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L'influence de non-sucres sur la cinétique de la cristallisation. D. SCHLIEPHAKE, E. ZEICHNER, F. A. ORLOWSKI et F. SCHNEIDER. p. 131–134

On examine l'effet de non-sucres sur la cristallisation du saccharose sous la forme de leur influence sur le rapport de leurs résistances au transfert de molécules at à l'incorporation de molécules dans la surface d'un cristal Les non-sucres ont un effet inhibitoire, considérable sur la réaction à la surface, et aux températures plus basses l'adsorption de substances colorantes et de substances de poids moléculaires élevés est plus dominant que l'adsorption de sels. Des résultats obtenus par l'analyse statistique de la distribution de la grandeur des cristaux a-t-on confirmé par des expériences de cristallisation dans des colonnes.

* * *

La carbonatation de liqueur. 3-ème partie. Méthodes laboratoires pour la comparaison de la qualité d'échantillons de liqueur ou de chaux. M. C. BENNETT et S. D. GARDINER. p. 135–137

Dans la première section de cet article les auteurs décrivent une station de carbonatation laboratoire et donnent des détails de la méthode expérimentale employée pour la carbonatation dans une seule chaudière sous les conditions identiques à celles-ci dans une raffinerie. Les mesures de la filtrabilité de la liqueur saturée sont donc convenables pour la prédiction du comportement d'un sucre brut, de la qualité de chaux d'une nouvelle source, ou du changement d'un variable de procédé, etc.

* * *

L'emploi de filtres-épaississeurs pour la première carbonatation dans les sucreries danoises. 1-ère partie. R. F. MADSEN. p. 137–140

On esquisse l'histoire de l'application de filtres à poches pour la première carbonatation dans la société DDS et donne les détails de l'application d'une station à filtres automatiques installée dans 1965 et 1966 dans deux sucreries danoises pour le jus de première carbonatation et qui se base sur des essais initiaux de 1963–64.

Der Einfluss von Nichtzuckerstoffen auf die Kinetik der Kristallisation. D. SCHLIEPHAKE, E. ZEICHNER, F. A. ORLOWSKI und F. SCHNEIDER. S. 131–134

Man hat den Einfluss von Nichtzuckerstoffen auf die Saccharose-Kristallisation in der Form ihrer Einwirkung auf das Verhältnis ihrer Widerstände der Molekulübertragung und der Molekuleinschliessung in die Kristalloberfläche untersucht. Nichtzuckerstoffe haben einen beträchtlichen Hemmungseinfluss auf die Oberflächenreaktion, und bei niederen Temperaturen ist die Adsorption von Farbstoffen und von höheren Molekularstoffen mehr emporragend als die Adsorption von Salzen. Die durch statistische Analyse von Korngrössenverteilung erhaltenen Ergebnisse werden an Hand Kristallisationsversuchen in Kolonnen bestätigt.

* * *

Karbonatation von Kläre. Teil 3. Labormethoden für den Vergleich der Qualität von Kläreen- oder Kalk-Proben. M. C. BENNETT und S. D. GARDINER. S. 135–137

In der ersten Sektion dieses Aufsatzes beschreiben die Verfasser eine Laborkarbonatationsanlage auch die für die Karbonatation in nur einem Kessel angewandte Versuchmethode, die unter den gleichen Bedingungen als in der Raffinerie durchgeführt wird. Daher eignen sich die Messungen der Filtrabilität der saturierten Kläre für die Vorhersagung des Verhaltens eines Rohzuckers, der Kalkqualität einer neuen Quelle, oder der Veränderung einer Verfahrensvariable, usw.

* * *

Anwendung von eindickenden Filtern für erste Karbonatation in den dänischen Zuckerfabriken. Teil 1. R. F. MADSEN. S. 137–140

Der Verfasser umreisst die Geschichte von Beutelfilter-Anwendung für erste Karbonatation in den dänischen Zuckerfabriken und gibt die Einzelheiten der Anwendung einer Station von automatischen Filtern, die in 1965 und 1966, auf der Base von ursprünglichen Versuchen in 1963–1964, in zwei dänischen Zuckerfabriken für ersten Karbonatationssaft eingerichtet wurden.

La influencia de no-azúcares sobre las cinéticas de cristalización. D. SCHLIEPHAKE, E. ZEICHNER, F. A. ORLOWSKI y F. SCHNEIDER. *Pág.* 131–134

El efecto de no-azúcares sobre cristalización de sacarosa se examina en términos de su influencia sobre la relación entre las resistencias a transferencia molecular y a incorporación molecular en la superficie del cristal. No-azúcares tienen un efecto relativamente importante de inhibición de la reacción a la superficie, y a temperaturas relativamente baja el adsorción de materiales colorante y de substancias de alto peso molecular es más dominante que el adsorción de sales. Resultas obtenido por análisis estatistical de distribuciones de tamaño de grano se confirman por experimentos en que cristalización se conduce en columnas.

* * *

Carbonatación de licor. Parte III. Procedimientos de laboratorio para comparar la calidad de muestras de licor o cal. M. C. BENNETT y S. D. GARDINER. *Pág.* 135–137

En la primera sección de este artículo, los autores describen un aparato de laboratorio y presentan detalles del procedimiento experimental que emplean para un carbonatación a solo tanque que da condiciones comparable con aquellas de la refinería. Medidas de la filtrabilidad de licor carbonatado se acomodan para predecir la conducta de un individual azúcar crudo o determinar la calidad de cal de un nueva fuente o el efecto de un alteración de un factor variable del proceso.

* * *

Uso de filtros espesantes para primera carbonatación en la Danish Sugar Corporation. Parte I. R. F. MADSEN. *Pág.* 137–140

La historia del aplicación de filtros a bolsa para jugo de primera carbonatación en la DDS se indica. Se presentan detalles del aplicación de un sistema automática que se ha instalado en 1965 y 1966 a dos azucareras danesas para filtración de jugo de primera carbonatación. La sistema se basa en experimentos iniciales de 1963–1964.

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Notes & Comments

UK Sugar Board report 1967.

The 10th Annual Report of the Sugar Board was published on the 21st March after presentation to Parliament by the Minister of Agriculture, Fisheries and Food. The Report deals with the activities of the Board for the year to 31st December 1967, and includes an audited statement of the Board's Accounts for that period.

During the year 1967 the world market price of raw sugar rose from £13 5s a ton at the beginning to £25 a ton at the end, but there were considerable fluctuations during the year, one of which (on the outbreak of war in the Middle East in June) raised the price as high as £32 a ton. The domestic ex-refinery price was kept fairly stable over the year by a total of eleven complementary changes in surcharge, and showed an average of about £70 13s 4d a ton.

The Board's revenue account showed a deficit of about £5 million over the year, but all except about £500,000 of this was due to two special factors. These were the inclusion in the year's accounts of the Board's liability to the British Sugar Corporation for a good deal more than one year's beet crop, and a reduction in the total volume of sugar subject to surcharge during the year. These factors, as is explained in the Report, are unlikely to recur in 1968 and may well be reversed, in part or in whole.

Although the average of the quoted ex-refinery price was higher in 1967 than in 1966, the Board's average realizations in respect of Commonwealth sugar and home beet sugar from sale prices and surcharge taken together were, largely owing to the change from a falling to a rising world market, about the same in both years, and the average rate of surcharge was also practically the same. Retail prices for granulated sugar have remained very much the same over the two years.

The Board's deficit on the year's trading amounted to £58·5 million on 1·7 million tons of Commonwealth and Irish sugar. The Board also paid £33·3 million to the British Sugar Corporation, making a total out-going of £91·8 million. Net receipts of surcharge collected in the year amounted to £86·8 million. The expenses of the Board and H.M. Customs (who collect the surcharge for them) together with the cost of interest were offset by dividends received by the Board on their shares in the British Sugar Corporation and by a credit in respect of the provision made for Corporation Tax in the previous year's accounts which was not now required.

From the deficit of about £5·0 million for the year 1967 there has to be deducted a cumulative surplus of about £300,000 at the end of 1966, leaving a deficit of about £4·7 million to be carried forward into 1968.

* * *

Mauritius sugar crop, 1967[1].

Harvesting of the 1967 crop started on the 27th June and finished on the 30th December 1967. The 23 mills crushed 5,722,900 long tons of cane, i.e. about 167,000 tons less than the record crop of 1965. Average cane yield reached the figure of 28·6 tons of cane per acre and ranked second after the record yield of 29·0 tons per acre in 1965. The average sugar recovery was only 10·98% (owing to unfavourable rainfall during the cane ripening period) and is the lowest recorded during the post-war period, excluding the exceptional 1960 cyclone year. As a result the yield of sugar per acre amounted to 3·14 tons and total sugar output to 628,270 tons, as against 552,915 tons in 1966, 653,940 tons in 1965 and 674,800 tons in 1963.

