). These three lines are convergent and at 55 purity $\eta_2 = 1$.

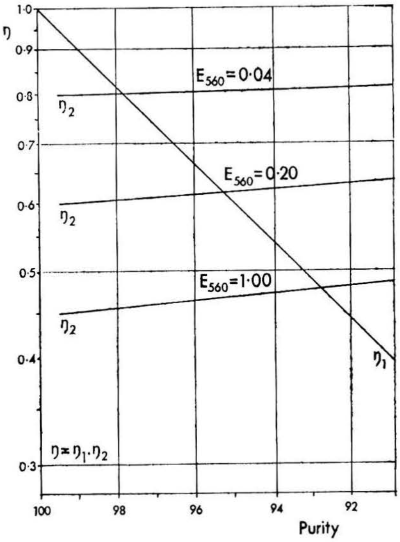

Fig. 3. Relationship between changes in value of η_2 (for solutions having a specific extinction of 0·04, 0·20 and 1·00 (560 nm) and purity of the crystallization solution.

Discussion of results

If the relationships between the coefficients η, η_1 and η_2 are plotted (Fig. 4), it will be seen that the results agree completely with previous test results[19]. According to formula (3) coefficient η_1 forms a straight line for all solutions. Coefficient η_2 also lies along a straight line if the solutions contain a constant amount of colouring matter. Solutions having lower colour contents or decolorized solutions are characterized by a higher value of η_2 (Fig. 3). Variation in colouring matter content is accompanied by a change in the crystallization velocity. Colouring matter in lower purity solutions, however, inhibits the crystallization rate to a smaller extent (Figs. 3 and 4).

A 5-unit drop in syrup purity from 100 to 95 will cause a reduction in the influence of colouring matter on the crystallization rate. In accordance with Fig. 4, inhibiting coefficient η_2 will have a value of 0·537 and not 0·500. In other words, if an increase in the colour of pure sucrose solutions from $E = 0{\cdot}02$ to $E = 0{\cdot}50$ causes a 50% reduction in the crystallization rate, then this same increase in extinction in 95 purity syrups will cause a crystallization rate reduction of about 46%.

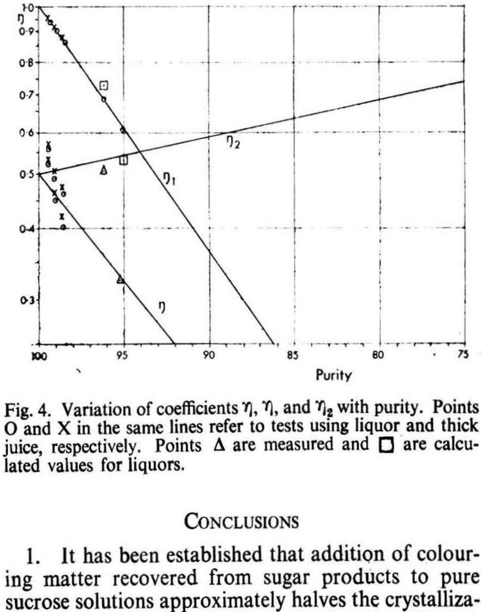

Fig. 4. Variation of coefficients η, η, and η_2 with purity. Points O and X in the same lines refer to tests using liquor and thick juice, respectively. Points Δ are measured and ☐ are calculated values for liquors.

CONCLUSIONS

1. It has been established that addition of colouring matter recovered from sugar products to pure sucrose solutions approximately halves the crystallization rate in solutions having an extinction of 0·5.

2. A further increase in the amount of colouring matter added to sucrose solutions has a significantly smaller effect on further decrease in the crystallization rate. A 400% increase in the amount of colouring matter in the sucrose solution causes a drop in the crystallization rate of about 25%.

3. In a log-log graph values of coefficient η_2, which expresses the inhibiting effect of colouring matter on the crystallization rate according to the extinction of the solution, for the same type of colouring matter lie along a straight line (Fig. 2).

4. With decreasing purity of the solution, changes in the colouring matter content will exert a progressively smaller effect on the crystallization rate.

5. Addition of colouring matter to pure sucrose solutions causes a reduction in the crystallization rate, e.g.

Solution extinction (560 nm)	*Inhibiting coefficient* η_2
0·04	0·80
0·20	0·60
1·00	0·45

The Cooling of Massecuites in Discontinuous Water-cooled Crystallizers

By H. J. SPOELSTRA and D. HOKS (Stork-Werkspoor Sugar NV)

INTRODUCTION

IN a former article[1] the natural cooling of massecuites in discontinuous crystallizers was discussed and approximation formulae were given with which the massecuite temperature can be calculated as a function of the cooling time for predetermined operating conditions.

In continuation of this work we now wish to do the same for discontinuously working *water-cooled* crystallizers.

Heat removal by these crystallizers takes place in two different ways at the same time, viz. (1) through the cooling elements to the flow of cooling water, and (2) by natural heat transfer from the crystallizer to the ambient surroundings.

The two modes of heat removal exert a reciprocal influence on each other, which makes the cooling process very complicated, and in our opinion it is for the moment of no practical use to analyse this problem in mere theoretical mathematical ways to find a general relation between the massecuite temperature and the whole complexity of influences.

We have therefore striven to develop a method according to which the massecuite temperature is first calculated with simple approximation formulae for the "water cooling" (the principal mode of cooling), applying thereafter a correction for the extra "natural cooling".

This leaves the way open, if so desired, to neglect the natural cooling (for instance, in cases with relatively very short cooling time) and to consider this extra cooling effect as a safety margin.

Nomenclature and simplifications

The same symbols and simplifications will be applied as indicated in the former article[1] about natural cooling.

Accordingly, for calculation purposes, we use the following constant average values during the cooling period:

W = quantity of cooling water (kg/hr).
t_c = temperature of cooling water (°C).
Specific heat of water = 1 kcal/kg/°C.

Further we introduce the following new factors:

CS = total outer surface of the cooling elements (sq.m.)
k_o = overall heat transmission coefficient (h.t.c.) between massecuite and water at the start of the cooling process ($\tau = 0$) based on CS and the mean logarithmic temperature difference between massecuite and water (kcal/sq.m./hr/°C).

Temperature rise of cooling water

In Fig. 1 are schematically indicated the temperature curves of a cooling process.

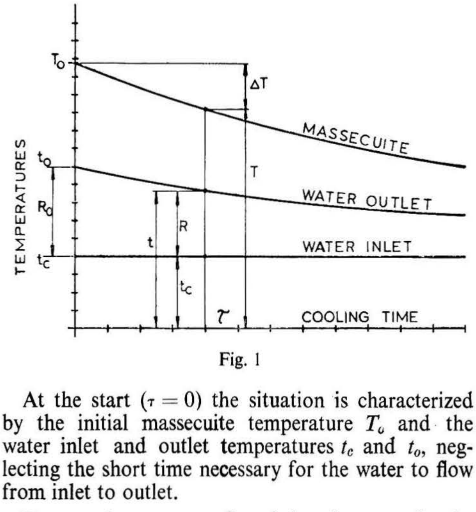

Fig. 1

At the start ($\tau = 0$) the situation is characterized by the initial massecuite temperature T_o and the water inlet and outlet temperatures t_c and t_o, neglecting the short time necessary for the water to flow from inlet to outlet.

From various tests we found that the curve for the temperature rise R as a function of the cooling time τ can be approximated with reasonable accuracy by a hyperbola and can be expressed by:

$$R = \frac{p\ R_o}{p + \tau} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

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[1] SPOELSTRA: *I.S.J.*, 1967, **69**, 195–197.

where p is the parameter of the hyperbola, which has to be determined empirically by cooling tests.

Heat removed by the water

At a random moment of the cooling process the heat removed by the water dQ_w between the times τ and $(\tau + d\tau)$ can be expressed by the differential equation:

$$d\,Q_w = WR\,d\,\tau = W\frac{p\,R_o}{p+\tau}\,d\,\tau$$

For a cooling period between $\tau = 0$ and τ the total quantity of removed heat is:

$$Q_w = WR_o p \ln\frac{p+\tau}{p}\text{ cal.}$$

The apparent partial temperature drop of the massecuite between the start of cooling and time τ due to the water cooling is thus, expressed in °C,

$$\Delta T_w = \frac{WR_o}{Mc}\,p\ln\frac{p+\tau}{p}\;\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Heat removed by natural cooling

The apparent partial temperature drop ΔT_1 of the massecuite due to natural cooling can be calculated with the formulae given in the first article[1].

Total temperature drop of massecuite

From tests made using a discontinuous water-cooled crystallizer for low-grade massecuite in a beet sugar factory we found that the temperature drop of the massecuite actually measured was almost always smaller than the sum of the aforementioned calculated apparent partial temperature drops.

Although the number of tests is rather small we consider it justifiable (especially in view of the approximate character of the calculating method) to work with:

$$\Delta T = \Delta T_w + \text{a}\;\Delta T_1\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3$$

in which for the moment a can be estimated as 0·6 (see below).

The heat transmission coefficient k_o.

For any existing crystallizer working under known conditions the initial temperature rise R_o of the cooling water can easily be measured and the initial h.t.c. can be calculated from:

$$k_o = \frac{W}{CS}\ln\frac{(T_o - t_c)}{(T_o - t_c) - R_o}\;\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

By repeating these measurements a good idea can be obtained of the magnitude of k_o for a particular type of cooling system.

The tests can be done easily because they only involve the measurement of the quantity of cooling water, its inlet and outlet temperatures and the massecuite temperature.

Moreover the tests are not time-consuming because the readings have *only to be made at the start* of the cooling process.

Conversely R_o can be predicted for predetermined conditions if one makes use of a k_o value assumed to be valid for a particular type of cooling system in the crystallizer. This of course applies especially to project work and shows the importance of a reliable value of k_o as starting point.

The specific cooling intensity

This is in general the ratio between the heat removed per unit of time and the heat content of the massecuite in the crystallizer based on the temperature difference $T - t_c$.

For the water cooling the specific cooling intensity at the start ($\tau = 0$) can be expressed by:

$$X_o = \frac{WR_o}{\text{Mc}\;(T_o - t_c)}\;\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

This has to be increased by the specific cooling intensity of the natural cooling[1], $x = \frac{AB}{\beta}$.

The total specific cooling intensity at the start is:

$$X'_o = X_o + x\;\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

In an existing crystallizer in operation a temperature rise R_o will be created depending on the water quantity W and the heat transfer properties of the cooling system. Both values W and R_o can easily

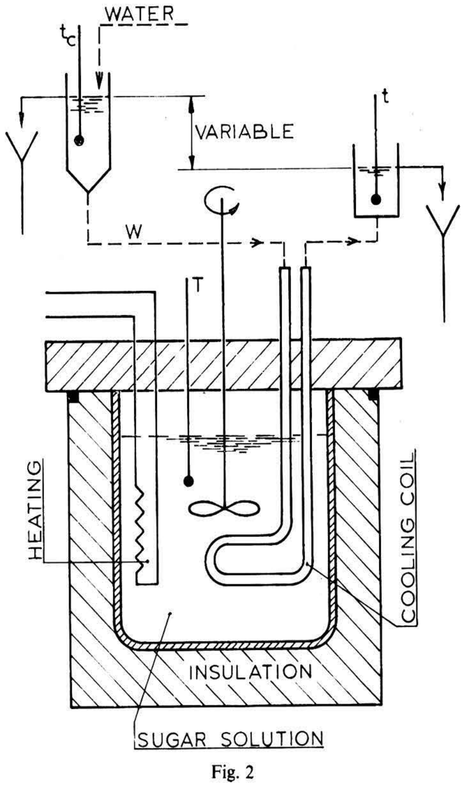

Fig. 2

be measured and with its product $W R_0$ the specific cooling intensity X_0 can be evaluated.

For project work however, the starting point is k_0 from which R_0 can only be calculated when the value of W is assumed. Theoretically the heat transfer in the cooling system is influenced by the water quantity (velocity); therefore it would be useful to know what we may expect in crystallizers as a result of the influence of the water quantity on the specific cooling intensity.

Crystallizers in normal operation would not be suitable for tests to investigate this influence and moreover the tests would be extremely time-consuming. We therefore decided to investigate this point by laboratory tests for which we used an apparatus schematically shown in Fig. 2.

A quantity ($M = 21{\cdot}53$ kg) of sugar solution of about 73° Brix could be kept at a constant temperature T_0 by a thermostatically controlled heating element. Through a cooling coil with $CS = 51$ sq.cm. made of copper tube (outer diameter $= 5$ mm) water was supplied at rates ranging from $W = 5$ to 20 kg/hr.

In Fig. 3 the results are given of two series of tests respectively with $T_0 = 76{\cdot}8$°C and $71{\cdot}9$°C and an average cooling water temperature of $t_c = 10{\cdot}8$°C.

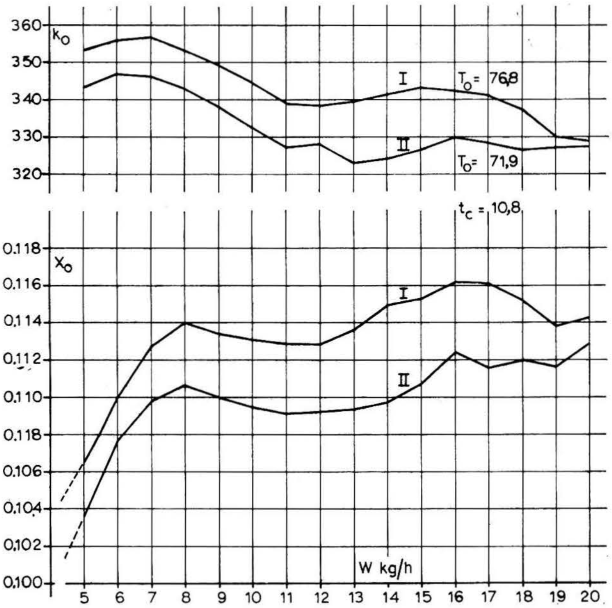

Fig. 3

It is apparent from the curves that, in general, the water quantity has an optimum value above which no or little practical gain in cooling intensity is to be expected.

We may expect an analogous phenomenon to occur in the cooling systems of industrial crystallizers and therefore we assume that around the optimum value of W (or slightly above) the specific cooling intensity determined by $W R_0$ can be considered constant.

This means that if a certain type of crystallizer, for instance with cooling coils, is generally operated at $W = 3000$ to 4000 kg/hr X_0 can be calculated by means of formula (5) with any value in between, say at $W = 3500$ kg/hr, and the specific cooling intensity will be almost unaffected by operating the crystallizer later at a different W between 3000 and 4000 kg/hr.

The parameter (p) *of equation* (1)

Since the curve of R as a function of τ depends on the total specific cooling intensity, the presumption of this curve being a hyperbola implies that there must be a relation between the parameter p and the value X_0', irrespective of the type of cooling system.

In three consecutive years we were able to make cooling tests at the Dinteloord beet sugar factory in Holland on a cylindrical low-grade crystallizer provided with cooling coils. Its main dimensions were $D = 2{\cdot}37$ m, $L = 8{\cdot}50$ m, nett massecuite content $V_c =$ about 300 hl, and cooling surface $CS = 35$ sq.m.

The results of the tests in round figures are summarized in Table I.

Further we carried out three series of cooling tests with our laboratory apparatus (Fig. 3), respectively for $T_0 =$ about 77°, $71{\cdot}5$° and 66°, whilst for each series the water quantity was varied from 5 to 20 kg/h.