Exports during the year totalled 523,039 tons, of which 470,889 tons were to the UK, 36,150 to Canada and 16,000 to the USA; this compares with total exports of 561,559 tons in 1966, of which 424,769 were to the UK, 10,320 to Malaysia, 111,970 to Canada, and 14,500 to the USA. Local sales totalled 29,208 tons in 1967 as compared with 28,520 tons in 1966, and the island ended the year with stocks totalling 128,005 tons, compared with 51,955 tons a year earlier.

* * *

World sugar production estimates, 1967/68.

F. O. Licht K.G. recently published their second estimates of world sugar production for the 1967/68 crop year[2]. By comparison with their first estimates[3], total production is now expected to reach 66,930,951 metric tons, raw value, instead of 66,224,300 tons, and compares with 65,324,475 tons produced in 1966/

[1] *Mauritius Sugar News Bulletin*, December 1967.
[2] *International Sugar Rpt.*, 1968, **100**, (8), 1–6.
[3] *I.S.J.*, 1968, **70**, 34, 63.

67. The rise in the total production estimate is principally due to the revision of estimates for the USSR, Poland and the EEC countries. In the USSR the beet crop during the 1967/68 campaign was a record one and therefore, in spite of low extractions, sugar production was higher than expected, at 10,400,000 tons by comparison with the original estimate of 9,600,000 tons.

The figure for Poland was also raised by 130,000 tons to 1,956,000 tons, and the final production of the EEC countries was nearly 100,000 tons higher than expected earlier. Insignificant changes in other countries brings the total for Europe from the earlier estimate of 25,077,900 tons to 26,147,956 tons.

This large increase is offset to some extent by a fall in the expected production in Cuba, now set at 4,800,000 tons instead of 5,200,000; and of India which is now expected to produce 2,440,000 tons instead of 2,700,000 tons. Only small changes are expected elsewhere in the Western Hemisphere and Asia, while the increase expected for the African continent is mainly due to the increased figure for South Africa where the former estimate of 1,724,000 tons has been raised to 1,805,375 tons.

* * *

World raw sugar prices.

During the period from the end of January there has been a gradual decline in sugar prices and the market seems to be very depressed, in contrast to the hopefulness which prevailed at the turn of the year. This seems to be undue pessimism since, although the good crops in Europe and especially the USSR have apparently indicated a smaller reduction in world stocks during 1968 than had earlier been expected, this is not necessarily the case.

The principal increase is in the USSR while half the amount is offset by the poorer prospects for Cuba. It seems likely, therefore, that the USSR will be able to do without a part of the Cuban imports contracted under the agreement between the two countries, and the remaining 400,000 tons could easily be absorbed by domestic consumption in the Soviet Union. Also, India's reduced tonnage, bringing her estimate to the low level of last year's production, could make it necessary for sugar to be imported to meet consumption demands.

Undoubtedly, the lack of reliable information from the USSR and Cuba plays its part in depressing the market. And uncertainties about the intentions of the EEC cannot help towards a better tone. Despite the frustrations and disagreements of the second UNCTAD Conference in New Delhi which ended in March, there was general acceptance of the need for international commodity agreements, and it is to be hoped that uncertainties and lack of cooperation can be resolved at the Geneva Conference to make a new International Sugar Agreement a reality and to bring stability to the industry. After all, to quote E. D. & F. MAN[1], "if politics could be forgotten, it is a comparatively easy equation to make production equal to consumption with a little goodwill and give-and-take attitude amongst producers".

* * *

Cuban sugar production prospects.

As a consequence of the severe drought experienced last year, it has been acknowledged generally that sugar production in Cuba will be smaller than the 1967 crop of 6·1 million tons. Reports had suggested that other factors were combining to make the crop one of the poorest for several years and unofficial estimates had varied widely.

On the 13th March the Cuban Premier announced that nearly 2½ million tons had already been produced and that the harvest would yield over 5½ million tons. It was pointed out at the time that on the very same date in 1966 Dr. CASTRO had forecast a crop of over 5 million tons, but that the final figure had been less than 4·5 million tons. A harvest of over 5½ million tons this year when climatic conditions have been extremely bad would require a very appreciable increase in organization and efficiency compared with 1967.

By 13th April, however, Reuter could report from Havana that production had reached 4 million tons. In C. Czarnikow Ltd.'s view[2], it was hardly likely that the output rate at the end of March—about 600,000 tons below the comparable figure for 1967—could be maintained as weather conditions were particularly favourable for the crop in 1967 and it was possible to extend the season greatly and to continue crushing the cane until July. Czarnikow therefore believes Licht's estimate of 4·8 million tons to be a reasonable figure. It is reported that workers are being mobilized in Cuba to harvest the cane, and it remains to be seen how successful this is and whether the spring rains will bring the season to a close at the normal time.

* * *

Japanese sugar refining capacity reduction[3].

The Japanese sugar refining industry is continuing its efforts in planning a reduction in its present sugar refining capacity by 30% by the 1970 financial year. The Japan Sugar Refiners' Association said in Tokyo that the present sugar refining capacity in Japan is estimated at 13,858 tons daily, which is believed to be far in excess of the nation's demand for refined sugar.

A tentative plan adopted by the Association's policy committee calls for collection of contributions from its members according to the size of their respective capacities, to compensate those manufacturers who scrap or "freeze" their production facilities. The Association will consult with the Government and smaller sugar refining firms on the tentative plan, which it hopes to implement with Government assistance.

[1] *General Remarks on the Sugar Situation*, 29th March 1968.
[2] *Sugar Review*, 1968, (859), 65.
[3] *Public Ledger*, 16th March 1968.

The Influence of Non-Sugars on the Kinetics of Crystallization

By D. SCHLIEPHAKE, E. ZEICHNER, F. A. ORLOWSKI aud F. SCHNEIDER
(Institut für landwirtschaftliche Technologie und Zuckerindustrie an der TH Braunchweig)
Paper presented at the 13th Congress of the Commission Internationale Technique de Sucrerie (CITS), 1967

It has been shown in previous investigations that a correlation exists between the variation with time of the grain size distribution of a crystallizate and the kinetics of mass transfer during crystallization[1].

Crystallization is a process made up of a large number of partial processes. The fact that over a range of small supersaturations the sum total of these separate stages may be represented with very close approximation as a first order reaction should not allow us to forget the complexity of the complete process[2,3].

However, the individual reaction stages can be classified under two main groups while disregarding a more precise subdivision; the first includes so-called surface reactions, while the second covers molecule transfer from the solution to the surface. It can be seen that the resistances to molecule transfer (W_D) and molecule incorporation in the surface of the crystal (W_R) are additive:

$$W_{total} = W_D + W_R .$$

If the crystallization rate of the crystal is expressed in terms of the linear growth of an axis per unit time, in the case of a pure surface reaction this rate is independent of the particular crystal size; if mass transfer is the only factor affecting growth, then the crystallization rate is dependent on crystal size and flow conditions.

In the first case, as shown in Fig. 1, the initial grain size distribution shifts during crystallization, without any reduction in the height of the maximum.

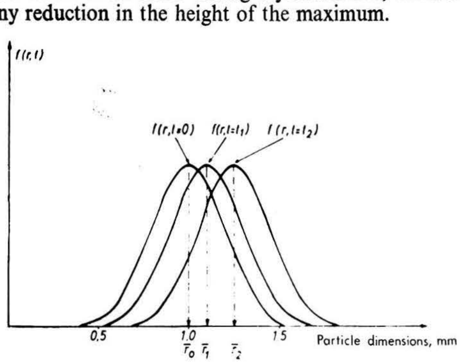

Fig. 1. Change of particle size distribution with time under the effect of a pure surface reaction

In the second case, not only does the distribution shift, but the curve also levels out, as seen in Fig. 2.

The degree of levelling-out depends on the correlation between crystal size and flow. This relationship can be expressed, in close approximation, by the following formula:

$$W_D = \frac{A}{r^v}$$

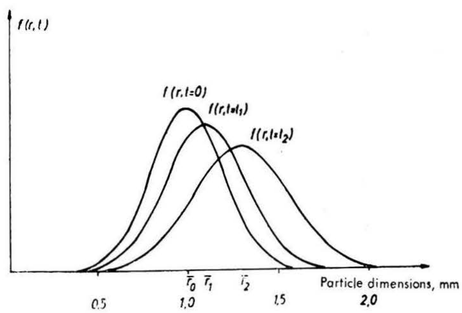

Fig. 2. Change of particle size distribution with time under the effect of material transfer

where r = particle dimensions, ν = exponent and A is a constant, i.e. the larger the crystal the smaller will be the resistance to transfer. If the above relationship is applied to a crystal sinking in a solution, then $\nu \simeq 2$.

If, for the following considerations, it is assumed that the crystal is sinking in the surrounding solution, then the total resistance can be resolved into its

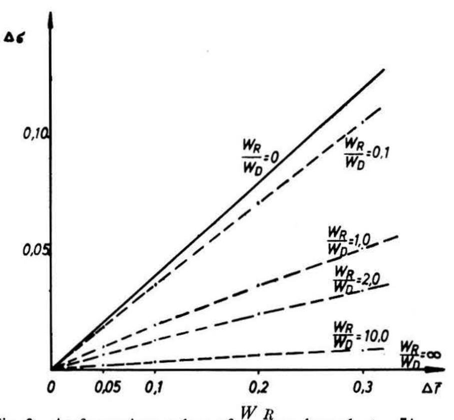

Fig. 3. $\Delta\sigma$ for various values of $\frac{W_R}{W_D}$ as dependent on Δr

[1] SCHLIEPHAKE: *Zucker*, 1965, **18**, 574–582; *I.S.J.*, 1966, **68**, 216.
[2] KUKHARENKO: "Principles of sugar technology". Vol. II. Ed. HONIG. (Elsevier, Amsterdam.) 1959.
[3] VANHOOK: *ibid.*

parts, the r-dependent resistance to transfer and the r-independent resistance to reaction. For each resistance ratio $W_R : W_D$ there is a corresponding increase in the change in distribution $\Delta\sigma$ as dependent on linear growth Δr (Fig. 3).

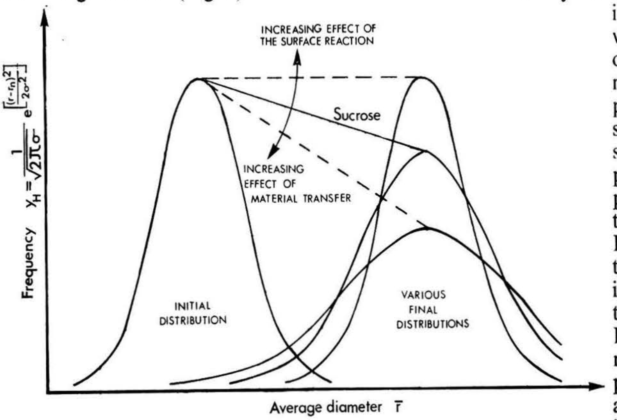

Fig. 4. Scheme of potential effect of non-sugars on particle size distribution during crystallization

If the change in grain size distribution during crystallization in pure solutions is compared with the corresponding change in the presence of non-sugars, it is possible to determine whether the non-sugars affect the resistance ratios.

Fig. 4 illustrates the basic potential influence of non-sugars as regards their effect on the change of grain distribution with time during crystallization. A normal distribution has been used as example.

If the crystallization rate in pure solution is used as a standard basis, then any retardation of the surface reaction must lead to a reduction in the change of σ with $\bar{r}$. The connecting line joining the maxima then lies above the standard curve for pure sucrose. If the mass transfer is inhibited by non-sugars, the connecting line for the maxima is below the standard curve, i.e. the standard deviations increase with increasing grain size.

In previous tests the effect of the following non-sugars has been studied:

1. KCl (2 and 5% addition).
2. Molasses (added until the colour content of the solution was 10°St).
3. High-molecular colouring matter fractions separated from molasses by electrodialysis and added until the colour content reached 10°St.

The experiments showed that in every case the surface reaction was inhibited despite the vast differences in the natures of the non-sugars added. Hence it predominates as a rate determining process (because it was the slower process) and in all tests the connecting lines joining the distribution maxima were above the standard curve for pure sucrose. Of course, the possibility of a simultaneous mass transfer effect cannot be excluded, although none was discovered with this method.

The influence of non-sugars is very clearly seen if the values of $W°_D / W°_{total}$ are related to temperature. First, the ratio $W°_D / W°_{total}$ is shown for crystallization in pure solution. The graph (Fig. 5) clearly shows the inaccuracy which may be expected in the results from parallel tests. The tests were carried out with varying mean sizes of the added crystals. It is seen that the resistance ratio $W°_D / W°_{total}$ is independent of the initial grain size. Fig. 6 shows the results of crystallization from a solution containing KCl compared with a pure sucrose solution. We see that the proportions of mass transfer resistance in the total resistance decrease with increasing KCl concentration. We conclude from the increase in the proportion of resistance in the surface reaction, i.e. decrease in the transfer resistance $W°_D / W°_{total}$ that the KCl is adsorbed on the surface and the rate of incorporation is reduced. This process becomes particularly significant at higher temperatures and increases with increasing KCl concentration.

If we consider the behaviour in solutions containing molasses (see Fig. 7) we see that at higher temperatures the effect of the salt dominates while on the other hand at lower temperatures the adsorption of colouring matter and other high-molecular components are dominant.

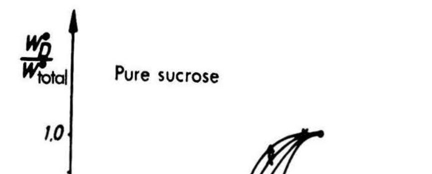

Fig. 5. Curve of relative diffusion resistance portion of total resistance during crystallization (pure sucrose).
I, II, III—injected crystals 0·63–0·75 mm
KI—injected crystals 0·50–0·63 mm

SAPRONOV & CHERNIKINA[4] also found in investi-

[4] *Sakhar. Prom.*, 1964, **38**, 817–821; *I.S.J.*, 1965, **67**, 122.

gation of colouring matter distribution in raw sugar crystal that the colour is preferentially deposited on the crystal surface.

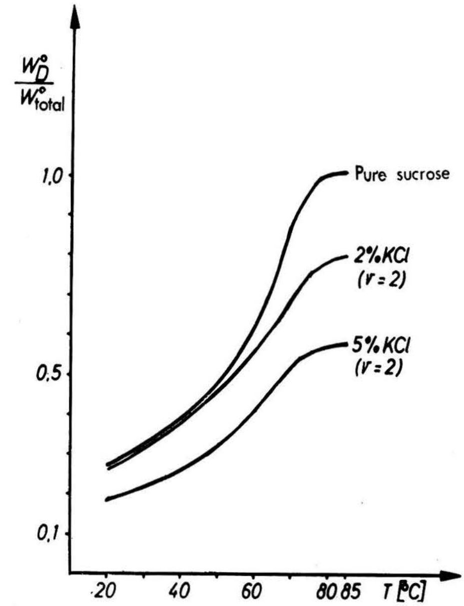

Fig. 6. Curve of resistance ratio $W°_D:W°_{total}$ with addition of 2 and 5% KCl compared with pure sucrose. (The curves represent mean values of single tests.)

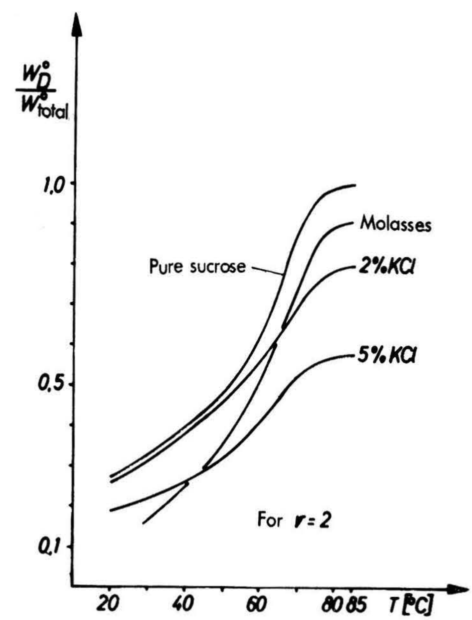

Fig. 7. Summary representation of $W°_D:W°_{total}$ ratio *vs.* temperature

Representation of the curves in the $W°_D/W°_{total}$ *vs.* temperature (T) graph depends on the arbitrary standardization of the $W°_D/W°_{total}$ values at 85°C, since this is the highest temperature that could be attained in the tests and was used as standard temperature for each series of tests. Standardization at 85°C means that we proceeded from the assumption that at this temperature $W°_D$ alone was decisive.

This assumption is not valid when non-sugars are added, since the activation energy of the surface reaction is altered. The temperature at which

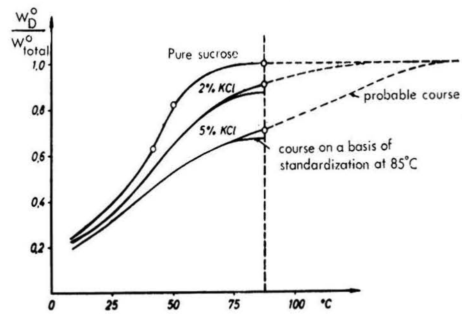

Fig. 8. Schematic representation of temperature dependence of $W°_D:W°_{total}$ ratio for pure sucrose and additions of impurities

$W°_D/W°_{total} = 1$ is higher. Correspondingly, the curves follow a path as shown in Fig. 8.

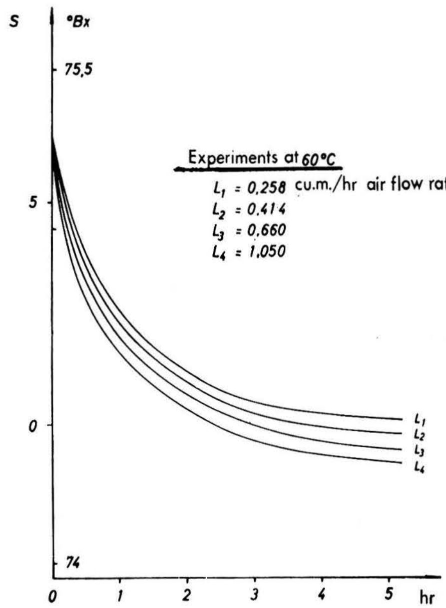

Fig. 9. Decrease in concentration with time under the effect of gas bubbles

The results obtained on the basis of analysis of the change in grain size distribution with time were confirmed by crystallization in bubble columns. In these tests the crystallization rate was measured as a function of the bubble path through a crystal suspension. In this way it is possible to determine the effect of crystal movement on the crystallization rate.