Table I. Results of cooling tests at Dinteloord

No.	Year	W	T_o	t_e	R_o	k_o	X_o	x	X'_o	p	ΔT	ΔT_W	ΔT_1	a
1	1964	2100	74	10	35	47	0·060	0·026	0·086	10	38	30	12	0·7
2	1965	2350	74·5	10	25	33	0·047	0·026	0·073	14·5	29·5	23	11	0·6
3	1965	3000	78	8	23	34	0·051	0·026	0·077	15	23	18	7·5	0·7
4	1965	3500	79	8	20	33	0·051	0·026	0·077	13·5	21·5	16	6·5	0·9
5	1966	4400	83	9·5	21	42	0·065	0·026	0·091	10	18	16	5	0·4
6	1966	2600	79	6·5	30·5	40	0·056	0·026	0·082	11	22	19	7	0·4
Average						38								0·6

Without going into further detailed discussions we can say that individually the data from these tests are not suitable to establish the relationship sought between p and X_o', but as a group they show in combination with the respective figures from Table I a distinct relationship as is apparent from Fig. 4.

We wish to emphasize that because of the limited number of tests the drawn curve still bears a certain speculative character and will need to be confirmed or revised by future additional cooling tests.

For the moment however, we hope that it may be helpful in predicting with acceptable accuracy the final massecuite temperature to be reached in discontinuous water-cooled crystallizers.

Calculation example

Let us consider a U-shaped crystallizer with water-cooled coils for low-grade massecuite, having the following dimensions and working conditions:

$D = 2{\cdot}0$ m; $L = 7{\cdot}0$ m and $f = L/D = 3{\cdot}5$. The gross volume $V_o = 250$ hl, but the actual massecuite volume $V_c = 230$ hl, so that $M = 34{,}500$ kg ($\gamma = 1{\cdot}5$) and the filling ratio $\beta = V_c/V_o = 0{\cdot}92$.

Cooling surface $CS = 40$ sq.m.
Water quantity $W = 3600$ kg/hr.
Massecuite: $\gamma = 1{\cdot}5$; $c = 0{\cdot}43$; $T_o = 72$°C.
Water: $t_e = 25$°C
Ambient temperature $t_1 = 30$°C
Heat transfer coefficient a' to the ambient surroundings $= 7{\cdot}0$

If at the start of the cooling process ($\tau = 0$) we measure a water temperature rise $R_o = 15°$, what massecuite temperature can we expect after a cooling time of 12 hours?

The partial natural cooling is calculated as follows[1]:

$$\text{Crystallizer factor } A = \frac{2f+1}{5fD} = 0{\cdot}229$$

$$\text{Operating factor } B = \frac{a'}{100\,\gamma\, c} = 0{\cdot}1085$$

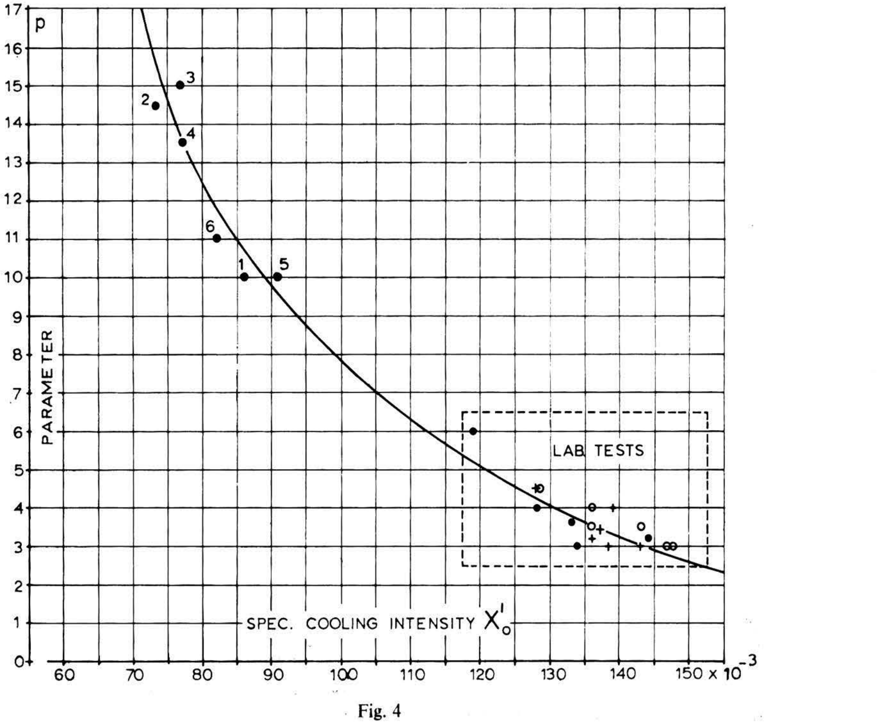

Fig. 4

Specific cooling intensity $x = \frac{AB}{\beta} = 0{\cdot}027$

Cooling factor (from nomogram) $y = 0{\cdot}28$
$\Delta T_1 = 0{\cdot}28\ (72° - 30°) = 11{\cdot}8°C$.

The partial water cooling is calculated as follows:

By equation (5), $X_o = \frac{3600 \times 15}{34500 \times 0{\cdot}43\ (72 - 25)} = 0\ 078$

and, by equation (6), $X_o' = 0{\cdot}078 + 0{\cdot}027 = 0{\cdot}105$. From Fig. 4 we see that the corresponding value of the parameter $p = 7{\cdot}0$, so that, from equation (2),

$$\Delta T_w = \frac{3600 \times 15}{34500 \times 0{\cdot}43} 7{\cdot}0 \ln \frac{(7{\cdot}0 + 12)}{7{\cdot}0} = 25{\cdot}5°C$$

and, from equation (3), $\Delta T = 25{\cdot}5° + 0{\cdot}6 \times 11{\cdot}8° = 32{\cdot}6°$.

The expected final massecuite temperature T is thus $72° - 32{\cdot}6° = 39{\cdot}4°C$ or, say, in practice, between 39° and 40°C.

By equation (4) $k_o = \frac{3600}{40} \ln \frac{(72 - 25)}{(72 - 25) - 15}$
$= 35$ kcal/sq.cm./hr/°C.

In a similar way the cooling time necessary to reach a required final massecuite temperature can be estimated.

Calculations can be substantially simplified by working out beforehand certain values in nomograms such as:

$$C_1 = p \ln \frac{p + \tau}{p} \text{ and } C_2 = \ln \frac{(T_o - t_c)}{(T_o - t_c) - R_o}$$

Acknowledgement

We wish to express our appreciation to the Dinteloord sugar factory for having enabled us to carry out the cooling tests.

Methods of Estimation of Aconitic Acid

By SURESH CHANDRA GUPTA and Miss URMILA CHETAL.
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THE aconitic acid content plays an important rôle in the manufacture of sugar from cane juice[1,2]. It contributes to the low pH of the juice and has been shown to be responsible for an appreciable part of the viscosity of technical sugar solutions in a sugar factory[3]. Aconitic acid accumulates in final molasses and its recovery from the latter is of considerable interest[4,5].

In such studies estimation of aconitic acid forms an important operation. FORT, SMITH, BLACK and MARTIN[6], DOOLAN[7], WIGGINS[8], LAUER and MAKAR[9], BETANCOURT[10], and MUKERJEE and CHANDRA[11] have analysed sugar house products for aconitic acid, the method employed by these workers being the well-known decarboxylation method developed by ROBERTS and AMBLER[12]. The advantage of this method is that it does not require special apparatus and can be carried out with the conventional laboratory equipment. DRAKE, WIGGINS and WISE[13] described a polarographic method for estimation of aconitic acid in sugar solution.

During a series of investigations on estimation of aconitic acid in Indian molasses we observed that the results obtained by these two methods diverged markedly. Detailed investigations showed that the decarboxylation method gave errors as high as 40–60%. We altered the existing decarboxylation method and the modified procedure enabled us to get reproducible results with reasonable accuracy (1–2%). The present report describes the modification of the decarboxylation method for estimation of aconitic acid in molasses.

EXPERIMENTAL

Materials

Pure aconitic acid (B.D.H. Ltd.) was used as the standard (m.p. found 190°C, lit. 191°C). Acetic acid and potassium acetate used were of "Analar" (analytical reagent) grade, while pure neutral lead acetate (B.D.H. Ltd.) was used. Carbonate-free NaOH was prepared from a concentrated solution according to the method of STEYERMARK[14]. Molasses samples were obtained from a number of commercial factories in India.

Equipment

A manual polarograph assembled by the authors was employed. The following were the characteristics of the capillary used.

$m = 1{\cdot}54$ mg
$t = 3{\cdot}10$ sec.

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[1] BALCH *et al.*: *Sugar*, 1945, **40**, (10), 32–35; *I.S.J.*, 1946, **48**, 186–187.
[2] MCCALIP and SEIBERT: *Ind. Eng. Chem.*, 1941, **33**, 637–640.
[3] SANDERA and PATEK: Zeit. Zuckerind. Czech. Rep., 1933–34, **58**, (26), 188–191.
[4] ANON: *I.S.J.*, 1959, **61**, 367.
[5] REGNA and BRUINS: *ibid.*, 1957, **59**, 121.
[6] *Sugar*, 1952, **47**, (10), 33–35.
[7] *Proc. 20th Conf. Queensland Soc. Sugar Cane Tech.*, 1953, 23.
[8] *Proc. B.W.I. Sugar Tech.*, 1951, 16.
[9] *I.S.J.*, 1951, **53**, 128.
[10] *Proc. XXIV Conf. Asoc. Tecn. Azuc. Cuba*, 1950, 519.
[11] *Proc. 24th Conv. Sugar Tech. Assoc. India*, 1956, (II), 241–248.
[12] *Anal. Chem.*, 1947, **19**, (2), 118–120.
[13] *I.S.J.*, 1955, **57**, 160–162.
[14] "Quantitative Organic Microanalysis", (Academic Press, New York). 1961, p. 326.

pH measurements were made using a radiometer type PMH 4C. Radiometer glass (G202 B) and calomel electrodes were used.

Decarboxylation method

The principle of this method is to precipitate quantitatively aconitic acid as lead aconitate and to decompose the precipitate with acetic acid when it gives off carbon dioxide according to the following equation:

$$\underset{\text{Aconitic acid}}{C_6H_6O_6} \xrightarrow{\qquad} \underset{\text{Itaconic acid}}{C_5H_6O_4} + CO_2$$

In order to determine the aconitic acid in molasses by the above method, 25 g of molasses is diluted to 200 to 250 ml with distilled water and the pH adjusted to 6·0 to 6·5. The diluted molasses is heated to boiling and 50 ml of neutral lead acetate solution (100 g/litre) are added and stirred. The precipitate is filtered on a Buchner funnel through asbestos-lined filter paper. The precipitate is washed with distilled water and then twice with acetone to remove fats and waxes.

When all the acetone is drained off, the precipitate together with filter paper and asbestos is dried in an air oven at 100–105°C for 30 minutes. It is then introduced into an Erlenmeyer flask containing 100 ml glacial acetic acid and 10 g potassium acetate, CO_2-free air being bubbled continuously. The outlet of the condenser is connected to a scrubber containing CO_2-free distilled water to collect the vapours of acetic acid from the evaporated mixture. This scrubber is connected to an appropriate apparatus. The air is bubbled for 25 minutes, in order to expel all carbon dioxide in the apparatus.

The outlet is then connected to an absorption tube containing 25 ml of IN NaOH. The contents of the Erlenmeyer flask are boiled for 1½ to 2 hours. When the reaction is complete, the absorption tube is disconnected and the bubbler tube emptied and rinsed with distilled water. 25 ml of saturated solution of barium chloride and five drops of phenolphthalein indicator are added and the mixture titrated with IN HCl. A blank test is made at the same time with no precipitate of lead aconitate but using exactly the same amount of NaOH. The quantity of aconitic acid present in the molasses is calculated from the amount of carbon dioxide evolved when the lead aconitate precipitate is boiled.

Polarographic method

Aconitic acid gives well defined polarographic reduction waves with half-wave potential $E_{\frac{1}{2}} = -0{\cdot}60$ volt in 1N HCl[15]. In our work we have observed half-wave potential $E_{\frac{1}{2}} = -1{\cdot}05$ volts (*vs.* SCE) in 1N acetic acid solutions, and our measurements have shown that the diffusion current is proportional to the concentration (C) of the aconitic acid (see Fig. 1). The details of this method employed for estimation of aconitic acid in molasses are as follows[16]:

25 g of molasses are made up to 500 ml with 20 ml of concentrated HCl and distilled water. The pH of a 20-ml aliquot is adjusted to 9–10 with 6N NaOH and the solution diluted to 50 ml with distilled water. 2 g of a 1:1 mixture of active carbon and diatomaceous earth are added to the above solution which is heated to 100°C on a water bath for ½ hour and filtered. A 20-ml portion of the filtrate is made up to 50 ml with 1N HCl. Some of the above solution is deoxygenated by passing pure nitrogen and is examined polarographically. The diffusion current gives an estimate of the aconitic acid computed from an i_d *vs.* C curve recorded with pure aconitic acid solutions (Fig. 1).

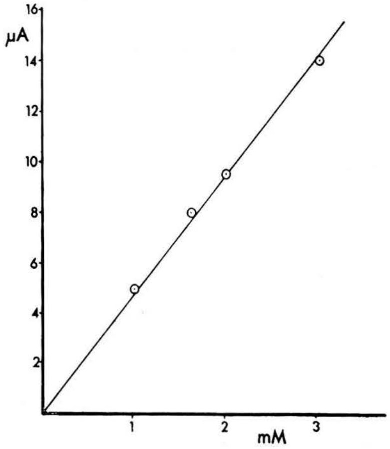

Fig. 1. Variation of the diffusion current (μA) with the concentration (mM) of aconitic acid.

RESULTS AND DISCUSSION

The aconitic acid content in molasses was determined by the decarboxylation and polarographic methods described above. These results are given in Table I.

Table I

Aconitic acid (%)

Sample No. (1)	*Decarboxylation Method* (2)	*Polarographic Method* (3)	*Difference* $\frac{(3)-(2)}{(3)}$ %
1	1·335	2·92	—54
2	1·343	3·80	—64
3	1·200	3·09	—61
4	1·660	2·86	—42

Polarograms of pure aconitic acid in 1N acetic acid give a value of 2·76 for the diffusion current constant I, calculated as $\frac{i_d}{Cm^{2/3}\ t^{1/6}}$, where i_d is the diffusion current (microamps), *C* is the concentration (mM), *m* the mass (mg) and *t* the life (sec) of the

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[15] SCHWAER and MULLER: *Coll. Czechoslov. Chem. Comm.*, 1935, **7**, 326–335.

[16] MATSUBARA and KINOSHITA: *Hakko Kyo Kaishi.*, 1960, **18,** 77–80; through *Chem. Abs.*, 1961, **56,** 9918 gh.

[17] MEITS: "Polarographic Techniques" (Interscience, New York). 1955, p. 47; KOLTHOFF and LINGANE: "Polarography" (Interscience, New York). 1946, p. 62.

mercury drop[17] (see Fig. 1). This constant I was employed for computation of the aconitic acid in molasses from the corresponding polarograms.

It is seen that the decarboxylation method indicates the presence of 1·0 to 1·5% aconitic acid in molasses which is in accord with the observations of earlier workers[6–11] who employed the same method. Column (3) gives the amount of aconitic acid in the same molasses estimated by the polarographic method. It is interesting to note that values obtained by the latter differed markedly from those obtained by the decarboxylation method, which indicated 40–60% less aconitic acid than that determined by the polarographic method.

Table II

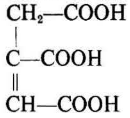
Modification of the Decarboxylation Method

Sample No. (1)	*Amount of acid taken* (2)	*Amount determined* (3)	*Error %* (4)	*Remarks* (5)
1	0·15 g	0·087 g	—42	Aconitic acid precipitation with neutral lead acetate at pH 6.
2	0·15 g	0·1044 g	—30	Aconitic acid precipitation at pH 8.
3	0·15 g	0·1318 g	—12	„ at pH 9.
4	0·15 g	0·1566 g	+4·4	„ at pH 10.
5	0·15 g	0·1479 g	—1·4	„ at pH 11.
6	0·15 g	0·1522 g	+1·2	„ at pH 11.