The bubble effect was produced with the help of an air stream having a moisture content corresponding to the partial pressure of water in the solution. The crystallization rate was represented as decrease in concentration of a supersaturated solution, and results are shown in Fig. 9.

The rate coefficients β of crystallization and their reciprocal, the total resistance to crystallization $W_{total} = 1/\beta$, can be determined from the rates at which mother liquor concentration falls.

The rate-independent W_R is obtainable from the decrease in 1/β and, as can be seen from the graph (Fig. 10), the plot of total resistance *vs.* a rate value

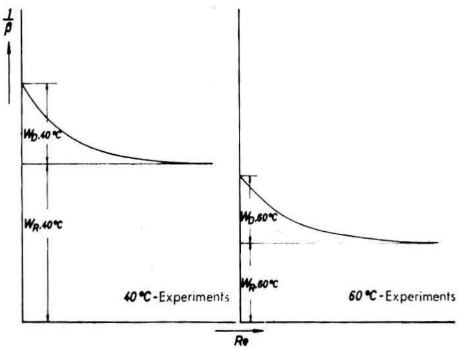

Fig. 10. W_D *vs.* gas flow, represented as Reynolds number

"Re" is asymptotic to the diffusion resistance. At a low bubble velocity, values of W_D / W_{total} are found which are very similar to those in the above-mentioned tests on grain size distribution (see Fig. 5).

Summarizing, it appears that the methods described open up the possibility of measuring directly the effect on crystallization, e.g. of non-sugars, and of comparing the effects by means of the ratio $W^\circ_D / W^\circ_{total}$.

Summary

Analysis of the change in grain size distribution during crystallization provides an indication of the temperature dependence of the crystallization resistances. The effects of non-sugars can be represented by their influences on these resistance ratios. From these it may be shown that non-sugars considerably inhibit the surface reaction and that, at lower temperatures, adsorption of colouring matter and higher molecular substances is dominant in contrast to salt adsorption.

Comparison with tests on sugar crystallization in bubble columns confirms both quantitatively and qualitatively the results obtained by the statistical method.

Correspondence

To the Editor,

The International Sugar Journal.

Dear Sir,

PROBLEMS OF INDUSTRIAL ALCOHOL FERMENTATION

Twenty-eight samples of Brazilian molasses, from the most important cane growing areas, were analysed to investigate causes of increased fermentation time. Analyses included determination of Brix, total solids, sugars (sucrose, invert and unfermentable sugars), ash (with complete analysis), nitrogen, SO_2, "gums" and pH. Sugar factory control figures were also calculated. Fermentation assays were made to estimate fermentation velocity and alcohol production, with *Saccharomyces cerevisiae* No. 1133. Brazilian molasses present a high sucrose content, low invert sugar and high index of exhaustion as calculated from the data of WEBRE[1]. Fermentation velocity and alcohol production varied widely, fermentation efficiency ranging between 44·30 and 94·92%.

In four samples with sluggish fermentation, invert sugar content was high (25–44%) and unfermentable reducing substances, obtained by the A.O.A.C. method, were low (6·70–1·97%). SO_2 determination by the method of OLBRICH & PEETZ[2] showed contents of 0·051–0·022%. From the analyses no cause has yet been found for poor fermentation, and research is proceeding on obtaining of better performance with abnormal molasses by the addition of nutrients.

We would welcome accounts of similar phenomena encountered by your readers as well as comments on the possible causes.

Yours faithfully,

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Canadian sugar factory closure.—On the 29th January Canada & Dominion Sugar Co. Ltd. announced that, after several months of reappraisal of beet sugar operations, it had been concluded that the manufacture of beet sugar in Ontario is unprofitable, that there is no prospect of improvement in the foreseeable future, and that the Company is forced therefore to close the Chatham factory. Improvements initiated in December 1965 had resulted in factory operation which is claimed to have been the most efficient in North America, but continuation of this long-term plan would require replacement of worn-out equipment at a cost of $1,000,000, and these injections of capital would far exceed earnings projections. There are no immediate plans for dismantling the plant and facilities for selling and distributing packaged, liquid and bulk refined cane sugar, from the Toronto refinery, will continue.

[1] *Mem. XXVI Conf. Asoc. Técn. Azuc. Cuba*, 1952, 163–165.
[2] *I.S.J.*, 1966, **68**, 378.

Liquor Carbonatation

Part III. Laboratory procedures for comparing the quality of liquor or lime samples

By M. C. BENNETT and S. D. GARDINER (Tate and Lyle Ltd., Research Centre, Westerham Road, Keston, Kent)

Introduction

A RECENT review of filtrability tests on affined raws[1] has drawn attention to the urgent need for a laboratory carbonatation procedure which could be used to predict the filtrability of carbonatated liquor in the refinery. This paper presents the details of a routine procedure which is currently used both in this Research Centre and in Tate & Lyle refineries to indicate the filtrability of incoming raws.

The experimental methods which will be described here were developed as part of a general investigation into liquor carbonatation and have been used to identify the optimum conditions for the carbonatation of certain types of liquor. In addition to the many process variables which affect the precipitation reaction, such as temperature, % solids and residence time, the carbonatated liquor filtrability has also been shown to be highly dependent on the quality of the lime used. The test procedure has therefore found frequent application in evaluating the suitability of lime from various manufacturers for the liquor carbonatation process.

The basis of the test procedure has been described in previous publications[2,3]. It was shown that in order to compare accurately the filtrability of two carbonatated liquors it is essential to examine the dependence upon the lime concentration used. Furthermore, the precipitation of $CaCO_3$ in any one liquor is critically dependent upon the conditions under which the reaction between lime and CO_2 is carried out. Optimum filtrability is obtained when the precipitation is carried out in a homogeneous environment, where the reactants are fed simultaneously into a relatively large volume of the reaction mixture at rates which maintain a required set of constant conditions. Those conditions are described most simply by the pH of the reaction mixture, and the optimum pH generally lies between 8·0 and 8·5 at which value the lime is fully "gassed-out". The reaction is therefore carried out in a single vessel, operated under conditions where the reaction mixture has effectively the same composition as the product carbonatated liquor. This experimental technique is referred to as single tank carbonatation.

Ideally, the reaction should be continued until steady state conditions are achieved, and the carbonatated liquor stream is then sampled for the filtrability measurement. When no attention is paid to the initial filling of the reaction vessel, this can require three or four volume displacements of the reaction vessel, and with a residence period of one hour, the experiment cannot take less than four hours. However, by careful control of the early stages of the initial filling of the vessel, we have found that steady state conditions can be achieved before the vessel reaches its normal working volume. In this way it will be seen that the time to complete a test carbonatation has been reduced to just over one hour, so that a filtrability figure can be available in two hours. A 400 g sample of affined sugar is required for each test and about 200 ml of carbonatated liquor filtrate is available for subsequent analysis.

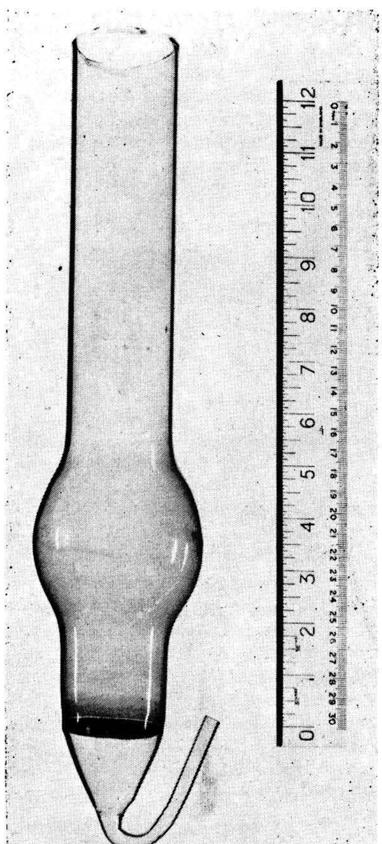

Fig. 1. The carbonatation reaction vessel.

[1] JENNINGS and ALEXANDER: *Proc.* 1966 *Tech. Session on Cane Sugar Ref.*, 1967, 62.
[2] BENNETT: *I.S.J.*, 1967, **69**, 101.
[3] BENNETT and GARDINER: *ibid.*, 198.

The carbonatation apparatus

The reaction vessel is shown in Fig. 1: it is made of Pyrex glass and carries a sintered glass disc (porosity No. 2) as a gas distributor. At the end of a carbonatation experiment, the bulb is about half filled with liquor, when the liquor volume is about 334 ml.

The vessel is mounted in a water thermostat bath operating at 80°C and provided with services as shown diagrammatically in Fig. 2. Limed liquor is placed in the storage vessel and pumped by the variable flow peristaltic or diaphragm pump through the preheater (a condenser heated by water from the thermostat bath) into the reaction vessel. The feed into the reaction vessel is by way of a flexible $\frac{1}{16}$-in bore tube discharging initially about 1 cm above the sintered glass disc.

Experimental procedures

(a) Carbonatation

The technique of single tank carbonatation is essentially that of a crystallization process in which seed crystals of precipitated $CaCO_3$ are grown under carefully controlled conditions into the large conglomerate particles characteristic of the steady state system.

Carbonatation is carried out at 65% solids (±0·5% solids) and at 76°C. To replace water lost by evaporation, the feed liquor is pumped into the reaction vessel at 56·5% solids. Suitable quantities for preparing the feed liquor are 400 g of affined sugar, 308 ml of distilled water, and the required weight of lime hydrate: 2·65 g of $Ca(OH)_2$ is required for 0·5% CaO on solids. The last is mixed into a smooth cream with approximately four times its own weight

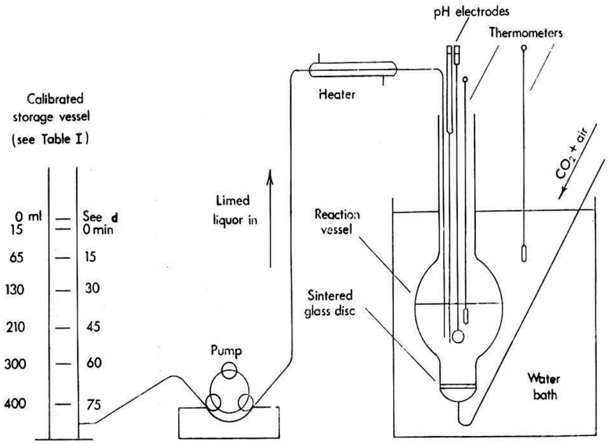

Fig 2. Apparatus for single tank carbonatation in 75 min

of water. The lime powder must be thoroughly wetted to prevent the subsequent formation of insoluble lime sucrates which would cause unwanted nucleation during carbonatation.

The sugar is dissolved in the remaining water at 60°C and the milk-of-lime is added with thorough mixing. The limed liquor is heated to about 75°C and strained into the storage vessel (see Fig. 2) through a 150-mesh screen.

The storage vessel is calibrated to provide a continuous check on the pumping rate which is progressively increased throughout the experiment, as indicated in Table I below. Of the 550 ml of 56·5% solids liquor in the storage vessel, up to 150 ml can be used for flushing and filling the pump and feed lines. With the carbonatation reaction vessel empty and an air flow of 500 ml/min through the sintered glass disc, 15 ml of the limed liquor is pumped into the reaction vessel and the pump is stopped. The pH electrodes are dipped into the liquor (for a lime concentration of 0·5% CaO on solids, the indicated pH

The reaction vessel is equipped with a thermometer and pH meter electrodes operating at the temperature of the reaction mixture, which, owing to continuous evaporation of water during carbonatation, is about 76°C, at which temperature the pH is measured. It was found convenient to increase the length of the calomel half-cell by a saturated KCl salt-bridge, and the electrode system was therefore calibrated against buffers at 76°C, under conditions similar to those in which the electrodes would normally be used. It was found important to wash the electrodes with dilute HCl after each experiment to remove deposits of $CaCO_3$.

CO_2 and air were passed through separate flowmeters and mixed before entering the reaction vessel through the sintered glass disc. After the early stages of each experiment were completed, the total gas flow remained constant at approximately two litres/min. At this flow rate the reaction mixture was highly turbulent and further mechanical mixing was found to have no effect.

should be >10). Without changing the air flow, CO_2 is admitted and the "seed" $CaCO_3$ is precipitated over a period of 5 min, as the pH is reduced to 8·0. If this "seeding" operation is carried out too quickly the subsequent precipitation lacks reproducibility; if carried out too slowly, excessive evaporation causes a serious reduction in gas absorption efficiency.

Table I. Liquor flow rates for single tank carbonatation

Limed liquor volume at 56·5% (ml)	*Time interval (min)*	*Pumping rate: limed liquor at 56·5% (ml/hr)*	*Carbonatated liquor volume at 65·0% (ml)*
0–15	0–5 (seeding)	0	12·5
15–65	0–15 (pumping)	200	12·5–54·5
65–130	15–30 ,,	260	54·5–108·5
130–210	30–45 ,,	320	108·5–175·5
210–300	45–60 ,,	360	175·5–251
300–400	60–75 ,,	400	251 –334

As soon as the "seed" carbonatated liquor reaches pH 8·0, the limed liquor dosing pump is started again and the pumping rate adjusted according to the programme in Table I. The CO_2 flow is also adjusted to maintain the pH in the carbonatated liquor constant at 8·0, and the air flow increased gradually as indicated in Table II. After 20 min, the air and CO_2 flow rates are adjusted simultaneously to maintain the constant pH of 8·0 and a total gas flow of about 2 litres/min. This procedure helps to standardize the loss of water by evaporation from the reaction vessel. During the course of the experiment, the pH may wander from the required value of 8·0. Corrective adjustment of gas flow must be made gradually if large pH swings are to be avoided. The limed liquor feed tube and the pH electrodes should be raised from time to time so that they remain positioned centrally in the bulk of the carbonatated liquor.

Table II. Air flow rates for single tank carbonatation

Time interval (min)	*Air flow rate (ml/min)*
0–5 (seeding)	500
0–10 (pumping)	500
10–15 ,,	1000
15–20 ,,	1500
20–75 ,,	2000 (total including CO_2)

After 75 min, 400 ml of limed liquor will have been pumped into the reaction vessel and, at 65% solids, the volume of carbonatated liquor will be 334 ml. The pump and CO_2 are turned off and the pH electrodes and feed tube are removed from the reaction vessel. Air is passed through (at 500 ml/min) for a few minutes longer to remove any gaseous CO_2. The carbonatation is now complete, and samples of carbonatated liquor may be removed for the filtrability measurement and for chemical analysis. For the former, it is convenient to measure 200 ml of the liquor into a cylinder mounted in the thermostat bath: the temperature of the liquor is thereby raised from 76°C to the bath temperature of 80°C in readiness for the filtration measurement at 80°C.

(To be continued)

Use of Thickening Filters for First Carbonatation by the Danish Sugar Corporation

by R. F. MADSEN (A/S De Danske Sukkerfabrikker, Copenhagen, Denmark)

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

PART I

THE use of bag filters or similar constructions for filtration in the sugar industry has a very long history.

The oldest bag filter construction we know is TAYLOR's filter which dates from about 1840, but the construction of this filter is rather different from the construction used today. By 1888–1889 several different designs had been made by DANĚK, KASALOWSKY, and MÜLLER[1,2], which differ only in minor details from the constructions used today. In the following years many other filters were introduced on the same principle.

In general these filters were used for the filtration of thin juice after sulphitation and for the filtration of syrup and remelt.

The use of this type of filter for first carbonatation juice was difficult, because the amount of sludge in first carbonatation is so great that manual operation of bag filters for first carbonatation involves an enormous amount of work, and because the bag filters are not particularly well suited for sweetening-off. It is for this reason that drum filters or similar filters are necessary as sweetening-off filters if bag filters are used as filter thickeners for first carbonatation.

The first use of bag filters as filter thickeners for first carbonatation juice dates from the nineteen-twenties, when Great Western Sugar Co. in U.S.A.

[1] LÉGIÉR: "Manuel de Fabrication du Sucre". (Paris) 1900.
[2] THIELER: "Die Filtration in der Zuckerindustrie". (Magdeburg) 1932.

installed Sweetland thickeners in some of their factories[3].

In these filter thickeners the bags were cylindrical, and there was a screw conveyor for the sludge in the bottom of the filters. The filters were cleaned by reverse flow of juice through the bags, and the filtration system was not very different from the system we now use in our factories.

After that time the system became almost forgotten. Most development work in the next 30 years was concentrated on the introduction of clarifiers and drum filters, which gave a continuous system with relatively low labour costs.

However, it has become more and more evident that the clarifier systems have several weak points.

If after-filtration is not used, it is impossible to get a sparkling juice without the use of an enormous amount of lime. If after-filtration is used, the decrease in labour by the introduction of clarifiers is limited. The rather long retention times gives higher colours than with traditional juice purification.

During the past decade the development of automatic control devices has made it more attractive to go back to filter thickeners for filtration of first carbonatation juice, as complete automation of filter thickeners can be effected without the use of final control elements other than automatic valves. HULPIAU[4], MOTTARD[5] and DUPONT[6] have in the last few years worked intensively with the use of bag filters for first carbonatation juice.

Juice purification within D.D.S.

Before the introduction of filter thickeners we have used, in the Danish Sugar Corporation, a system with clarifier and after-filtration as described by H. BRÜNICHE-OLSEN[7].