The polarographic method involves computation from the diffusion current, i_d, for the molasses and from the calibration curve of i_d *vs.* C (see Fig. 1), which has been recorded with pure aconitic acid solutions. It has been established in studies on polarography that the diffusion current of any system is inhibited by the presence of surface-active substances and gums, so that, if a system containing aconitic acid also contains gums and surface substances, the i_d will be lower than in the pure system. Molasses is known to contain appreciable quantities of gums, waxes and surface-active substances. Since the calibration curve is for pure aconitic acid solutions, one would expect that use of this curve would give low estimates of aconitic acid in molasses. However, the values obtained by the decarboxylation method are lower than obtained by the polarographic method, which indicates that presumably the data given by the decarboxylation method are erroneous. This deduction is supported by results we have obtained on estimation, by decarboxylation, of aconitic acid in its pure solutions (see Table II).

Principle of modification of the decarboxylation method

As pointed out earlier, the decarboxylation method involves precipitation of aconitic acid as lead aconitate and decomposition of the latter by acetic acid. The accuracy of the method depends on the extent of complete precipitation of aconitic acid, as lead salt. Aconitic acid is a tribasic acid



$$\begin{array}{l} CH_2\text{—}COOH \\ \mid \\ C\text{—}COOH \\ \parallel \\ CH\text{—}COOH \end{array}$$

For convenience sake let us refer to it as H_3A. The reaction that is responsible for the formation of lead aconitate is

$$3\ Pb^{++} + 2A^{---} \longrightarrow Pb_3A_2$$

The lead ions do not combine with undissociated aconitic acid, but with its anions, chiefly the trivalent aconitate. The amount of lead aconitate to be obtained as precipitate depends upon the dissociated trivalent aconitate ions present in the system. These could be computed with ease from the knowledge of dissociation constants of the acid. Reference to the literature indicates inadequate work done on the determination of dissociation constants of the acid. The first and second dissociation constants have been reported in the literature[18], however, as follows:

$$k_1 = 1{\cdot}58 \times 10^{-3}$$
$$k_2 = 3{\cdot}5 \times 10^{-5}$$

There are no data on the magnitude of the third dissociation constant, k_3, of the acid on which investigations are in progress in the authors' laboratories. We however assume for the present that k_3 is roughly 5×10^{-7} based on a deduction which may or may not be valid, i.e. that the difference between k_3 and k_2 is roughly equal to the difference between k_2 and k_1 as in the dissociation of citric acid[19]: $k_1 = 8{\cdot}7 \times 10^{-4}$, $k_2 = 1{\cdot}8 \times 10^{-5}$, $k_3 = 4 \times 10^{-6}$.

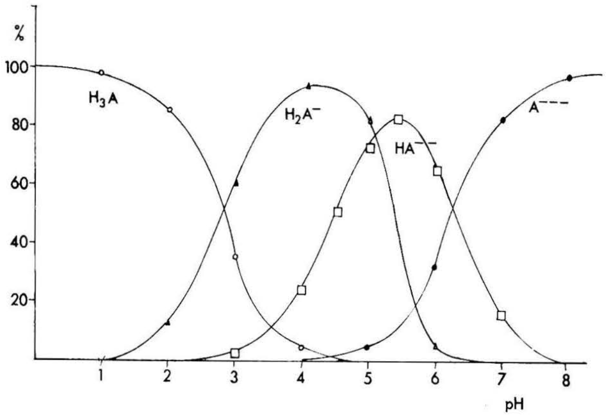


Fig. 2. Comparison of different anions of aconitic acid at different pH.

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[18] KIRK: "Encyclopedia of Chemical Technology", Vol. I (Interscience Encyclopedia Inc., New York). 1952, p. 160.

[19] LANGE: "Hand Book of Chemistry" (McGraw-Hill Book Co. Inc., New York). 1961, p. 1199.

From the above values of k_1, k_2 and k_3 of aconitic acid, one can compute the concentration of various anions (H_2A^-, HA^{--}, and A^{---}) of the acid at different pH values (see Fig. 2). It is seen that at pH 6·5 where the precipitation of aconitic acid as lead aconitate is recommended in the decarboxylation method (see above), only about 50% of the acid remains in the form of completely dissociated trivalent ion, A^{---}, and the precipitation of aconitic acid as lead aconitate is therefore likely to be incomplete at pH 6·5, leading to excessive error in the determination of the acid by the decarboxylation method. These considerations are not materially affected by the possible inaccuracy in the magnitude of k_3 for aconitic acid assumed above by the authors.

Complete precipitation of aconitic acid as lead aconitate can be expected at pH values higher than 9 (see Fig. 2). Modification of the decarboxylation method therefore involves raising the pH of molasses to 10 to 11 prior to the treatment with lead acetate to precipitate aconitic acid as lead aconitate.

Results using the modified decarboxylation method

In the initial series of experiments the accuracy of the modified procedure was tested with pure aconitic acid solutions. In this, aliquots of standard solutions of aconitic acid were brought to different pH values in the range of 6–12 pH with 1N NaOH, and then treated with lead acetate as described earlier. Table II gives a typical series of results obtained with pure aconitic acid solutions. In this, colum (4) shows the error in the determination at different pH values. The error decreased with increase in pH, from 40% at pH 6 to ±1·5% at 11 pH.

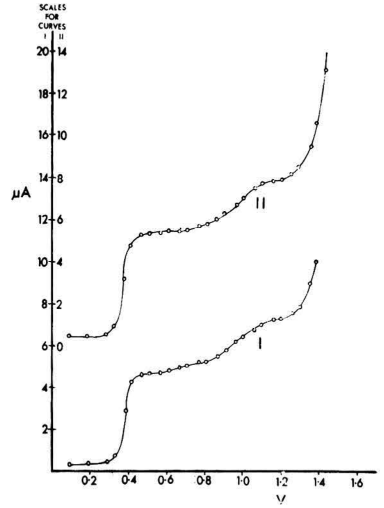

Fig. 3. Polarographic estimation of lead and aconitic acid at pH 5 (curve I) and pH 10 (curve II)

That the error of as much as 40% in the determination of aconitic acid at low pH values was due to incomplete precipitation of aconitic acid was also shown by polarographic investigations of aconitic acid. In these experiments, aliquots of solutions of pute aconitic acid were maintained at pH between 5 and 10 and treated with neutral lead acetate. The precipitate formed was quantitatively collected and dissolved in 1N acetic acid. The acid solutions were maintained at 20°C in order to minimize any decomposition of aconitic acid (cf. the decarboxylation method described above). The solutions were analysed polarographically under conditions corresponding to data in Fig. 1.

These results are given in Fig. 3 in which curve I refers to the precipitate obtained at pH 5 and curve II, at pH 10. From these, the amount of aconitic acid and lead were estimated from the corresponding diffusion current constants obtained with pure solutions. It is seen that the precipitate obtained at pH 10 contained more lead and aconitic acid, because of complete precipitation of acid as lead aconitate, than at pH 5.

Table III. Comparison of the results of estimation of aconitic acid in molasses by the modified decarboxylation method and the polarographic method

Molasses sample	A	B	C	D	E
	aconitic acid, %				
Decarboxylation method, precipitation at pH 6.	1·660	1·64	1·76	1·780	1·80
Decarboxylation method, precipitation at pH 11.	2·045	2·26	2·18	2·920	2·64
Polarographic method	2·860	2·92	2·575	2·084	2·92

In Table III are given results from the estimation of aconitic acid in five molasses samples by the original and modified decarboxylation methods and by the polarographic method. It is seen that the modification brings the results into closer agreement.

SUMMARY

The decarboxylation method of ROBERTS and AMBLER for estimation of aconitic acid gave results with error as high as 40–60% by comparison with polarographic analysis made by a modification of the technique outlined by DRAKE, WIGGINS and WISE. The error in the decarboxylation method was found to be due to incomplete precipitation of aconitic acid as lead aconitate at the suggested pH 6·5. The decarboxylation method was modified and it was observed that complete precipitation of lead aconitate occurred at pH > 11. This modified procedure showed an error of only 2%. Estimation of aconitic acid in molasses by the modified method gave results which were more in accord with the polarographic data.

ACKNOWLEDGEMENT

The authors' thanks are due to the U.P. Council of Scientific and Industrial Research for a maintenance grant to one of us (Miss Chetal).

Sugar cane agriculture

Observations on the effect of season, nitrogen, phosphate and potash on the nutritional status, yield and growth pattern of plant cane. D. P. BECKFORD. *J.A.S.T.J.*, 1965, **26**, 17–22.—Results are given of extensive field experiments with different planting dates and different fertilizer treatments and their effects on yield. Practical applications of the results obtained point to the advantage of applying nitrogen in two applications and the addition of less potash to fields planted after March in one area.

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The pests of sugar cane in Jamaica. I. Jumping borer (*Elasmopalpus lignosellus*). II. Yellow aphis (*Silpha flava*). J. R. METCALFE. *J.A.S.T.J.*, 1965, **26**, 28–32.—The two pests are described. The jumping borer, previously a minor pest, has increased, especially on non-irrigated cane which is burned. The yellow aphis is a minor pest in Jamaica, with seasonal outbreaks of short duration. A list is given of its natural enemies or predators, which are many, and epidemiology is discussed at some length. Control measures for both pests are outlined and photographs are given of the pests.

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The variety situation in Jamaica. C. E. M. SMITH. *J.A.S.T.J.*, 1965, **26**, 39–48.—The good and bad points of several varieties in Jamaica are discussed, these being considered on the following basis: (1) commercial or near commercial varieties, (2) varieties recently emerged from final trials, and (3) varieties in final trials. Estates' opinions of new varieties are given, mainly in tabular form. Some of the newer varieties are regarded as sufficiently productive to justify their use as alternatives to, if not replacements for, present commercial varieties.

* * *

Flowering and seed production. S. D. FASIHI and A. M. GORSI. *Ayub Agric. Res. Inst. Ann. Rpt.*, 1964–65, 142–146.—The activities of the four high-altitude outstations for the inducement of flowering in different sugar cane varieties and the degrees of success obtained is discussed. Reference is made to the establishment of a fifth outstation set up at Deval (3800 ft). Fifteen varieties of cane were initially established.

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Herbicidal weed control in sugar cane. J. R. ORSENIGO. *Ann. Rpt.* (Univ. of Florida Agric. Expt. Stas.), 1966, 273.—A preliminary account is given of a project involving the use of several pre-emergence herbicides, notably "Atrazine" + CDAA, CDAA and "Fenac".

Irrigation of sugar cane in Jamaica. J. A. KELLY. *J.A.S.T.J.*, 1965, **26**, 49–52.—Present irrigation practices (mainly surface, not overhead irrigation) are discussed and the possibility of improving these considered in order to make more effective use of available water or to economize in supplies. It is pointed out that pumping of water since the 1940's has risen at such a rate that it is overtaking the recharge of water in the subterranean aquifers from the interior of the island. This induces saline water to enter the basin of aquifers.

* * *

Raising and selection of seedlings. S. D. FASIHI, H. AHMAD and N. NASEEM. *Ayub Agric. Res. Inst. Ann. Rpt.*, 1964–65, 146–149.—The progress made in trying new locally bred sugar cane varieties for West Pakistan is discussed. Fourteen varieties have been found promising and have been selected for the semi-final trials.

* * *

Nitrogen favours production of cane and depresses sugar content. W. KENNING and R. F. DE ULLIVARRI. *La Ind. Azuc.*, 1967, **72**, 87–90.—An account is given of nitrogen fertilizing experiments in several areas of Mexico from 1962 to 1965. The following commercial sugar cane varieties were used in the experiments: CP 34-120, CP 48-103, NA 56-30, N:Co 310. Results are summarized in tables and a graph showing the steady increase in cane yield as nitrogen application is increased up to 90 kg per acre. The accompanying decrease in sugar content of the juice is also shown.

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New observations on smut of sugar cane. W. B. TÓFFANO. *Biologia*, 1966, **32**, 171–178; through *Plant Breeding Abs.*, 1967, **37**, 576.—Of 84 varieties subjected to artificial inoculation with *Ustilago scitaminea*, 45, including *Saccharum spontaneum*, proved resistant. In spite of poor disease resistance, *S. barberi* has proved a more valuable source material than *S. spontaneum* for producing improved canes, owing to its greater adaptability to local climatic conditions.

* * *

Nutrient requirements of sugar cane grown for sugar on organic soils. J. R. ILEY. *Ann. Rpt.* (Univ. of Florida Agric. Expt. Stas.), 1966, 287.—Preliminary experiments with lime dressings on muck soils are referred to. These were upset by the advent of freezing weather. More extensive trials, spanning a stretch of 35 miles, are planned.

Sugar cane nematode control. ANON. *Ann. Rpt.* (Univ. of Florida Agric. Expt. Stas.), 1966, 290. The results of tests with various nematicides are given. A preplant application of a dichloropropene-dichloropropane nematicide resulted in increased yield which extended to the first ratoon. In other tests ethylene dibromide, DBCP and "Mocap" applied as a side dressing at planting increased yield by 10% or more. In another test DD appeared to be more effective than "Telone". "Zinophos" also gave favourable results. In a test to evaluate flooding for nematode control for sugar cane in muck soil, a beneficial effect of sulphur was observed; 200 lb sulphur applied at the commencement of flooding treatment increased the effectiveness of root knot nematode control.

* * *

Sugar cane nutrition on sandy soils of south Florida. P. H. EVERETT and J. R. ILEY. *Ann. Rpt.* (Univ. of Florida Agric. Expt. Stas.), 1966, 326.—A programme of research is outlined involving N-P-K rate study, frequency of fertilizer application and N source.

* * *

Responses of sugar cane to supplementary irrigation on two soils in Natal. G. D. THOMPSON, J. M. GOSNELL and P. J. M. DE ROBILLARD. *Experimental Agriculture*, 1967, **3**, 223–238.—Results are given of supplementary irrigation experiments on Clansthal sand and Windermere clay soils. Each experiment included a dry land control, and soil moisture was estimated weekly in each plot with a neutron probe. Results showed that there were significant increases in yield with increasing quantities of water applied. The crops exploited soil moisture to a depth of 6 feet in the sand and 3 feet in the clay, even with maximum water treatments. Conclusions reached were that where available water for supplementary irrigation is limited, heavy soils should be irrigated in preference to sandy soils, and that the most effective use of both rainfall and irrigation water is achieved when one cusec is used to irrigate about 200 acres.

* * *

Preliminary studies on the degree of frost tolerance of some sugar cane varieties. C. N. BABU and N. S. MANN. *J. Res. Punjab Agr. Univ.*, 1966, **3**, (3), 268–269; through *Biolog. Abs.*, 1967, **48**, 5973–4. Preliminary studies on the degree of frost tolerance of some important sugar cane varieties carried out at Jullundur are reported. Both the effect of the artificial cold treatment of buds as well as the effect of natural frost conditions were taken into consideration. Among nine varieties tested, Co 1328, Co 1148 and Co 975 were regarded as the most resistant to frost.

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Phosphate and potash requirements of sugar cane in relation to soil chemical analysis and soil type. I. C. R. HOLFORD. *Australian J. Exp. Agr. Anim. Husb.*, 1966, **6**, (23), 409–417; through *Biolog. Abs.*, 1967, **48**, 4123.—The superphosphate and potassium chloride requirements of sugar cane were studied in relation to soil test levels on 25 different soil types in Fiji. Percentage yields of sugar cane in fertilizer field experiments harvested over a 5-year period were highly correlated with soil test levels in the control plots. Critical soil test levels were found to exist, below which soils gave significant yield responses to applied nutrients. There was some evidence to suggest that soil type may be a useful complementary criterion for predicting fertilizer requirements.