From the main liming the juice is pumped through the preheaters where the juice is heated with vapour from the vacuum pans, condensate, 5th and in some places 4th vapour to a temperature of about 82–85°C, before it goes to the continuous first carbonatation. Into the first carbonatation is dosed milk-of-lime corresponding to an increase in alkalinity of about 0·4%.

The first carbonatation vessel is normally made with as much internal circulation as possible. From first carbonatation the juice is led to the Dorr clarifier. The sludge from the clarifier is drum-filtered; two-thirds is returned to the second compartment of the BRIEGHEL-MÜLLER prelimer in order to increase the filtrability and settling qualities. The total $CaCO_3$ content in the first carbonatation juice is normally 2·5–3% CaO w/v. One-third of the sludge is sweetened-off at the drum filters.

The clear juice from the clarifier is sent to an after-filtration on filter presses or Kelly filters before it goes to second carbonatation. Some unfiltered first carbonatation juice is normally used as filter-aid on the filter presses.

This system has many advantages; with a limited consumption of limestone (2·6–2·9% $CaCO_3$ on beet is normal), the settling qualities, the filtrability, and the juice purification are satisfactory. The steam economy is very good because almost all juice heating before first carbonatation is done by waste heat (vacuum vapour from the vacuum pans, and condensate and 5th vapour from the evaporator).

The system has, however, one important and some minor disadvantages; the important disadvantage is that the juice purification is not satisfactory without after-filtration. Experiments have shown that the

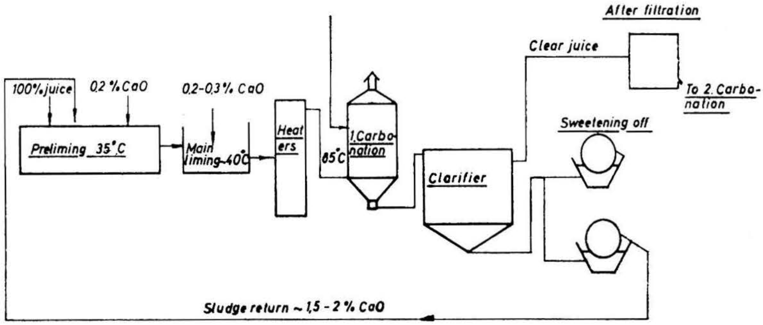

Fig. 1.

In this system, shown in Fig. 1, the preliming is rather cold (35–40°C) as the diffusion juice (25°C) goes direct to the BRIEGHEL-MÜLLER preliming from the D.D.S. diffuser, and the only heating comes from the returned sludge. In the preliming the juice is limed to an alkalinity of 0·2% CaO. From the preliming the juice goes to the main liming where it is limed with milk-of-lime to an alkalinity of 0·4–0·5% CaO.

amount of lime salts as well as colour will increase greatly if after-filtration is omitted. The minor disadvantages are the slow start-up and the rather

[3] WEISS: *Centralblatt fur die Zuckerindustrie*, 1927, 1460.
[4] *I.S.J.*, 1963, **65**, 77.
[5] *ibid.*, 357; 1964, **66**, 12.
[6] *ibid.*, 1966, **68**, 323, 358.
[7] *Paper presented to the* 13*th Meeting, Amer. Soc. Sugar Beet Tech.*, 1964; *I.S.J.*, 1965, **67**, 119.

difficult control of the returned sludge with the drum filters. These disadvantages, and the fact that the increased capacity of some of our factories made the clarifier capacity unsatisfactory, made it advisable to find a new method where the disadvantages were eliminated without the loss of the advantages.

The good results of using bag filters for second carbonatation made it natural to try to use the same type of filters for first carbonatation.

Experimental

In 1963–1964 experiments were made with an old bag filter for thick juice rebuilt for the purpose. The test set-up is shown in Fig. 2.

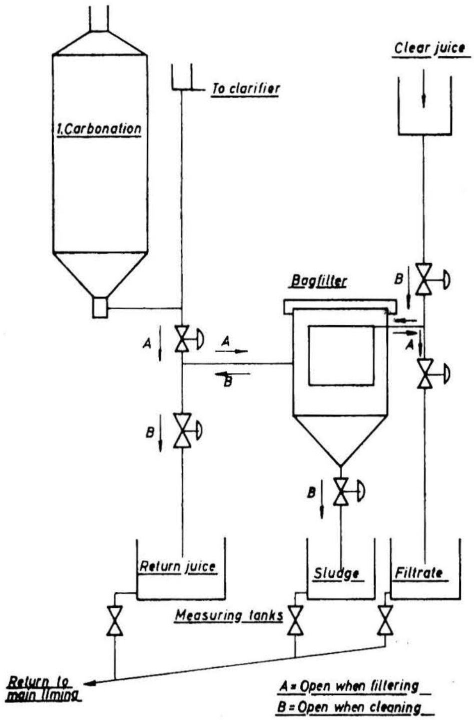

Fig. 2.

Juice from first carbonatation at a factory using the above juice purification system was fed to the filter with about 6·5 m w. g. inlet pressure and was discharged as filtrate. The filter was cleaned in the following way:

The inlet and normal outlet were closed, and the inlet for washing juice, sludge outlet, and return juice outlet were then opened. After 10–15 seconds the sludge outlet was closed. About 10 seconds later the washing juice inlet was closed, after which the valves of the filter were reset for normal filtering.

The experiments resulted in the fact that with this kind of filtering we could obtain a filtering capacity of about 35 litres/sq.m./min net, when the TC (total content of $CaO + CaCO_3$ determined by titration to pH 4·0) of the juice was about 2·5% CaO w/v, and F_k (coefficient of filtration determined according to BRIEGHEL-MÜLLER's method) about 2–3.

For the cleanings, which were made at intervals of 3½ min, about 80 litres washing juice were used per sq.m. filter surface.

The TC of the sludge could be determined according to how long the bottom valve was kept open, and it could be up to more than 20% CaO w/v.

Apart from these experiments we made corresponding experiments with a set-up as described by HULPIAU[4], MOTTARD[5], and DUPONT[6]. These experiments were made with partial as well as complete emptying of the filter at each cleaning, but without reverse flow of juice into the bags.

The experiments with this test set-up showed a net filtering capacity of 20 litres/sq.m./min., and filter cake stuck rather easily between the frames.

The experiments with both arrangements showed that for good operation the filter had to be absolutely free from stays, etc. inside, as any such internal part easily allowed accumulation of sludge. Furthermore the filter had to be equipped with large valves, as the cleaning was most effective when carried out as quickly as possible.

In order to conduct the emptying of sludge in the experimental set-up it would be necessary to put in an automatic control which forced a certain volume out each time. It was impossible to keep anything like a constant TC in the sludge outlet using only a time control. Furthermore the experiments showed that the filters ran best and were most effectively cleaned when they were provided with continuous venting.

Installation in factories

Based on these experiments, in 1965 Odense Sukkerfabrik, and in 1966 Gorlev Sukkerfabrik were supplied with automatic filters of our own construction for thickening first carbonatation juice.

In Fig. 3 a diagram shows the installation as it was carried out in Gorlev.

The diffusion juice is fed to a BRIEGHEL-MÜLLER prelimer at a temperature of about 25°C. In the second compartment of the prelimer the sludge returned from the filters is added, and by this process the temperature is raised to about 35°C.

In the last compartment of the prelimer is added milk-of-lime to an alkalinity of about 0·2% CaO. The juice is led from the prelimer to the main liming tank where milk-of-lime is added to an alkalinity of 0·4–0·5% CaO. Here the juice has a retention time of 30–60 minutes.

From the main liming the juice is pumped normally through the preheaters and is heated to 82–87°C, after which it goes into first carbonatation.

Sufficient milk-of-lime to give a total of about 0·8% CaO—calculated on the amount of juice—is led direct to first carbonatation. Thence the juice is led to a receiver and from there to the filters.

The clear juice from the filters is used partly as washing juice for filter cleaning, and partly is passed on to second carbonatation.

The sludge from the filters is automatically separated so that some of it goes to sweetening-off on drum filters (about 40–45%), while some is led back to the preliming (55–60%) in order to improve the filtration qualities.

If this system is compared wtih the system using a Dorr clarifier as before, it will be seen that the filter thickener takes the place of the clarifier, after-filtration, and the part of the drum filter which is used for sludge return.

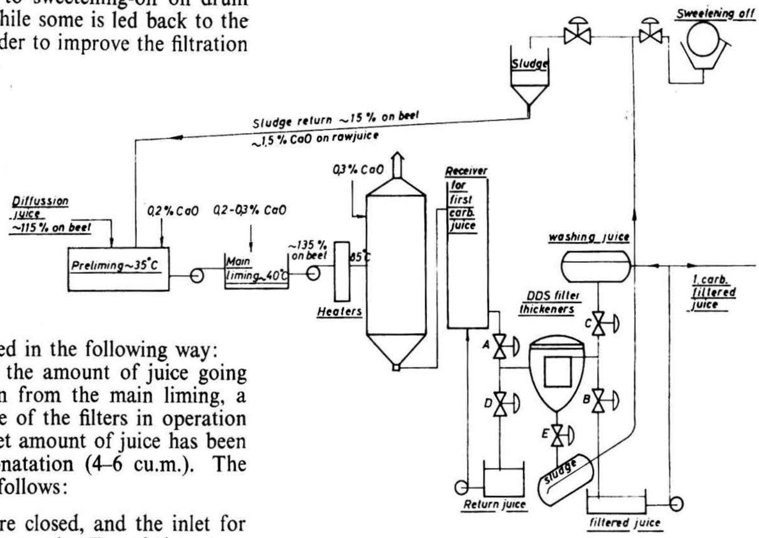

Fig. 3.