* * *

Strains of sugar cane mosaic virus. E. A. ABBOTT and R. L. TIPPETT. *Tech. Bull.* (USDA), 1966, (1340), 25 pp; through *Rev. Appl. Mycology*, 1967, **46**, 319–320.—The symptoms of strains A, B, C, D, E, F and H on different hosts are described. It was concluded that an attempt to describe all variants of the virus would have no practical value. C, D and F were unstable on the sugar cane variety CP 31–294 and some plants infected with these showed a gradual change to symptoms typical of A. Details are given of physical properties, differential hosts, effects of host and temperature on strain stability, and susceptibility of sugar cane and other hosts to the virus.

* * *

Good ratoon yields up to the 9th ratoon. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **14**, (1 & 2), 4.—The conditions and cultural practice prevailing on some Philippine sugar estates, where exceptionally good ratoon crops are obtained, are described. These ratoon crops often exceed or equal the plant crop. Good drainage and rich soil are considered to be factors largely responsible.

* * *

A red rot resistant mutant of sugar cane induced by gamma irradiation. J. T. RAO, K. V. SRINAVASAN and K. C. ALEXANDER. *Proc. Indian Acad. Sci.*, 1966, *Sect. B*, **64**, (4), 224–250; through *Rev. Appl. Mycology*, 1967, **46**, 320.—Plants from vegetative buds of Co 449 exposed to a range of gamma radiation from a ^{60}Co source were inoculated with strain D of *Glomerella tucumanensis*, to which this variety is highly susceptible. Resistance was found in two mutant clones derived from the 3rd bud of the irradiated plant material which had been exposed to 500 and 3000 r respectively. All other clones were susceptible.

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Germination of sclerotia of sugar cane ergot. V. RAJENDRAN. *Current Sci.*, 1966, **35**, 472–473; through *Rev. Appl. Mycology*, 1967, **46**, 320.—The germination of sclerotia from infected canes was favoured by darkness and a temperature of 35–40°C. A description is given of the fungus. Measurements agreed with those of *Claviceps purpurea.*

* * *

Sexuality in *Ustilago scitaminea*. K. C. ALEXANDER and K. V. SRINIVASAN. *Current Sci.*, 1966, **35**, 603–604; through *Rev. Appl. Mycology*, 1967, **46**, 320.—Two sexually distinct types were distinguished among single-sporidial cultures. Surface-sterilized buds from the sugar cane varieties Co 213 and CP 33–409 became infected only when inoculated with pairs of compatible lines. The degree of virulence and susceptibility to different combinations were found to vary.

Sclerophthora macrospora **on sugar cane in South Africa.** G. ROTH. *Z.Pfl.Krankh. Pfl. Path. Pfl. Schutz.*, 1967, **74,** (2), 83–100; through *Rev. Appl. Mycology*, 1967, **46,** 448–449.—This disease, severe on the varieties N:Co 310 and N:Co 293 in Natal, has apparently not been reported from other cane-growing countries. Symptoms, including a reddish leaf discoloration, are described. A thick and thin walled type of mycelium was found, although each could develop into the other. The fungus occurred mainly in the intercellular spaces around the vascular bundles.

* * *

Notes on cane varieties recommended for release (in Mauritius). ANON. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 60–61.—The following varieties have been recommended for release for commercial cultivation: M.409/51, M.13/53, M.13/56 and N:Co 376. Details are given of the characteristics of each variety including notes on their resistance to diseases such as gummosis, leaf scald, chlorotic streak and yellow spot.

* * *

The history of the sugar estates of Mauritius. G. ROUILLARD. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 106–141.—Notes are given on the history of various sugar estates and sugar mills in Mauritius, most of which were established at various periods during the last century. Some interesting old photographs are reproduced.

* * *

Investigations on the cigale sugar cane pest (*Yanga guttata*) **(Malagasy).** M. MONTSARRAT. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 213–219.—Information is given on research work carried out so far on various aspects of this problem, including life history, habits, ecology and alternative host plants. The latter include some common grasses, notably llang grass (*Imperata cylindrica*).

* * *

Status of new varieties. L. L. LAUDEN. *Sugar Bull.*, 1967, **45,** 212.—Most of the nine new unreleased varieties in the USA transferred to secondary increase stations were in good form last summer, mosaic disease not having been bad. Unfortunately one of the varieties highest in sugar has shown more mosaic than is desirable at several locations.

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New borer chemicals. L. L. LAUDEN. *Sugar Bull.*, 1967, **45,** 212.—Reference is made to the fact that it was expected that liquid "Guthion" and "Azodrin" would shortly be cleared for use for borer control in cane in the United States.

* * *

Choppers cut 80% in North Eton. ANON. *Producers' Rev.*, 1967, **57,** (4), 5.—Chopper cane harvesters are now cutting 80% of the crop in the Eton district of Queensland and as far as can be ascertained are creating no milling difficulties. Reference is made to the fact that the mill is not now financing bins and this is a hardship for some growers.

Spectacular irrigation scheme for Bundaberg. K. F. PHARR. *Producers' Rev.*, 1967, **57,** (4), 9–18, 20. This is a summary of a detailed official report on surface and underground water conservation in this cane growing area of Queensland.

* * *

Soldier fly research presses ahead. S. GREENAWAY. *Producers' Rev.*, 1967, **57,** (4), 75.—Reference is made to research work in progress on the soldier fly (*Altermetoponia rubriceps*) and the fact that, as more becomes known about this Queensland sugar cane pest, changes in methods of control may be expected. In the past growers have been told to disc-in insecticides when they are applied, just prior to planting. Now it is recommended that "Dieldrin" should always be ploughed-in.

* * *

Control of sugar cane top borer (*Scirpophaga nivella*) **through an indigenous parasite** (*Isotima javensis*). A. N. KALRA and H. DAVID. *Indian Sugar*, 1967, **16,** 883–888.—Successful results in introducing the parasite, indigenous in northern India, to other parts of India are recorded. Outside India the parasite has been successfully introduced to Taiwan.

* * *

Utility of trash in sugar cane cultivation in the eastern tract of Uttar Pradesh. V. S. BHADAURIA and B. K. MATHUR. *Indian Sugar*, 1967, **16,** 903–908.—Trials are reported that were carried out to test the effects of mulching newly planted setts with cane trash. It was concluded that, in dry areas and especially where irrigation is inadequate or labour for hoeing scarce, trash mulching is beneficial and results in higher yields.

* * *

Hot water treatment for control of grassy shoot disease. G. R. SINGH. *Sugar J.*, 1967, **29,** (12), 14–16. This Indian sugar cane disease, troublesome in parts of India (Maharashtra State), is believed to be due to a virus. Hot water treatment of seed setts at 50°C for 2 hours effectively controlled the disease in two varieties, 2½ and 3 hours being needed for other varieties. It was thought more than one strain of the virus may have been present.

* * *

Ratoon stunting disease. A. G. GILLESPIE, J. E. IRVINE and R. L. STEERE. *Sugar J.*, 1967, **29,** (12), 18–19. Recent laboratory studies in attempts to improve methods of diagnosis of the disease are reported. A biological assay technique (utilizing variety CP 44-101) is described. It yielded results in less than half the time of previous tests, i.e. in 30 days. An improved method of purifying the virus is also described. Electron microscope studies suggest that the virus consists of spherical particles. It is hoped to find a serological method for diagnosing RSD in the field.

Sugar cane harvesting field day. ANON. *Sugar J.*, 1967, **29,** (12), 26–27.—Many types of cane harvesting equipment on view or operating at the field day in Louisiana are described. Some of the harvesters were new and being shown for the first time. Progress during the last two years in this field is discussed. It is stated that the most pressing problems now are the removal of the tops from recumbent cane and removal of the leaf trash.

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Research on sugar cane borer sex attractant. S. D. HENSLEY. *Sugar J.*, 1967, **29,** (12), 40–43.—Progress made on this project since it was commenced at Louisiana State University in March 1965 is described. Work on synthesis of the attractant has been encouraging. Several synthetic compounds that are structurally near the partially identified natural attractant have been bioassayed in the laboratory. Males have responded to one of these in experiments but not when exposed in traps in the field.

* * *

Sugar cane yield increase due to fertilizers in Louisiana. L. E. GOLDEN and R. RICAUD. *Sugar Bull.*, 1967, **45,** 226–227, 230.—Results, summarized in a table, are given of fertilizer trials at the Louisiana Agricultural Experimental Station during the 12-year period 1952–1963. The greatest increases were obtained from N and greater increases from K than from P. Increases were greater with ratoon cane than with plant cane. Yield increases due to use of NPK fertilizer averaged 18 to 20% of total crop production. From these increases growers receive a gross return of 4 to 5 dollars per dollar invested in fertilizers.

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Control of Johnson grass and raoul grass on ditchbanks. ANON. *Sugar Bull.*, 1967, **45,** 228.—The use of sodium chlorate and MSMA (monosodium methane arsonate) with these two grass weeds on ditchbanks is explained. Both herbicides are effective with both weeds.

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Bibliography of sugar cane varieties. ANON. *Brasil Açuc.*, 1967, **69,** (5), 48–51.—An alphabetical list is given of over 70 articles on sugar cane varieties appertaining to tropical American countries.

* * *

Amounts of labour used on Louisiana sugar cane farms and goals for the future. G. R. TIMMONS. *Sugar Bull.*, 1967, **45,** 240–246.—Results are given of a survey of the amount of labour employed on 42 Louisiana cane farms, each of about 100 acres, with a view to encouraging better labour management generally. The following goals were suggested: (1) one worker for every 35 acres during the planting season, (2) one harvester operator for 500 acres of cane, (3) one loader operator for 900 acres of cane and (4) one worker for every 75 acres of cane during cultivation.

New experiment sub-station established at Pongola. ANON. *South African Sugar J.*, 1967, **51,** 394–397. A description is given of the lay-out and proposed activities of this new sub-station of the sugar experiment station at Mount Edgecombe, Natal. Photographs illustrate the rapid development that has taken place on land that was virgin bush a short time ago, the land having been leased to the South African Sugar Association by the Department of Lands. The field station will be used primarily as an environmental site for the selection of new varieties of sugar cane for commercial production in irrigated areas in South Africa. An area has been set aside for agronomic research with special reference to the consumptive use of water by sugar cane and the use of herbicides for weed control under irrigation.

* * *

Irrigation, overhead?, surface? J. TURCK. *South African Sugar J.*, 1967, **51,** 399–405.—The relative merits of overhead or sprinkler irrigation and surface irrigation under South African conditions are discussed at some length. With the hilly nature of the Natal coastal sugar cane belt, overhead irrigation is often the only form of irrigation possible. On the other hand in northern Zululand, Pongola and the eastern Transvaal, where the land is much flatter and the soil heavy, surface irrigation may be preferred and be cheaper.

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Agricultural seminars cover variety of popular topics. ANON. *South African Sugar J.*, 1967, **51,** 409–411. Seminars sponsored by the South African Sugar Association Experiment Station are now being held all over the cane belt and are proving immensely popular and useful with cane growers. Summaries are provided of three lectures given at a seminar held at River's Bend Estate, Nkwaleni. These dealt with herbicides, soil and water conservation and cattle on cane farms.

* * *

Controlling weeds in Mexican cane fields. A. L. FORS. *Sugar J.*, 1967, **30,** (1), 12–16.—The earlier and present day use of chemical weedkillers in Mexican cane fields is discussed, especially on the large Tamazula estate, in the State of Jalisco, where over 8000 hectares of cane are grown. The use of herbicides has greatly increased in recent years. A list is given of the various herbicides in use in Tamazula and the methods of using them outlined.

* * *

Irrigation at Ingenio Los Mochis. T. B. FRASER. *Sugar J.*, 1967, **30,** (1), 42–44.—The methods of surface irrigation employed at this large Mexican sugar cane estate, in the State of Sinaloa, are discussed. Some 60,000 acres of mainly flat land are devoted to cane on this estate. All the irrigation water is obtained from the large Government-owned Miguel Hidalgo dam, which has never failed, water being paid for on a cultivated area basis. The clay soils are rich in potash and nitrogen is the only nutrient applied.

Sugar beet agriculture

The influence of different methods of stubble cultivation on the growth of sugar beet. O. Furrer. *Schweiz. Landw. Forsch.*, 1966, **5**, 456–468; through *Soils and Fertilizers*, 1967, **30**, 306.—Results are given of eight trials conducted for three years at three sites. Treatments were: no cultivation, rotovating to a depth of 6–8 cm, skimming to 6–8 cm and green manuring with rape. Yields of beet and tops were reduced by lack of cultivation but sucrose concentration increased and financial returns were little affected. Rotovation and skimming were alike in their effects on yields, sucrose content and profit. Green manuring on average had no effect on yield and sugar contents, and production costs made it unprofitable. Stubble cultivation significantly prevented drying-out of the soil, especially during dry autumn weather.

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Spraying of sugar beet with urea. P. F. J. van Burg. *Landbouwvoorlichting*, 1966, **23**, 257–259; through *Soils and Fertilizers*, 1967, **30**, 306.—On a calcareous loam, urea spraying had little effect on the beet or sugar yield but increased leaf production.

* * *

The effect of boron fertilizer, which produces favourable effects on sugar beet and toxic effects on beans on Tokachi volcanic upland soils in Hokkaido. T. Mori, K. Watanabe and I. Fujita. *Res. Bull. Hokkaido Nat. Agric. Expt. Sta.*, 1966, **90**, 61–64; through *Soils and Fertilizers*, 1967, **30**, 425.—Beans, especially red beans (Azuki beans), are frequently grown in rotation with sugar beet. It is recommended that boron application to sugar beet should not exceed about 4 kg/ha B_2O_3 when red beans are the following crop.

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The efficacy of localized fertilizer application in sugar beet grown on a dark brown chernozem in the southeast of Rumania. G. Coculescu and D. Isfan. *Anal. Inst. Cent. Cerc. Agric.*, 1964, **32**, 269–279; through *Soils and Fertilizers*, 1967, **30**, 425.—Eight kg/ha P_2O_5 as pelleted superphosphate was applied near the seeds of sugar beet during planting on a dark brown chernozem. Yields were significantly increased on plots unfertilized or fertilized with N only, but not on plots basically fertilized with P. Localized superphosphate application did not induce significant increases in the sugar content of the roots. On a well fertilized dark brown chernozem, localized superphosphate application at planting is unnecessary.

Time course of low temperature inhibition of sucrose translocation in sugar beets. C. A. Swanson and D. R. Geiger. *Plant Physiology*, 1967, **42**, 751–756.—Earlier studies have indicated that the inhibitory effect of low temperature on organic translocation rates gradually diminishes with time. This time factor effect has been found to be highly significant in the case of the sugar beet. The present paper reports the results of a study to characterize quantitatively and in detail the time-course response of sucrose translocation in sugar beet to low temperatures applied to the petiole of the donor leaf. The half-time of inhibition, defined as the time required for 50% inhibition of the control or pre-cooling rate, varied from 4 to 15 minutes, and the half-time of recovery from 30 to 100 minutes. Maximum inhibition varied from 68 to 92%. When the duration of the low temperature period was such as to permit subsequent full recovery, re-warming of the petiole zone to 25° to 30°C effected little or no increase in the translocation rate. It was apparent that subjecting the petiole zone to a temperature generally considered inhibitory to physiological processes resulted in little or no impairment to the translocation process after a suitable thermal adaptation period.

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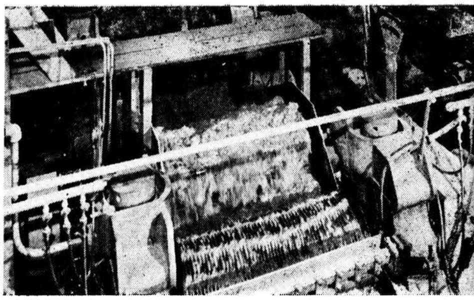
Why grow sugar in Britain? D. B. Campbell. *World Crops*, 1967, **19**, (3), 29–31.—The sugar beet and sugar cane industries are compared, attention being drawn to the heavy Government subsidies paid out to the sugar beet industry in Britain. The writer argues that (*i*) beet has to be planted each year while cane can ratoon, (*ii*) beet produces about 2 tons of sugar per acre per annum while cane produces about 4 tons, (*iii*) beet acreages must be rotated while cane can be grown on the same land every year, (*iv*) beet must be harvested annually while the age of cane at reaping can be flexible, (*v*) fertilizer and lime requirements for beet are much higher than for cane, and (*vi*) beet factories in temperate climates operate for very restricted periods each year while cane factories in the tropics operate for long periods in the year. It is contended that the only real advantage that beet would have over cane in open competition is its proximity to the main consumer markets. It is also argued that if sugar beet were not grown this would be a great help to the developing countries in the tropics many of which have to rely so much on cane sugar production in their economy.

Cane sugar manufacture



Development of mechanical ash removal at Frome. D. H. Bramah. *J.A.S.T.J.*, 1965, **26**, 56–59.—Details are given of the arrangements for ash removal from the furnaces of nine Babcock & Wilcox W.I.F. boilers. Initially a double chain conveyor was installed to transfer the manually raked ash to a secondary carrier which carried it up to a disused evaporator effect (with conical bottom and discharge grate) for removal by truck. The conveyors were made from old bagasse carrier parts, each conveyor being operated through a V-belt drive at 100 ft/min. The existing cleaning doors were replaced by suspended ones which opened sideways. The graphited asbestos closure seals have an average life of only about one crop and will eventually be modified. Mechanical ash removal has now been introduced. This involves use of a modified Aveling Barford "Calf Dozer" fitted with a two-stage, double-acting hydraulic ram, pump and valve assembly as used on commercial vehicles, the ram giving a 12 ft extension. The complete assembly travels backwards and forwards to draw the ash out from the furnaces. A second "Calf Dozer" is used as standby. Removing the firebars and increasing the number of tuyères down towards to furnace floor level has reduced cleaning intervals to once every 24 hr, while the cleaning time for one boiler has been cut from 7 hr 35 min using 15 men to 3 hr using 6 men. The intervals between repairs to the furnace door and replacement of flame plates have been increased.

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Frome's molasses exhaustion system. K. A. White. *J.A.S.T.J.*, 1965, **26**, 60–62.—Details are given of the system at Frome whereby 60% of the *C*-massecuite from two massecuite receivers below the vacuum pans is handled by three Blanchard crystallizers in series followed by a Werkspoor crystallizer, while the remaining 40% passes through four Blanchard crystallizers (Nos. 4, 5, 6 and 7) in series. All of the massecuite is then combined in a common header tank and passes to a Green-Smith reheater[1], in which the massecuite temperature is raised from 100°F and 115°F on discharge from the Werkspoor and No. 7 Blanchard crystallizers, respectively, to 125°F using hot water at 133°F. The reheater throughput is 22–29 tons of massecuite per hr. The centrifugal station for *C*-massecuite curing comprises three BMA and eight Broadbent machines, although, because of difficulties with this combination, the Broadbent machines are to be replaced with BMA centrifugals. Advantages of the system include the possibility of cooling the massecuite to 106°F through increased retention in the Blanchard crystallizers, and controlled reheating without appreciable risk of crystal resolution. Final molasses apparent purity in 1965, using the system, was 30·40 compared with 32·46 in 1964 (before the system was installed) while the sucrose content was 41·23% compared with 45·17% on solids, the overall recovery from molasses being 85·16% in 1965 and 83·97% in 1964. Diluted final molasses of 85°Bx is used as lubricant between crystallizers Nos. 1 and 2 where the massecuite has a temperature of 120–130°F.

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Production capacity of a sugar factory. J. S. Carbonell. *La Ind. Azuc.*, 1967, **72**, 91–93.—The exact capacity of a sugar factory is an important factor in its operation, planning, cost analysis, etc., but it is usual to express this capacity in terms of the original design, modified by alteration or addition to the plant. This design capacity is often lower than the true capacity because of the elimination of initial troubles, bottlenecks, etc., and also because of the elasticity necessarily involved in the design itself.

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Discussion on the cleaning of evaporators with W.B.A. brushes. A. Jans. *J.A.S.T.J.*, 1965, **26**, 70–71.—At Innswood the tubes in the quintuple-effect evaporator are cleaned with double brushes after 3 hours' boiling of a 24·57°Bx caustic soda solution. The brushing takes 4 hr, compared with 6½ hours using single brushes after 3 hours' boiling of a 34·14°Bx caustic solution. The 17·25% reduction in lost time is equivalent to 4 days' grinding per crop, while brush consumption has been reduced, giving a total crop saving on brushes of over £287.

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The evaluation of magnesium oxide in juice clarification. J. R. Wotherspoon. *J.A.S.T.J.*, 1965, **26**, 65–69. Trials at Monymusk in which "Magox" magnesium oxide was added to juice 4 min before lime was added showed that the evaporator scale was softer than with lime and cleaning was easy. The indicated evaporation rates were higher with lime treatment than with "Magox" + lime, while the slowing down rate of the evaporator after a 6-day run (expressed as °F temperature difference required per lb of water

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[1] *See I.S.J.*, 1965, **67**, 271–274, 298–300.

evaporated/sq.ft. of h.s./hr) was 5·8% with "Magox" + lime and 16·2% with lime alone. While final molasses viscosity and sugar invert content, ash content, colour content and pH were approximately the same with both treatments, the sucrose loss in molasses after "Magox" + lime treatment was some 10–12% higher, so that the use of "Magox" is considered uneconomical except in unusual circumstances.

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Methods of sampling and weighing in the cane sugar factory. E. Piat. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 23–31.—The various methods and equipment used in sampling and weighing cane, bagasse, 1st expressed and mixed juice, filter mud, molasses and sugar are described.

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The influence of preparation and feed in mill extraction. T. Maigrot. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 192–202.—Difficulties associated with mill cane feed at Belle-Vue factory have been overcome by dividing the cane carrier into two sections with a cane knife set at the head of the first section rotating in the opposite direction to cane flow. The knife set at the head of the second section thus receives cane which has already been treated, so that its efficiency is raised. Each carrier section is individually controlled through Heenan & Froude slip-coupling transmissions. The milling tandem comprises two Fives Lille-Cail mills followed by two Walkers Ltd. units which have floating top rollers instead of fixed ones as usually supplied by the manufacturers. Irregularities in cane feed to the mills and roll slip were eliminated by installing an Australian-type feed chute at each mill.

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Adaptation of steam accumulators to the sugar industry. R. Raffray. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 203–208.—At Union Flacq sugar factory difficulties in increasing boiler pressure sufficiently rapidly by raising the heating rate have arisen because of the distance between the bagasse fuel store and the furnaces. The problem has been overcome by installing a steam accumulator, and the way in which the arrangement operates is described.

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High pressure boiler control. F. le Guen. *Rev. Agric. Sucr.* (Mauritius), 1966, **45,** 209–212.—High relative humidities in Mauritius cause air from a compressor to be very moist, creating difficulties with pneumatic controls through the intoduction of an oil-water mixture. Means of overcoming this problem are discussed as are the various criteria applicable to automatic control of high-pressure boilers.

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Notes on the Rabe clarifier, diffusers and the Dowson & Dobson dryer (in South Africa). L. Lincoln. *Rev. Agric. Sucr.* (Mauritius), 1967, **46,** 28–33. Difficulties with the Rabe clarifier at Umzikulu are discussed, and details given of the De Smet cane diffuser at Entumeni and the BMA cane diffuser at Dalton. Brief mention is made of the fully-automatic Fives Lille-Cail mills at Jaagbaan, which have been found to work completely satisfactorily without any stoppages, and of the advantages of cane diffusion. Also described is a Dowson & Dobson dryer, used in the chemical industry and for drying of maize, which has been applied to refined sugar drying at Gledhow and to raw sugar drying at Sezela. Once the difficulty of maintaining regular feed has been overcome, it is considered promising for raw sugar drying.

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Studies on the keeping qualities of Indian plantation white sugars. III. Comparative studies on the keeping quality of carbonatation and sulphitation sugars. N. A. Ramaiah and B. I. Nemade. *Sharkara,* 1966, **8,** 78–85.—While differences were found between the keeping quality of hopper sugar, single-cured *B*-sugar and double-cured *C*-sugar, all exhibited loss in whiteness with storage time. The higher the purity, the better was the keeping quality, while sulphitation sugars kept better than did carbonatation sugars. The higher alkaline carbonates content in carbonatation sugars is considered the most likely cause of the poorer keeping quality of these sugars.

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Sugar crystallization in vacuum pans. IV. Laboratory assessment of optimum conditions. P. G. Wright and D. H. Foster. *Tech. Rpt. Sugar Research Inst. Mackay,* 1966, (76), 36 pp. + diagrams; through *S.I.A.*, 1967, **29,** Abs. 220.—The effects of variables on crystallization velocities (*c.v.*) of low-grade massecuite from four Australian factories were measured in a laboratory pan. Conditions at which nucleation of syrups commenced were also studied[1]. In seeded syrups *c.v.* (g/sq.m./hr) increased linearly with oversaturation (*o.s.*) above a given $o.s.{:}c.v. = K(o.s. - c)$, where K and c (commonly 0·015–0·07) are constants for the massecuite. At purities < 80, log *c.v.* decreased linearly with increasing impurity:water ratio in the mother liquor. In Racecourse factory massecuite, *c.v.* decreased by 11% and 8% per unit purity decrease at 1·08 and 1·20 supersaturation, respectively. Kalamia massecuites, which had lower reducing sugar:ash ratios, showed lower *c.v.* values. *c.v.* increased with temperature at constant supersaturation and purity. At purities < 65, this effect was reduced by the increase in impurity:water ratio with temperature. In crystallization tubes containing a few large crystals, *c.v.* increased with stirring rate up to 25 r.p.m. Under the usual vacuum pan conditions, doubling the stirring speed would increase *c.v.* by $\sim 40\%$. These results are used to calculate theoretical deposition and evaporation rates in vacuum pans. Times for *A*- and *B*-strikes could in theory be reduced from 104 and 220 min to 37 and 89 min, respectively, by improved circulation and boiling at temperatures > 160°F; practical boiling times would be 53 and 146 min.

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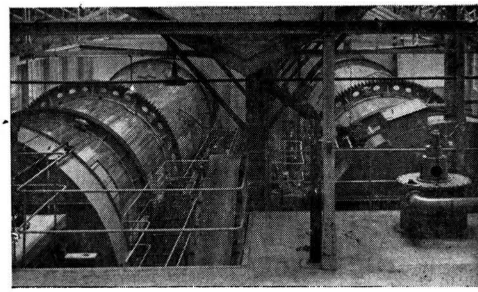
[1] *See also* Penklis & Wright: *I.S.J.*, 1964, **66,** 19.

Beet sugar manufacture



Chlorination of recycled diffusion water to protect it against the development of micro-organisms. T. Pietrzykowski, S. Godwod, H. Feldchaj and Z. Zareba. *Prace Inst. Lab. Badaw. Przem. Spoz.*, 1966, **16,** (1), 5–19; through *S.I.A.*, 1967, **29,** Abs. 117.—Laboratory and factory tests showed that the necessary dose was 7–8 mg Cl_2/litre, increased every 3–5 days to 13–14 mg/litre for 8–12 hr.

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Solution of the general problem of heat- or mass transfer in a layer. G. A. Aksel'rud. *Inzh.-Fiz. Zhurn.*, 1966, **11,** (1), 93–98; through *S.I.A.*, 1967, **29,** Abs. 219.—A general solution for mass transfer across an infinite plate, cylinder (as in beet cossettes) or sphere is presented in terms of dimensionless numbers. Two approximate solutions for a very long and a very short layer respectively are given.

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Main problems of management and purification of sugar factory effluents in Rumania. G. I. Manea, R. Cojocaru, A. Otahal, I. Birca and C. Gajban. *Hidroteh. Gospodar. Ap. Meteorol.*, 1966, **11,** 141–147; through *S.I.A.*, 1967, **29,** Abs. 227.—The water recycling and effluent treatment system at Bucecea factory is described. Water consumption with recycling is only 4 cu.m./ton of beet, compared with 19 cu.m./ton without recycling. The dimensions of water supply plant are thereby decreased. Flume muds (soil) and carbonatation muds are slurried with water to concentrations of 16% and 20% dry solids, respectively, and transported to reservoirs separately from other effluents; excess water is drained into the ground, or discharged at intervals. Disposal of the dry mud is a problem for which there is no satisfactory solution at present.

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The significance of mould in beet sugar technology. II. Tests on the pectin and cellulose decomposing capacity of some moulds isolated from stored beet. H. Klaushofer and F. Hollaus. *Zeitsch. Zuckerind.*, 1967, **92,** 295–298.—Tests with nine different species of mould isolated from stored beet showed that all were capable of hydrolysing sodium polypectate, while only three had any effect on cellulose. These three (*Botrytis cinerea*, *Fusarium poae* and *F. solani*) were found to be capable of growing on damaged or undamaged beets after only three days. *Botrytis cinerea* transferred to damaged tissue exerted the greatest destructive effect.

Tests on application of computers for regulating sugar factory production processes. S. Gawrych. *Gaz. Cukr.*, 1967, **75,** 105–108.—A survey is presented, with 38 references to the literature, of tests conducted on computer control of various beet factory and refinery processes.

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The danger of dust explosion in sugar silos. G. Kühnen. *Sucr. Belge*, 1967, **86,** 465–478.—See *I.S.J.*, 1967, **69,** 86.

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Effect of vapour bubble agitation on the crystallization rate of sucrose. D. Schliephake and F. A. Orlowski. *Zucker*, 1967, **20,** 347–351.—Details are given of a method used to determine the effect of vapour bubbles on crystallization rate, in which air was used as agitation medium in a laboratory vacuum pan consisting of a riser and a downtake. The moisture content of the air feed was adjusted to correspond to the vapour pressure of the sugar solution. Results of the tests, conducted at 40°C and 60°C, are given in graph form.

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Spreckels builds beet sugar factory in Arizona. Anon. *Sugar y Azúcar*, 1967, **62,** (6), 46–48.—The Chandler beet sugar factory is described.

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100 years of Leipnik-Lundenburger Zuckerfabriken-Actiengesellschaft. Anon. *Zucker*, 1967, **20,** 357–360. The history of this sugar company, which operates two white sugar factories at Dürnkrut and Leopoldsdorf in Austria, is outlined.

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Ion exchange membranes in the sugar industry. II. Effect of sucrose concentration on swelling and conductivity of ion exchange membranes. K. Číž. *Listy Cukr.*, 1967, **83,** 127–132.—In laboratory tests it was found that the degree of swelling of ion exchange membranes was maximum at 10–12°Bx after which it fell linearly with increase in Brix, the volume of the membrane remaining constant at 40°Bx. The swelling pressure (osmotic pressure) was directly proportional to the degree of swelling at 10–50°Bx. Conductivity was proportional to diffusivity and mobility of the membranes, and fell linearly with increase in sucrose concentration.

Optimum application of wash water in automatic white fillmass centrifugals. J. P. THOMAS, O. V. BONNEY and R. E. HALLBECK. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14**, 181–189.—Tests with an automatic Western States centrifugal used to cure white sugar massecuite showed that variation in wash water temperature between 75°C and 95°C and between 90°C and 127°C, and variation in wash water pressure between 40 and 70 p.s.i.g., had little effect, if any, on sugar quality, yield and moisture content. Sugar quality in terms of ash and colour content suffered if continuous washing was used instead of periodic washing. A time of 15 sec was found preferable between completion of charging and the first wash. Sugar yield and quality were also affected by the total amount of wash water; sugar yield fell by 2·5 lb for every lb increase in the water, although sugar quality did not rise proportionally with increase in the amount of water. The optimum amount of water varies from strike to strike and is best determined by measurements of conductivity ash in the spun sugar.