The filters are controlled in the following way: From a measurement of the amount of juice going to the first carbonatation from the main liming, a signal for cleaning of one of the filters in operation is given each time a preset amount of juice has been added to the first carbonatation (4–6 cu.m.). The cleaning procedure is as follows:

The valves A and B are closed, and the inlet for washing juice C, the bottom valve E, and the return juice valve D are opened. The bottom valve is closed when a set amount is measured in the measuring vessel. The cleaning is stopped, and normal filtering is resumed, when a preset amount of washing juice is led to the filter (about 3 cu.m.).

The filters in use are cleaned in sequence. As about 5 cu.m. juice from the main liming plus the return juice (about 3 cu.m.) minus the sludge (about 1 cu.m.) are filtered at each cleaning, the total filtration/cleaning is about 7 cu.m. The net filtration/cleaning is 5 cu.m. minus 1 cu.m. sludge which equals about 4 cu.m./cleaning. The cleaning procedure takes about 30–35 seconds.

The use of the filters in this way gives the maximum throughput/sq.m. filtering area/time, because the filters are used only as long as they give a high flow, and they are cleaned when the flow has fallen.

The special system of automation based on flow measurements instead of time control increases the capacity, as it is impossible to hold optimal conditions with time control. The filters are unstable if they are used under optimal conditions. If conditions (with time control) changed a little, for instance TC increased a little, this would increase the TC of the sludge, and the sludge volume going out of the sludge valve within a given time would decrease, as the viscosity increases a lot, and within a few cleanings the sludge volume would decrease so much that the filter would fill up with sludge. In order to prevent this it would be necessary either to empty the filter completely with decrease in capacity or to hold a low sludge density.

The volumetric measurement of cleaning juice prevents the use of too much washing juice and increases, therefore, the net capacity.

Drum filter filtrate and return juice are returned to the first carbonatation receiver.

The drum filter filtrate, we thought, could be sent direct to second carbonatation, but in practice it appeared that we cannot rely on its being sparkling, for which reason we have preferred to filter it once more at the bag filter in order to be quite sure to get completely safe filtration with sparkling juice.

Apart from the automatic controls for normal operation the systems are equipped with a special automatic device for cleaning and emptying of the filters, so that only one single operation of a switch is necessary when the filter has to be disconnected, after which the filter is cleaned twice or three times and then emptied.

The filter is free from sludge residues when this operation has been finished.

Another setting of the same switch gives an automatic acid washing of the filter; the filter is cleaned automatically 2–3 times, after which it is emptied. After emptying it is filled up with water to a certain level, and 5% acid added through the bags from the clear juice side, after which the filter is left for 3–4 hours. The acid is then emptied through a drain valve, and the filter washed down with water.

(To be continued)

Sugar cane agriculture

Advances in fertilizer practices in the Mexican sugar industry. R. P. HUMBERT. *Sugar J.*, 1967, **30**, (1), 20–22.—The phenomenal rate of growth of the Mexican sugar industry in the last ten years and the greatly increased use of fertilizers is discussed. Production increased from a million tons in 1957 to two million tons in 1965. The writer considers Mexico has the potential to eclipse Cuba as a sugar producer. The methods of applying ammonia in liquid form to the soil are described and the benefit that has resulted from application of urea by air on some of the larger Mexican estates discussed.

* * *

Inauguration and growth of sugar cane research in Mexico. G. ARCENEAUX. *Sugar J.*, 1967, **30**, (1), 62–63.—The sugar industry of Mexico is old and may be said to date from 1522 when Cortez established a sugar cane plantation and mill near Vera Cruz. Comprehensive sugar cane research in Mexico was only initiated in recent times, largely as a result of the Ford, Bacon and Davis report, in which the author participated. The various lines of research now being carried out are described.

* * *

Sugar varieties in Mexico. A. GONZALEZ G. *Sugar J.*, 1967, **30**, (1), 70–72.—Mexico has 16 different sugar cane areas all with different climatic and edaphic conditions. The problem of the variety or varieties of cane best suited for each of these areas therefore becomes complex. The cane breeding stations now established in different parts of Mexico and the methods of selection employed are described. A table shows the commercial varieties at present grown and the percentage of the total crop each variety is responsible for. The variety Co 290 leads easily with 30·9%, second place going to the variety Co 213 with 12·9%. As yet, Mexican varieties represent only a small percentage.

* * *

Phil 58-260—a good plant crop but a poor ratooner? ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **14**, (1 & 2), 6.—From small-scale variety trials it is considered, on a basis of one plant crop plus one ratoon crop, that Phil 54-60 is still a better variety than Phil 58-260.

* * *

Red stripe plagues Phil 54-60; control measures explained. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **14**, (1 & 2), 7.—Reference is made to the fact that the sugar cane variety Phil 54–60 has been observed heavily infected with red stripe disease (*Xanthomonas rubrilineans*), a bacterial disease. Possible remedial measures are discussed. Early planting is one of them.

* * *

The need for better roads. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **14**, (1 & 2), 8–9.—The writer considers one of the most neglected aspects in the operational functions of some Philippine sugar estates is road maintenance. The effect of bad roads in preventing or slowing down the haulage of cane is discussed.

* * *

Control of sugar cane downy mildew in Taiwan. H. T. CHU. *Taiwan Sugar*, 1967, **14**, (2), 10–13, 26.—The known history of this disease (*Sclerospora sacchari*) in Taiwan is given and the methods adopted for its control on the island described. Many of the newer varieties, notably F 146, 148, 149 and 150, show a high degree of resistance to the disease.

* * *

Reclamation of marginal lands. R. H. TSENG. *Taiwan Sugar*, 1967, **14**, (2), 24.—The need for the Taiwan Sugar Corporation to obtain more land for sugar cane cultivation and the steps the Corporation is taking to achieve this are explained. Reclamation of tidal land has proved expensive but success has been achieved in reclamation of old river beds and construction of terraces on the lower mountain slopes.

* * *

Semi-automatic and automatic gates for surface irrigation. ANON. *Sugar y Azúcar*, 1967, **62**, (7), 10–12.—The value of semi-automatic and automatic gates is discussed, especially in relation to reducing labour costs. Reference is made to some 1500 acres in Hawaii with this type of irrigation control, which cuts labour by half. It is operated by an inexpensive clock which must be reset by hand.

* * *

Smut and sugar cane. ANON. *Bol. Informativo Copereste* (São Paulo), 1967, **6**, (4), 8.—The incidence of sugar cane smut (*Ustilago scitaminea*) in Brazil is discussed, and resistant and susceptible varieties of cane indicated, including those the cultivation of which is now prohibited.

* * *

Poor germination of sugar cane. F. VEIGA. *Bol. Informativo Copereste* (São Paulo), 1967, **6**, (5), 4. Bad germination of sugar cane setts due to rotting caused by the fungus *Ceratocystis paradoxa* (pineapple disease or "mal do abacaxi") is discussed and the desirability of pre-treatment with a suitable mercurial fungicide pointed out, various commercial preparations being available, such as "Aretan", "Neantina", "Biosan" and "Ardisan".

* * *

The origin and evolution of the sugar cane industry in Paraguay. E. FRIEDMANN. *La Ind. Azuc.*, 1967, **72**, 111–113.—This is the second of three articles on the subject, the author being the son of one of the founders of the modern sugar industry of Paraguay. The establishment and development of some of the early sugar estates in Paraguay in the latter part of last century are discussed.

* * *

New cane varieties for all regions—how these are being developed. P. G. C. BRETT. *South African Sugar J.*, 1967, **51**, 468–471.—An account is given of the selection work carried out at the experiment station at Mount Edgecombe in Natal and of the important rôle played by the sub-stations established in different cane growing environments, the latest being that at Pongola for irrigated cane.

* * *

An outbreak of Eye Spot disease. G. M. THOMSON. *South African Sugar J.*, 1967, **51**, 485–487.—A severe outbreak of Eye Spot disease (*Helminthosporium sacchari*) of sugar cane has recently taken place in the Mount Edgecombe area of Natal. A description of the disease is given to assist cane growers to recognise it. This is the most serious of the leaf spotting diseases of sugar cane. The variety affected is N 50/211, which is proving highly susceptible. Hitherto commercial varieties in Natal have maintained a high degree of resistance.

* * *

Maturity testing using a hand refractometer. C. WHITEHEAD. *South African Sugar J.*, 1967, **51**, 489–493.—The value of the hand refractometer in testing the maturity of different fields of cane, with a view to priority of harvesting, is discussed and the method of using the instrument carefully explained with diagrams.