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Tests on evaluation of thick juice and liquor decolorization using decolorizing resins. F. PERSCHAK. *Zucker*, 1967, **20**, 377–385.—Laboratory and pilot-scale tests on decolorization with "Amberlite IRA 900" and "Lewatit MP 500" are discussed. Results for thick juice are expressed in terms of juice analysis and sugar evaluation by the Braunschweig points system as well as sieve analysis. The decolorizing efficiencies ranged from 41·34% to 70·53%. The original 63°Bx, 94·0 purity juice had an ash:solids ratio of 1·650 and a colour content of 16·0°St. General improvements in sugar yield and quality were obtained. Addition of NaOH to the NaCl used for regeneration improved colouring matter elution. Despite a 37% drop in resin capacity after 100 cycles, the decolorizing efficiency was still satisfactory.

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Exergetic comparison of evaporator units for the cane sugar industry. T. BALOH. *Zeitsch. Zuckerind.*, 1967, **92**, 366–368.—Evaporation schemes desctibed by STAUB and PATURAU[1] are further discussed and the steam and exergy consumption of all 10 schemes are tabulated. It is concluded from the exergy values that vapour compression does not provide as significant an improvement in steam economy as would be expected from the drop in steam consumption. The most effective measures are considered to be distribution of vapour consumption over all stages of the evaporator station and maintenance of a lower exhaust steam pressure.

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Examination of the kinetics of sugar extraction from a layer of cossettes. N. N. PUSHANKO and V. M. LYSYANSKII. *Izv. Vuzov, Pishchev. Prom.*, 1967, (3), 122–127.—Diffusion tests carried out with an experimental unit showed that the mass transfer coefficient increased by 300–400% with increase in the juice flow rate from 4 to 10 cm/sec, increased linearly with temperature rise in the range 55–83°C, and also rose to infinity with increase in the reduced radius *R* of the cossette layer, considered as an infinite cylinder, above values of 2 mm. The relationship with *R* indicates the basic rôle played by internal diffusion resistance which increases with cossette thickness.

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Optimum piezometric levels in sugar factory evaporators. N. YU. TOBILEVICH, I. I. SAGAN' and M. N. CHEPURNOI. *Izv. Vuzov, Pishchev. Prom.*, 1967, (3), 128–131.—Tests on two coupled evaporator vessels (2nd effects) showed that at a juice level of 110–115% of the tube length the amount of scale deposited on the heating surface was 70% lower than at an optimum level for heat exchange of 40%. This stabilized performance, increased throughput and lengthened the period up to boiling-out by 70% (52 days). The fall in heat transfer coefficient during 80 days at the higher level was smaller than with the lower level.

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Kiryat-Gat sugar factory and the sugar industry in Israel. M. ROCHE. *Ind. Alim. Agric.*, 1967, **84**, 763–769.—An illustrated account is given of Kiryat-Gat white sugar factory, one of Israel's two sugar factories. Erected by Soc. Fives Lille-Cail, the factory can slice up to 2400 tons of beet per day, although the total amount of beet sliced in a campaign is restricted to 160,000 tons. The factory produces some two-thirds of the country's sugar production.

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Some considerations on the Quentin process. J. HUBERLANT. *Sucr. Belge*, 1967, **86**, 505–514.—The Quentin ion exchange process in which molasses K and Na are replaced by Mg is described and the advantages, disadvantages and costs of the process discussed. Among the disadvantages mentioned are possible difficulties in selling molasses because of the change in composition, and its unsuitability for citric acid production. The chief advantage lies in the possible 0·3–0·4% extra white sugar recovery or 4–6 units molasses purity drop.

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Horizontal silo cuts costs for Michigan Sugar Co. ANON. *Sugar y Azúcar*, 1967, **62**, (8), 41–42.—Information is given on a 1000-ton capacity white sugar silo erected at Caro sugar factory. The first horizontal bulk sugar silo to be erected in the US, it incorporates a belt conveyor running the length of the building just below the roof ridge and a movable plough which discharges the sugar from both sides of the belt. A control system maintains relative humidity within the range 50–60% and temperature at 60–65°F, electric heating coils in the concrete sides and floor of the building maintaining a temperature of 60°F beneath the sugar. The sugar is reclaimed by drag scraper and is used for liquid sugar production or in dextrose blends.

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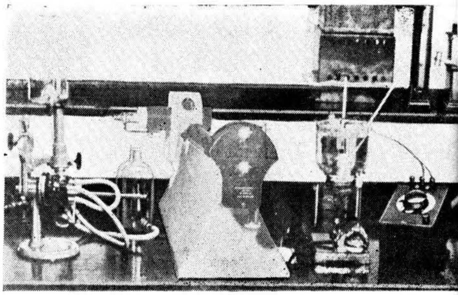
[1] Principles of sugar technology. Vol. III. Ed. P. Honig. (Elsevier, Amsterdam.) 1963. Ch. 2.

Laboratory methods & Chemical reports



From laboratory practice. S. T. KOZHEMYAKIN. *Sakhar. Prom.*, 1967, **41**, (5), 30–31.—Information is given on various pieces of laboratory equipment used at the author's sugar factory for determining cossette sugar content, pulp sugar content and the moisture content of wet and pressed pulp.

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Crystallization of sucrose, D-glucose and D-fructose in supersaturated solutions in the metastable zone. J. VAŠÁTKO and A. SMELÍK. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Experiments with pure aqueous solutions showed that the limit of the metastable zone was expressed in a graph of sucrose concentration (g/100 g) *vs.* temperature by a concave curve for supersaturated sucrose solution, but followed a convex path in the case of D-glucose and D-fructose, the narrowest metastable zone being found with D-fructose and the widest with D-glucose. The form of the limit curve was also found to depend to a certain extent on the form in which concentration was expressed, i.e. g/100 g of solution, g/100 g of water, or moles/100 g of water. The limit also depended on whether a certain modification or type of crystal was formed. Changes in mobility of molecules of the components of a solution according to temperature and concentration affected the positive or negative values of the constants in the appropriate empirical quadratic functions of temperature.

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Some data on variation in sucrose solubility and other physical properties in the presence of non-sugars in the form of K, Ca or Mg. P. PIECK, J. HOUSSIAU and R. VANDEWYER. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—In a study of the Quentin process[1] changes in the physico-chemical properties of sugar solutions in which known quantities of K^+ and Na^+ cations were exchanged for Mg^{++} or Ca^{++} ions were investigated. Sucrose solubility fell with increase in the number of cations exchanged. Ion exchange also increased the viscosity of Steffen waste water (a practically sugarless solution of non-sugars), the increase being greater when K^+ ions are replaced by Mg^{++} ions than by Ca^{++} ions, but the viscosity of saturated sugar solutions fell after ion exchange. The presence of sugar considerably reduced the fall in the equivalent electrical conductivity caused by exchange of K^+ ions. Surface tension was hardly affected by ion exchange itself, but fell quite appreciably as a result of the drop in Brix of saturated sugar solution. When Ca^{++} ions were exchanged for K^+ ions, the crystallization rate in impure solution increased to a maximum corresponding to 45% ion exchange. When Mg^{++} ions replaced K^+ ions there was no maximum, but the rate rose significantly as the percentage of ion exchange increased. The frequent appearance of fine grain made these measurements very difficult. The Quentin process is considered suitable as a means of facilitating boiling and low-grade curing, apart from the drop in molasses sugar.

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Adsorption of colouring matter by sucrose in sugar products. H. ZAORSKA. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Sucrose solution passed through an active carbon column after decolorization of a wash liquor desorbed colouring matter from the carbon, the colour of the solution leaving the column increasing with reduction in the sucrose concentration. When saturated sucrose solution to which colouring matter had been added was passed through a column filled with fine sugar crystals, a certain decolorization took place, the effect being greater with finer crystals and hence with greater total crystal surface. The adsorptive capacity per unit area of sugar crystal was such as to give similar decolorizing effects as active carbon per unit area, particularly in the case of colouring matter (e.g. caramel) having a specific extinction at 500 nm. The results are related to sugar crystallization in coloured solutions, where the colouring matter has a retarding effect on the crystallization rate. It is suggested that a major part of the colouring matter in sugar solutions does not occur as separate soluble compounds but forms specific complexes with sucrose, which increases the solubility of the colouring compounds just as non-sugars increase sucrose solubility. In both cases the sucrose molecule is linked to the impurities.

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Effect of the number of sugar crystals in a solution on the crystallization rate. S. ZAGRODZKI. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Tests with a laboratory crystallizer[2] showed that the crystallization rate of a supersaturated sugar solution containing a large number of crystals was lower than

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

[2] *ibid.*, 1965, **67**, 301.

that of a solution containing a smaller number of crystals, the rate being closely related to the ratio between the total free space between the crystals and the total volume of crystals and mother liquor. Similar results were obtained at varying supersaturations, temperatures and crystal sizes. The value of the crystallization "retardation coefficient" (*h*) is approximately given by $\left(\frac{V_m - V_k}{V_m}\right)^2$, where V_m and V_k are, respectively, the volume of the mixture and the total crystal volume. The coefficient was found to have similar values for all crystal sizes at various supersaturations and temperatures.

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Habitus variation of sucrose in the presence of non-sugars relating to their crystalline structures. G. Mantovani, G. Gilli and F. Fagioli. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Modifications to the habit of single sucrose crystals grown under controlled conditions in the presence of glucose, fructose and galactose were found to be slight, whereas raffinose, which is the only one of the four sugars found to be embodied in the sucrose crystal lattice, caused considerable changes in the sucrose crystal habit. The mechanism of the changes is discussed in detail with the aid of diagrams.

* * *

Measurement of crystallization rate. The effect of various parameters. P. Devillers. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Crystallization studies with a continuous circulation system incorporating crystallizer, heater, pump, heater, saturater, cooler and heater showed that the crystallization rate is not proportional to supersaturation at low supersaturation, but rises at an increasing rate with increase in supersaturation. At constant supersaturation, the rate increased approximately 4-fold with temperature rise from 40°C to 70°C. At 40°C the crystallization rate increased by a maximum of approximately 100% with increase in the circulation rate from 0 to infinity (> 3 cm/min). pH had no effect on crystallization rate. Ionizable impurities and various non-sugars tested had a slight reducing effect on crystallization rate when present in moderate amounts, and hardly changed the crystal form. On the other hand, very small amounts of raffinose markedly reduced the rate and considerably changed the crystal form. Total deionization of beet factory products would not therefore increase the crystallization rate, since it would not remove raffinose.

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Use of the E. Calvet microcalorimeter for the study of sugar solution crystallization. F. Heitz and N. Tikhomiroff. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Studies with single sucrose crystals suspended in sugar solutions at varying temperatures demonstrated the applicability of the Calvet microcalorimeter in investigations of crystal growth or dissolution, which processes are measured in terms of the flow of heat generated. Even though a thermal inertia has been found to cause discrepancy between the true and the measured heat flow, an equation representing heat flow as a function of time is shown to be of use in calculating crystallization parameters such as diffusion and crystallization rate, crystallization surfaces and supersaturation.

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The problem of choice of crystallization temperature. G. Pidoux. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—From previous studies on the viscometry of supersaturated sucrose solutions a formula is derived for calculation of the optimum temperature for boiling at a given supersaturation and Brix:

$$\theta_c = e^{(3{\cdot}403+0{\cdot}59s)}$$

where θ_c = optimum boiling temperature, e = exponent, and s = supersaturation. It has been found that boiling at about 65°C and 1·3 supersaturation will give high quality crystals as well as permitting economies in vapour, reduction in boiling time, avoidance of excessive coloration during boiling and a cut in crystallizer retention time. The optimum boiling temperature given by the above formula is lower than is generally used.

* * *

Continuous crystallization with crystal size classification. S. Hill. *Paper presented to the 13th Congr. C.I.T.S.*, 1967.—Three possible arrangements of series-connected crystallizers with one or more crystal classifiers[1] are considered: (i) one classifier at the end of the crystallizer line returning undersized crystals to the first crystallizer; (ii) the same, but with return of crystals to the last crystallizer; and (iii) each crystallizer followed by a classifier returning rejected crystals to that crystallizer and feeding suitable crystals to the next crystallizer. Differential equations are derived for each arrangement and are easily formulated in terms of the mean residence times of the growing crystals in the crystallizers, the volumetric rate of extraction of massecuite from the pans, the crystal growth rates and the characteristic curves of the classifiers. While an analytical solution is not generally possible, an analogue computer was used to solve the equations for given values of the parameters, and in two cases the effect on the output crystal size distribution of unequal growth rates was determined. Coefficients of variation smaller than 30% can be achieved with comparatively simple arrangements without undue demands on the classifier and at a moderate massecuite flow rate through the classifier.

* * *

Deleterious effect of extraneous matter on milling and recovery of sugar. R. B. L. Mathur. *Indian Sugar*, 1967, **16**, 875–879.—The disadvantages of processing dirty cane are discussed and the losses in bagasse, filter cane and final molasses calculated. The drop in mixed juice purity and in total recovery and the rise in final molasses purity are calculated and tabulated for cane carrying 3–17% extraneous matter. The losses are also expressed in monetary terms.

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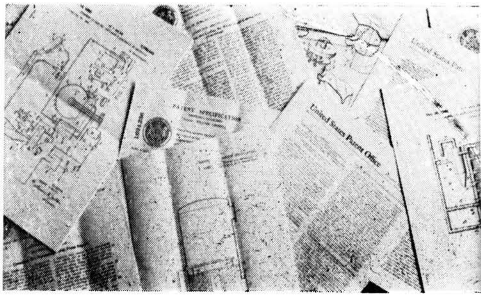
[1] *See I.S.J.*, 1968, **70**, 89.

Patents



UNITED STATES

Refining unwashed raw sugar. S. P. MARINO, of Tarrytown, NY, USA, *assr.* CORN PRODUCTS COMPANY. **3,290,173.** 3rd February 1964; 6th December 1966.—Unwashed raw sugar is dissolved in water to give a 30–65°Bx (45–65°Bx) solution (at 50°–80°C) and this treated with either 0·5–3·5% of lime and enough phosphoric acid to bring to a pH of 6·0–7·0, or with 0·1–0·15% on sugar solids of P_2O_5 as phosphoric acid and neutralizing to pH 7·0–8·0 with lime. The organic non-sugar-free neutralized solution is heated to 85°C, filtered and decolorized with granular carbon (up to 10% w/w on sugar solids) at a temperature below 85°C during 4 hours, to a colour less than 1·0 on the Horne scale. The decolorized solution is demineralized by passing through an electrodialyser (maintaining a pH of 6·0–7·0 by intermittent additions of NaOH) to give a product of Brix greater than 30°, colour less than 1·0 on the Horne scale, pH about 6·5 and containing less than 0·3% invert and 0·1% ash. The solution may be boiled to crystalline sugar or used as a liquid sucrose by treating with a mixed-bed ion exchange resin to reduce the ash to less than 0·009%. Alternatively it can be converted to an invert syrup by subjecting to the action of a strong sulphonic acid-type cation exchanger to bring the pH to 3·0 at which it is held at 85°C for a time sufficient for the required degree of inversion (48–56%, 95–99%), followed by neutralization to pH 5–7 and concentration to 76·0–76·6°Bx (71·7–72·3°Bx).

* * *

Method for increasing sugar cane yield. A. W. EVANS, *assr.* E. I. DU PONT DE NEMOURS & CO., of Wilmington, Del., USA. **3,291,592.** 20th April 1964; 13th December 1966.—The cane is sprayed, 5-35 days before harvest, with an effective amount of a substituted uracil compound having five substituted groups or atoms in its molecule, the range of variants for each substituent being recorded.

* * *

Cyanoethylated hydroxyalkyl sucrose. G. P. TOUEY and H. E. DAVIS, *assrs.* EASTMAN KODAK CO., of Rochester, NY, USA. **3,298,845.** 28th June 1965; 17th January 1967.—The compounds, suitable as plasticizers for cellulose esters (butyrate) or polyvinyl acetate, etc., or for impregnation of paper used in electrical capacitor manufacture, include cyanoethyl hydroxyethyl (or hydroxypropyl) sucrose in which substantially all the OH groups have been replaced with cyanoethyl groups. The latter is prepared, e.g. by dissolving sucrose in dimethyl formamide, reacting with ethylene oxide in the presence of tetramethylammonium hydroxide at room temperature, removing the solvent and excess ethylene oxide from the mixture and cyanoethylating with excess acrylonitrile.

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Cane stubble remover and replanter. V. A. BOOTS, of Belle Glade, Fla., USA. **3,294,046.** 8th December 1964; 27th December 1966.

* * *

Beet harvester. D. H. SCHAAL, W. J. SCHAAL and M. N. SCHAAL, of Berthond, Colo., USA. **3,294,177.** 17th August 1964; 27th December 1966.

* * *

Crude sugar liquor defecation. H. E. BODE, of Cleveland, Ohio, USA. **3,298,865.** 18th April 1966; 17th January 1967.—Non-screened cane juice, invert molasses or affination wash liquor, is blended with a phosphated starch paste and sufficient lime or barium oxide or hydroxide added to adjust to an alkaline pH (greater than 7·4). The solution is heated (to not higher than 180°F) and the insolubles separated from the sugar liquor which may then be inverted.

* * *

Apparatus for processing crushed fibrous stalks (Bagasse fibre separation). K. M. GUNKEL, of New Canaan, Conn., USA, *assr.* W. R. GRACE & CO. **3,299,477.** 20th March 1964; 24th January 1967.

The rotor 10 is supported by the unit 90 through collar 92 and flange 91; it is driven by belts connecting sheave 60 to a motor and carries hammers 12 which rotate at peripheral speeds of about 20,000 f.p.m., their tips being close to the cylindrical screen surface 22. This screen is supported by flange 76 from casing 80 which surrounds it and has two ports. A fan 32 within port 31 causes suction of air through the other port and around the screen, the air flow being controlled by damper 30. A similar fan 42 and damper 38 are provided for the two ports 88, 86 in the lower casing which surrounds the support 90. Above the

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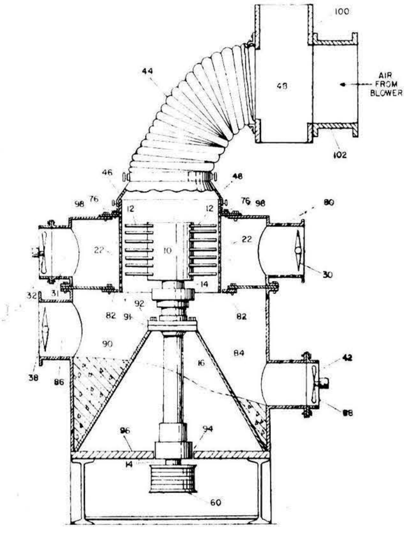
Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C.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

screen is a conical section 46 connected to a flexible duct 44 which is connected to a preliminary separation unit 48 and to a port 102 for entry of air.



Bagasse passes into the unit 48 and is drawn by the current of air into duct 44; heavy material such as tramp iron, rocks, etc. are too heavy and fall through the bottom of the unit 48. The bagasse passes into the hammer unit which separates the pith particles; these, being smaller than the perforations in screen 22 are drawn through it by the air flow through housing 80, while the fibre passes down by gravity to the lower compartment. This is provided with a concrete fill which guides the flow of air and fibres into the port 88 where they are carried by the fan 42.

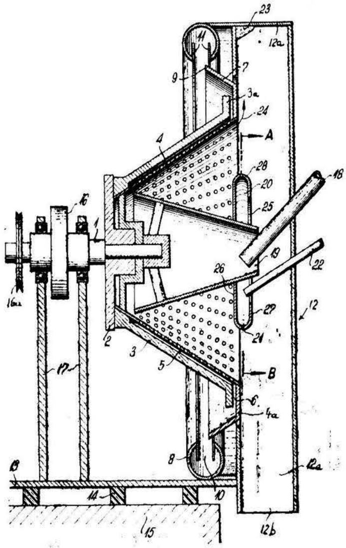
* * *

Surface-active compositions containing mixtures of mono- and di-alkoxymethyl ethers of sugar. G. R. AMES, of Redhill, Surrey, England, assr. US SECRETARY OF AGRICULTURE. **3,300,413.** 12th July 1965; 24th January 1967.—The surface-active agent consists of about equal parts by weight of a mono-alkoxymethyl ether of glucose or sucrose (sucrose) and a di-alkoxymethyl ether of glucose or sucrose (sucrose) in which the alkyl group contains 6–12 carbon atoms.

* * *

Centrifugal. J. VON RÖTEL, of Dortmund, Germany, *assr.* MASCHINENFABRIK BUCKAU R. WOLF AG. **3,301,708.** 5th May 1964; 31st January 1967.

The housing 13, mounted on cushioning members 14 from a base 15, carries a horizontal shaft 1 supported by bearing plates 17 and driven through a sheave 16a and clutch 16. The shaft carries hub 2 with which rotate the frustro-conical drum 3 housing screen 4, flange 4a with the reverse conical baffle section 7, and the internal solid cone section 19 carrying a flange 26. Into the narrow end of cone 19 penetrates pipe 18 through which massecuite is delivered. It is carried by the solid cone to the narrow end of the cone section containing screen 4. Here the massecuite is separated into crystals and molasses, the latter passing through the screen into the space 5 from which it flows to space 6. From this it is directed by flange 7 into the annular space 10 between ring plates 10 and is collected by annular pipe 8 and withdrawn continuously or regularly. The crystals continue to the edge of the screen 4 and overflow into the chamber 12.



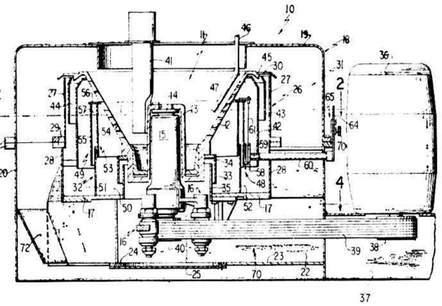
Almost pure syrup is admitted through pipe 22 into the space formed between the rotating flange 26 and stationary flange 27; a series of small holes in the edge of the U-shaped web 28 permit this to flow outwards and impinge on the discharged crystals which are dampened and form a cushion 23 within the collector; this prevents damage to further crystals leaving the screen. The damp sugar is carried by its weight to the bottom of the collector 12 from which it is removed for further treatment.

* * *

Preparation of bagasse (for board manufacture). J. A. RIONDA, of Thibodaux, La., USA, *assr.* NATIONAL BAGASSE PRODUCTS CORPORATION. **3,302,246.** 16th January 1964; 7th February 1967.—The bagasse is first classified to remove a light fraction containing loose pith, dirt, etc., and the heavy fraction subjected to a first milling to break up the fibre bundles and separate pith from the fibres. The mass is again classified to remove dirt, pith, small particles and fibres, etc. in a light fraction. A second milling and third classification follow, giving a final heavy fraction. The three light fractions are combined and re-classified to give a light fraction for disposal and a heavy fraction which is returned to the mass formed by the second milling. Between the second milling and the third classification the bagasse may be moistened to 25–30% and then dried to 1½–5% moisture by weight.

* * *

Continuous centrifugal. T. R. LAVEN, of Hamilton, Ohio, USA, *assr*. THE WESTERN STATES MACHINE Co. **3,302,794.** 30th October 1964; 7th February 1967. Liquid separated from crystals of sugar in the centrifugal 10 may be entirely mother liquor or may be wash syrup supplied inside the basket through pipe 46 with its perforation portion 47. The liquid receiving space 32 is divided into two parts 50, 51 by means of an adjustable partition 48 which comprises a fixed vertical cylindrical partition 52 and two concentric partitions 54, 55 mounted on annular ring 56 which can be raised or lowered, so varying the regions of liquid discharge into parts 50, 51 of space 32. The raising or lowering of the movable partitions is effected by means of a series of pulleys 58 mounted on shafts 59 which are journalled in tubes 60 which pass through the housings and are controlled by quadrant brackets 65.



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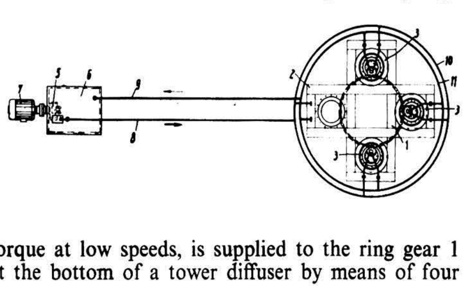
UNITED KINGDOM

Beet harvesters. J. D. DYSON and C. R. DYSON. **1,069,432.** 13th March 1964; 17th May 1967.

* * *

Power transmission (for tower diffuser drives). BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT, of Braunschweig, Germany. **1,069,590.** 21st December 1965; 17th May 1967.—A reliable drive, providing high torque at low speeds, is supplied to the ring gear 1 at the bottom of a tower diffuser by means of four hydraulic motors 3 mounted on a stationary frame 2 and connected to the gear 1 through pinions 4. Hydraulic fluid for the motors is supplied by pump 5 arranged in supply tank 6 and delivered to the motors through pipe 8 and ring line 10, returning through ring line 11 and pipe 9.



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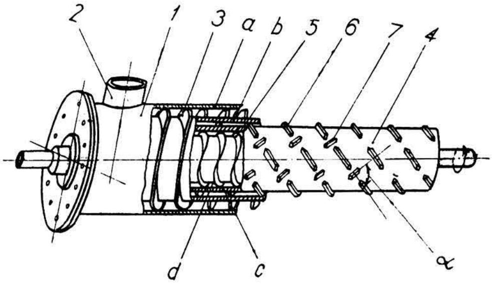
Continuous crystallization of fondant sugar syrups. DEPUTY MINISTER OF THE MINISTERUL INDUSTRIEI ALIMENTARE, Bucharest, Rumania. **1,071,944.** 23rd March 1965; 14th June 1967.

The crystallizer comprises a cylinder 1 provided with a double skin *a* and *b* between which are baffles which direct the flow of cooling water which is admitted and discharged from the cylinder through ports which are not shown. Within the cylinder a beater 4 is rotated. This also is provided with a double skin *c* and *d* with baffles fitted to control the flow of cooling water which circulates within the beater. Mounted on the beater are sets of baffles 6 and 7, one series directing the flow of syrup, admitted through port 2, towards the exit of the cylinder and the other series directing the flow in the opposite direction. The syrup entering the crystallizer is thus subjected to rapid cooling and simultaneous advancing, returning and rotational movement, the overall effect being the production of fine crystals and advance towards the discharge end of the unit at a relatively lower speed.



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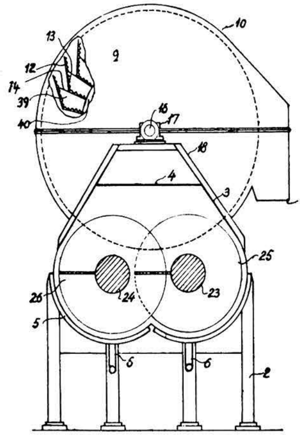
Cane diffuser. A/S DE DANSKE SUKKERFABRIKKER, of Copenhagen, Denmark. **1,072,169.** 29th December 1964; 14th June 1967.

At the upper end of a twin-scroll lixiviation trough is mounted a discharge mechanism in the form of a housing 10 having a discharge opening 11. At the centre of the housing is a driven shaft 16 carried by bearing 17, and from the shaft extend radial plates 12, the outer edges of which are provided with teeth 13. The ends of the plates are bent and perforated, while further perforated plates 14 extend between the original direction of the plates until they meet the next plate 12 of the series. Thus the perforated plates form pockets which collect exhausted bagasse brought to the upper end of the trough and carry it round and to the discharge port 11, its water content draining through the perforations and so back into the trough. The teeth on the edges of the plate cause disintegration of compressed lumps of bagasse brought to the upper end of the trough.



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Molasses purification. Rubicon GmbH, of Frankfurt/Main, Germany. **1,073,284.** 11th February 1965; 21st June 1967.—Beet or cane molasses is applied (at up to 130°C) to an ion exchange resin, and the resin eluted with water before equilibrium is attained between the liquid inside the resin and that outside the resin. Those portions of the eluate having a richer sucrose content than that of the molasses applied are collected for separate treatment for sugar extraction. The less rich sucrose fractions contain a higher proportion of monosaccharides than the original molasses and may be used as a source for recovering these; alternatively, these fractions may be added to fresh molasses for a second treatment.

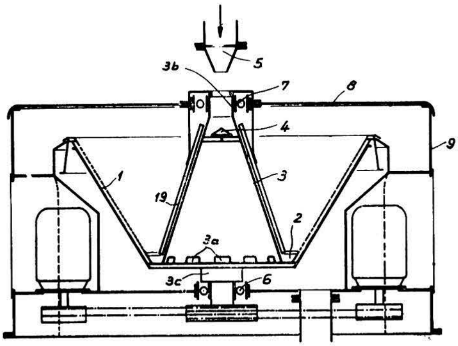
* * *

Glutamic acid recovery. Kyowa Hakko Kogyo Co. Ltd., of Tokyo, Japan. **1,079,527.** 20th October 1964; 16th August 1967.—Glutamic acid is recovered from a fermentate (e.g. of cane or beet molasses) by adding at an elevated temperature (at least 50°C) at least sufficient Ca^{++} ions (as quickline or slaked lime) to be equivalent to the glutamic acid content, filtering off insoluble matter at a temperature at which calcium glutamate remains dissolved, (concentrating to 1/3–1/2 volume,) and thereafter (crystallizing or) precipitating the calcium glutamate [by adding an equal volume of a water-miscible alkyl alcohol (methanol)]. The calcium glutamate is then redissolved in water at a temperature higher than 50°C, the solution filtered and cooled to ambient temperature to recrystallize the calcium glutamate. The product may be converted to sodium glutamate by dissolving in water at higher than 50°C, adjusting to pH 7·0–8·5 with H_2SO_4 or CO_2 while adding an at least equivalent amount of a Na salt (Na_2CO_3, $NaHCO_3$ when CO_2 is used, Na_2SO_4 when H_2SO_4 is used). The quantity of oxalic acid equivalent to any remaining Ca content is added to the solution, the calcium oxalate separated and the sodium glutamate crystallized. Alternatively, the calcium glutamate solution may be passed through a bed of cation exchange resin containing Na-form sulphonic acid groups, whereby the Ca ions are exchanged for Na ions and the sodium glutamate can be crystallized from the treated solution.

* * *

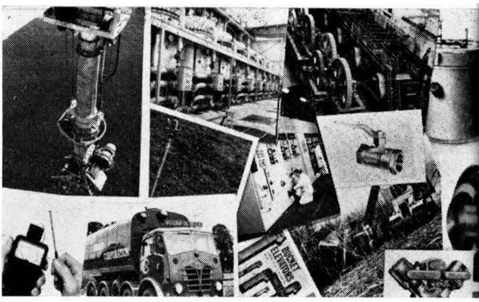
Continuous centrifugal. Hein Lehmann & Co. AG, of Düsseldorf, Germany. **1,074,229.** 15th September 1965; 5th July 1967.

Massecuite fed to the centrifugal through feed nozzle 5 is distributed evenly by cone 4 onto the inner surface of cone 3 over which it passes in a thin layer to the lower widest end and is discharged through slots 3a onto the flat plate 2 and so to the lower edge of the cone 1 which is provided with a screen on which the crystals are separated. The cone 3 is mounted on the plate 2 and rotates with cone 1, an extension 3b at its upper end being located in bearing 7 and the solid shaft 3c being located in bearing 6. The shaft and cones are rotated by means of the two motors operating through belts and the pulley at the bottom of the shaft. In order to heat the massecuite just before it is transferred to the screen, thereby reducing its viscosity, stationary induction heater 19 is mounted outside cone 3 which is given a ribbed surface for better heat conduction. Alternatively, a rotating electric heater can be mounted below the plate 2, taking up current through slip rings mounted on the shaft 3c.



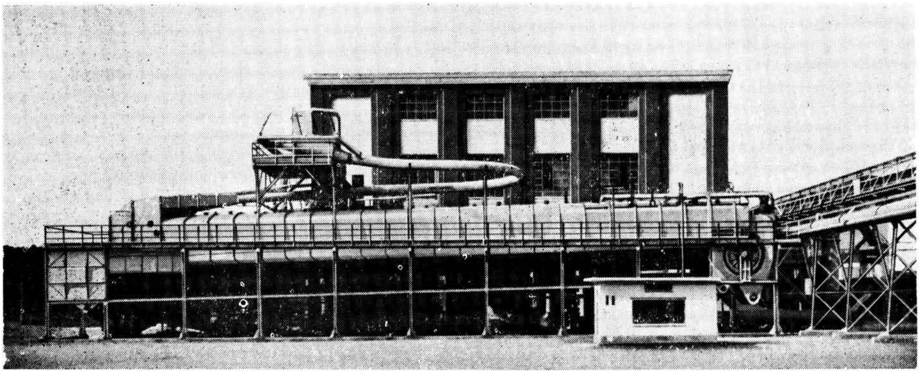
The drive may be by means of bevel gears instead of belts, and various means may be adopted to limit the flow of massecuite through slots 3a in accordance with the centrifugal force exerted by the massecuite, e.g. counterweighted or sprung flaps or baffles.

Trade notices



De Smet diffuser for cane and beet. Extraction De Smet S.A., 265 Av. Prince Baudouin, Edegem-Antwerp, Belgium.

The illustration shows a De Smet diffuser which can be used to process cane or beet subject to certain modifications, which do not involve the diffuser itself but which concern the preparation and dewatering equipment. If the cane is passed through two sets of knives and a shredder before diffusion, the capacity of the TN (direct) type of diffuser will be about the same as with beet diffusion. If, however, the diffuser is preceded by two sets of knives plus a 3-roller mill, or one set of knives, a shredder and a 3-roller mill, the capacity will be about double the beet throughput. The simplest and most economical bagasse dewatering process involves the use of one or more conventional mills, while beet cossettes are best dewatered in screw presses. All auxiliary equipment for the diffuser, including pumps, clarification plant, instrumentation, band weighers, etc. is applicable to both beet and cane. Conversion of the diffuser from beet to cane or *vice versa*, as at Azucarera de Salobreña in Spain, takes only a few hours. To date 34 De Smet beet diffusers and 13 cane diffusers have been sold. Among the other advantages of the De Smet design is the possibility of varying the capacity by 10% above to 30% below the nominal without any drop in efficiency.



Dorr-Oliver 300° DSM screen. Dorr-Oliver Inc., Stamford, Conn., USA.

An application data sheet, No. DSM-B, gives information on a new screening device suitable for size separation and dewatering of sugar and melt liquor. It has the same basic design, principle of separation and advantages as the DSM screen, the only difference lying in the cylindrical screening surface, which is extended to form an arc of 300°. Flow at a feed pressure between 25 and 50 p.s.i. is in the range 35–220 g.p.m. depending on screen slot opening and approximate mesh size.

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PUBLICATIONS RECEIVED

CROFTS FLEXIBLE COUPLINGS. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire, England.

Publication 366 is a 4-colour booklet in English, German, French and Spanish, which provides load classification and service factors, descriptions and dimensions, specifications, erection and maintenance instructions, etc. for the various types of flexible coupling produced by Crofts.

* * *

MASSEY-FERGUSON TRACTORS. Massey-Ferguson (Export) Ltd., Coventry, England.

Information on the 1968 range of MF tractors covers the MF 178 72·5 h.p., MF 175S 67 h.p. and MF 165 60 h.p. models. Standard equipment includes dual clutch transmissions, providing six forward and two reverse gears, although MF "Multi-Power" transmission, which doubles the number of gears, is available as an alternative.

Operated hydraulically, this transmission provides a high and a low ratio in each standard gear, gear changing involving no de-clutching. The MF 178 and 175S models have heavy-duty front axles fitted as standard, and front and rear track widths are adjustable. Maximum p.t.o. ranges from 57 h.p. on the MF 165 to 69 h.p. on the MF 178.

Brevities

UK sugar surcharge increase.—As the world price of raw sugar has fallen during the past month, the UK Minister of Agriculture, Fisheries and Food has made Orders under the 1956 Sugar Act increasing the surcharge in conformity with this price movement from 3¼d per lb (30s 4d per cwt) to 3½d per lb (32s 8d per cwt) from 5th March 1968. With the gradual drift in prices, the London Daily Price has reached its lowest value (£22 per long ton c.i.f. UK) since devaluation of sterling in November 1967.

* * *

New Czechoslovak sugar factory.—Work is progressing on erection of the new CEKOP sugar factory at Hrochuv Tynec, in Czechoslovakia. This will be the largest sugar factory yet built by CEKOP, the Polish organization, and will have a daily slicing capacity of 4000 tons of beet.

* * *

Fabcon Inc. sugar process chemicals.—Under the terms of an agreement signed between Fabcon Inc. and Colloids Inc., the latter company is licensed to manufacture, use and sell Fabcon chemicals, such as "Pan Aid Concentrate", "Fabcon I-12", "Cane Milling Aid", "Zuclar 106" and "Pure Aid" in Australia, EEC and EFTA countries, India, Mexico and South Africa.

* * *

By-product utilization in Brazil[1].—A group of industrialists in Fortaleza is seeking to build a factory in the Curu Valley in São Paulo for the production of paper from bagasse. In Paraná the Secretary of Agriculture is studying the utilization of sugar cane by-products which, in that State, could produce 20,000 tons of cellulose, 40,000 litres of furfural, 100 tons of fertilizer and 160 tons of wax.

* * *

New cane diffusers for the Philippines[2].—Three new sugar plants, each to have a capacity of 3500–4000 tons of cane per day, are being built. All are to use the cane diffusion system. They are the AIDSISA factory at Silay, Negros Occidental, the Balayan factory in Batangas, Luzon, and the Sagay factory at Fabrica, Negros Occidental. The AIDSISA diffuser is due to start operations early in 1968 and the others in 1969.

* * *

Guyana sugar production 1967[3].—An all-time record sugar crop of 343,922 tons was achieved in 1967. The previous record was 334,441 tons in 1960. The 1967 crop was the first for many years in which the industry had no problems from drought, industrial relations or political disturbances and the crop also reflected the industry's steady expansion policy over the years. The total value of sugar exports in 1967 is estimated at approximately £12·3 million, of which approximately £4·5 million constituted dollar earnings from sugar sold to the United States and Canada. Agreement has been reached between the Government, Bookers Sugar Estates Ltd., the Demerara Co. Ltd., the Commonwealth Development Corporation Ltd., Barclays Overseas Development Corp. Ltd. and the Royal Bank of Canada to set up the Cane Farming Development Corporation Ltd. to assist with long-term and crop finance to cane farmers for expansion of the sugar industry. The long-term finance, amounting in total to $3·7 million, will be provided by C.D.C., B.O.D.C. Ltd. and the Royal Bank of Canada and will enable new ground in the vicinity of the[7] sugar factories to be planted to cane; overall supervision and expertise will be provided by the two sugar companies.

* * *

EEC sugar production quotas, 1967/68.—The EEC Commission recently promulgated a decree concerning adjustment of production quotas for the campaign year 1967/68. The production quantities provided for are as follows:

	Adjustment	*Revised quota*
	(metric tons,	*white value)*
Belgium/Luxembourg	+ 21,694	551,694
France	—165,987	2,134,013
Holland	+ 5,876	580,876
Italy	+ 64,401	1,294,401
West Germany	+ 37,684	1,737,684

* * *

New sugar factory for the USSR[4].—A new sugar factory with a processing capacity of 3000 tons of beets per day was recently put into operation in the Soviet Union. The factory was constructed with the participation of specialists from Poland.

* * *

Dominican Republic sugar target, 1968[5].—The Dominican Republic's sugar production target for the current year is 907,400 tons. In a decree issued in January by President BALAGUER it was laid down that the 1968 crop would embrace the entire calendar year. The twelve State mills are authorized to produce 581,000 tons, with the two private concerns Central Romana and Casa Vicini producing 256,000 and 70,400 tons, respectively. The decree established an export quota of 777,400 tons, comprising 435,000 tons for the US market and 342,000 tons against world market or other US needs. Domestic consumption was put at 130,000 tons.

* * *

Brazil sugar production quota increase[6].—The Brazilian Instituto do Açúcar e do Alcool has authorized production of an additional 180,000 metric tons by sugar factories in Alagoas and Pernambuco. This sugar is destined for export before the start of the new campaign year which starts in June in southern Brazil and in September in the north-east. Of the additional quantity, 120,000 tons is to be produced in Pernambuco and 60,000 tons in Alagoas.

* * *

Taiwan sugar exports, 1967.—Exports of sugar from Taiwan in 1967 amounted to 566,000 metric tons, of which 214,000 tons were shipped to countries of south-east Asia. Sugar production in 1968 is estimated at 876,000 tons.

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Lebanon sugar imports limitation[7].—A Government decree of 20th November 1967 limits each of the three sugar refineries at Tripoli, Chekka and Zelka to an annual import allowance of 900 tons of raw sugar for refining purposes.

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[1] *Brasil Açuc.*, 1967, **70**, 360–361.

[2] *Sugar y Azúcar*, 1968, **63**, (1), 38.

[3] *Barclays Overseas Review*, January 1968, 79.

[4] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (1), 11.

[5] *Public Ledger*, 13th January 1968.

[6] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (2), 6–7.

Board of Trade J., 1968, **194**, 210.

Dutch sugar imports and exports[1]

	1967		1966		1965	
	metric tons					
Imports	*Raws*	*Refined*	*Raws*	*Refined*	*Raws*	*Refined*
Belgium/Luxembourg	1,319	8,014	—	4,085	645	4,996
Cuba	1,354	29,308	1,132	25,191	2,803	24,354
Czechoslovakia	151	11,033	—	2,876	130	5,792
Denmark	—	3,225	—	4,918	—	8,685
France	14,903	32,126	5,640	53,973	4,505	67,000
Germany, West	5	5,102	3	303	10	66
Surinam	5,500	2,029	4,915	2,471	6,614	847
UK	—	43,514	3,115	21,604	1	11,588
Other Countries	223	37	137	259	15	366
	23,455	134,388	14,942	115,680	14,723	123,694
Exports						
Belgium/Luxembourg	—	4,345	—	3,870	—	3,091
Germany, West	—	704	20	2,403	—	1,476
Other Countries	41	677	81	890	51	1,109
	41	5,726	101	7,163	51	5,676

Brevities

Greece sugar expansion plans[2].—Hellenic Sugar Industry S.A., the national company which operates the three Greek sugar factories, plans to build a fourth factory in Thrace which should come into operation in two years' time. The existing three factories provide about 80% of consumption, some 110,000 tons of sugar in 1967.

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Uganda sugar production, 1967[3].—According to the Sugar Manufacturers' Association, 135,245 tons of sugar were produced in Uganda during 1967 compared with 125,476 tons in the previous year.

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US sugar quotas 1968[4].—On the 19th January the US Dept. of Agriculture announced that first quarter quotas were to be increased by 100,000 tons to 1,022,360 short tons, raw value, thus raising permitted imports for the first half of the year to 2·2 million tons.

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Sudan sugar situation[5].—The Guneid sugar factory, which was erected in 1962 with an annual production capacity of 60,000 tons of sugar, made 13,000 tons in 1963, 19,500 tons in 1964, 16,500 tons in 1965 and 24,500 tons in 1966. The main reason for the low production is that cane yield has remained below expectations. The factory was built to crush 4000 t.c.d. and a second factory with the same capacity at Khashm El Girba began its trial campaign in the middle of 1966. Both factories have a cane area of 32,000 feddans (abbout 13,500 ha). Production prospects for Khashm El Girba are more favourable than for Guneid. By increasing domestic production it is hoped to become independent of sugar imports which in recent years have been: 1963 112,000 tons, 1964 121,000 tons, 1965 187,000 tons and 1966 132,000 tons.

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Portuguese West Africa sugar production[6].—Sugar production in Angola reached 80,000 tons in 1967.

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Dutch sugar production, 1967[7].—Sugar production in Holland in 1967 was 690,000 metric tons, white value, compared with 527,000 tons in the previous year, according to the Central Bureau of Statistics. The Bureau had announced earlier[8] that sugar beet production was 39% higher at 5,074,000 tons, owing to an increase in the area under cultivation and a 26% improvement in the yield per hectare to 50·5 kilos.

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Portuguese East Africa sugar production[9].—The sugar factories of Mozambique produced 165,000 tons of sugar in the 1966/67 season.

Bulk storage installation for Brazil[10].—Fives-Lille de Brasil, a subsidiary of Soc. Fives Lille-Cail, has obtained a contract, together with three other Brazilian companies, for the construction of a raw sugar storage installation and bulk loading equipment near Recife, in Pernambuco, Brazil. With a capacity of 200,000 tons of sugar (two warehouses of 100,000 tons capacity) and 10 million litres of molasses stored in two tanks, the installation will be the largest in the world. The sugar will be loaded into ships via a weigh tower. Cost of the installation will be 35·5 million francs.

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Sugar in Portuguese East Africa.—It is reported in the local press that 400,000 tons of cane are to be grown along the banks of the Púngoè river (Mozambique) during 1969. The cane will be processed at a new sugar factory at present under construction.

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New Chairman of British Sugar Corporation Ltd.—Mr. G. B. Thorley has been appointed Chairman of British Sugar Corporation Ltd. in the place of Sir Edmund Bacon, who is retiring.

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Polish sugar production.—According to official figures released for 1967/68, Poland produced a record 1,760,000 metric tons of sugar from something over 15·5 million tons of beet. The previous record was of about 1,654,000 tons in 1964. Average beet yield in 1967/68 was 35·8 tons per hectare.

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Hungarian sugar production 1967/68.—It is reported[11] that 3·3 million tons of sugar beet were grown from 90,000 ha, yielding 550,000 tons of sugar, raw value (407,000 tons of white sugar). The average campaign length was 127 days.

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UK sugar beet price 1968/69.—The guaranteed price to be paid to farmers in the UK for sugar beet in 1968/69 has been fixed at 136s 6d per ton, on a basis of 16% sugar content. This represents an increase of 3s 6d per ton on last season's price. A differential of 10s 0d for every 1% above or below 16% sugar content will apply. The area to which this price applies is the same as in 1967/68, i.e. 443,000 acres.

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[1] C. Czarnikow Ltd., *Sugar Review*, 1968, (851), 30.
[2] *Zeitsch. Zuckerind.*, 1968, **93**, 41.
[3] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (3), 6.
[4] C. Czarnikow Ltd., *Sugar Review*, 1968, (850), 25.
[5] *Zeitsch. Zuckerind.*, 1968, **93**, 41.
[6] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (3), 6.
[7] *Public Ledger*, 3rd February 1968.
[8] *ibid.*, 13th January 1968
[9] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (3), 6.
[10] *L'Usine Nouvelle*, 1967, **52**, 23.
[11] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (6), 3.