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Irrigation and the sugar industry. F. B. HAIGH. *Australian Sugar J.*, 1967, **59**, 103–109.—The history and present state of irrigation of sugar cane in Queensland is reviewed. From 1963 to 1966 the area irrigated increased from 80,000 to 140,000 acres, this being mainly in the Burdekin Delta, Bundaberg and Mackay areas. It is the result of individual farm exploitation of available underground, and to a lesser degree, surface water supplies. It is pointed out that the lack of knowledge in the utilization of irrigation water, e.g. the optimum amount of water that should be applied under a given set of conditions in Queensland, is a drawback. This kind of knowledge is required to assist future planning.

Fewer nuts, more cane. ANON. *Australian Sugar J.*, 1967, **59**, 115.—Results are given of experiments in the chemical control of nut grass (*Cyperus rotundus*) in sugar cane in Queensland. This weed can reduce cane yields by as much as 40%. It competes with the cane for soil moisture at critical periods and removes considerable amounts of nutrients. Soil fumigation with methyl bromide gave complete control but is too expensive for use on an acreage basis. The use of 2,4-D amine gave worthwhile short-term control. The new weedkiller CP 31675 (at 6 and 7½ lb active ingredient per acre) gave satisfactory control, lasting for 16 months, but more field work is needed before general recommendations are issued.

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When frost occurs. ANON. *Australian Sugar J.*, 1967, **59**, 121.—Recent experimental work in South Africa on frost resistance in sugar cane is discussed. In Queensland well grown fields with tall stems and much foliage are less liable to suffer frost injury than cane stands less well developed. The importance of the growing point remaining undamaged to ensure recovery and obviate subsequent damage to the stem from rot is discussed. Growers are advised to examine carefully the growing points or shoot buds before sacrificing a crop.

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Cane borer heavy in 1967 cane crop. L. L. LAUDEN. *Sugar Bull.*, 1967, **45**, 256.—Reference is made to heavy borer infestations in some US cane fields during 1967. The correct use of appropriate insecticides ("Azodrin", "Guthion" and "Sevin") is discussed.

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Borer infestations and loss in the 1966 Louisiana sugar cane crop. L. J. CHARPENTIER, R. MATHES and W. J. MCCORMICK. *Sugar Bull.*, 1967, **45**, 264–266.—A table is given with data showing sugar cane borer infestation (*Diatraea saccharalis*) of cane collected at Louisiana mills during the period 1961–66. The table is discussed. The percentage of bored joints in 1966 was 14, as against 18 for 1965 and less for the four earlier years. The crop loss for 1966, due to borers, was estimated at 11%.

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Spectacular advances in sugar cane agriculture. J. A. ROWE. *Producers' Rev.*, 1967, **57**, (7), 9–10.—This is a summary of an address by the Minister of Primary Industries, Queensland, at the annual field day at the Bundaberg Experiment Station. The advances in cane nutrition, pest control, disease eradication and mill technology were due to the activities of the four sugar cane experiment stations. The Minister pointed out that in private industry it was commonly accepted that at least 2% of gross income was a reasonable allocation for research activities, whereas the Bureau's experiment research stations in Queensland were costing the sugar industry only about one sixth of this normally accepted figure.

Fertilizer advances in the last ten years. K. C. LEVERINGTON. *Producers' Rev.*, 1967, **57**, (7), 11-12.—The changes that have taken place in fertilizer usage in sugar cane in Queensland are described, notably the increasing use of ammonium phosphates, urea and aqua ammonia. The following forecast is made: although the fertilizers now in use in Queensland are the products of very advanced technology, in other countries, where much larger chemical industries exist, a host of new products are under test and undoubtedly in years to come Australians will be using many of these on their farms.

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Causes of cane hauling derailments. A. K. ROSELER. *Producers' Rev.*, 1967, **57**, (7), 21-23.—See *I.S.J.*, 1968, **70**, 52.

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New device makes tractor braking safer. ANON. *Producers' Rev.*, 1967, **57**, (7), 25.—A description is given of the device, completely new on world's markets. It is a unit whereby wear on existing left or right hand braking systems is automatically corrected before any stopping or slowing power is applied to the wheels when braking is applied. It fills a long-felt need.

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Queensland's phosphates. ANON. *Producers' Rev.*, 1967, **57**, (7), 29.—Reference is made to the recent discovery of extensive deposits of mineral phosphate in the Cape region north of Cookstown in Australia. It is pointed out that this could not have been made at a better time, for the phosphatic material on Nauru and Ocean islands, now meeting Australia's requirements, including those of the sugar industry, are not expected to last more than 20 years. The discovery was the outcome of examining and analysing rock cores from exploratory oil wells.

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Johnson grass in the Burdekin area. O. W. STURGESS. *Producers' Rev.*, 1967, **57**, (7), 39-43.—A description is given of the methods successfully employed in eradicating Johnson grass (*Sorghum halepense*) from cane fields in Queensland, some of which had been abandoned because of the weed. Treatment was similar to that adopted in Louisiana—repeated ploughing and discing followed by the use of a herbicide ("Dalapon" with a surfactant) for destruction of seedlings. For infected areas unsuitable for ploughing (e.g. rocky waste land) "Hyvar X" used at the rate of not less than 20 lb/acre eliminated the weed.

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Herbicidal trials during the early growth of furrow-irrigated sugar cane, 1965. I. J. FOSTER, D. H. GREEN and B. KALOGERIS. *Misc. Rep. Trop. Pestic. Res. Inst., Arusha*, 1966, (538), 43 pp.; through *Hort. Abs.*, 1967, **37**, 697.—Results are given of tests with eleven chemicals as pre-emergence herbicides. H-7175 was very effective but other phenylureas were not. In a trial of post-emergence treatments "Prometryne" and GS 11.349 were very good. The post-emergence activity of "Diuron" was improved by the addition of urea to the spray solution. Reasons for the performance of particular herbicides under the conditions of the trials are discussed and contrasts are drawn between results from areas of rainfed and furrow-irrigated cultivation.

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Feeding sugar cane with filter press mud. A. K. KADIRVELU. *Indian Farming*, 1966, **16**, (9), 37; through *Hort. Abs.*, 1967, **37**, 698.—In three years of trials applications of filter press mud up to 15 tons/acre progressively increased cane yields. The yield increase produced by a further 5 tons/acre was only marginal.

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Studies on sugar cane yield in relation to the percentage and time of occurrence of borers causing dead heart. J. L. CHUNG and T. W. JUWEI. *J. Agric. Assoc. China*, 1966, (55), 62-74; through *Hort. Abs.*, 1967, **37**, 699. The effects of dead heart on yields of sugar cane (variety N:Co 310) were studied for two seasons. Observations were made after inducing 50%, 30%, 10% and nil dead heart in cane plots for the whole of the tillering period or for the first or second halves of the period. Tillering increased with the percentage of dead heart, but the percentage of millable cane stalks formed was greatest in the control plots. Sugar losses were greatest when dead heart occurred throughout the tillering period (25·2% loss from 50% dead heart), and next greatest when it occurred in the latter half of the period.

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"Telodrin" for control of sugar cane pests and for increasing cane yield. O. P. SINGH and P. C. SONEJA. *J. Res. Ludhiana*, 1966, **3**, 41-49; through *Hort. Abs.*, 1967, **37**, 700.—"Telodrin", γ-BHC and "Heptachlor" were tested for the dual control of termites and shoot borers by a single application at planting time. "Telodrin" treatment was the most effective in reducing the incidence of both pests. It also increased germination and the number of millable canes per ha and raised yields.

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Translocation of ^{14}C in the sugar cane plant during the day and night. C. E. HARTT and H. P. KORTSCHAK. *Plant Physiol.*, 1967, **42**, 89-94; through *Hort. Abs.*, 1967, **37**, 701.—The time-course of translocation of ^{14}C from the blades of the sugar cane plant was investigated by analysis and radioactive counting of successive samples punched from a single blade. The rate of translocation, expressed as percentage, was highest immediately after the application of the radioactive CO_2. The translocation of labelled sucrose was slower at night. Translocation of sucrose during the night may be triggered by different mechanisms from those by day.

A technique for studying root exudates of sugar cane. J. T. MILLS and A. J. VLITOS. *Phytopathology*, 1967, **57**, 8–9; through *Hort. Abs.*, 1967, **37**, 701.—The apparatus described consists of a light-excluding "Perspex" box into which roots of sugar cane may be suspended while the shoots grow in light. Root exudates are collected in sterile flasks after passing through bacteriological filters. Some results of tests involving these exudates and fungal growth are given.

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Preliminary studies on pith development in sugar cane. S. R. RANGANATHAN. *Indian J. Agric. Sci.*, 1966, **36**, (5), 239–242; through *Biol. Abs.*, 1967, **48**, 6896. The extent of pith formation in a number of sugar cane varieties in various stages of growth was studied. The varieties studied were known to be "pithy" or "less pithy". The extent of pith formation was expressed as a percentage of the total volume of the cane. Positive and highly significant phenotypic and genotypic correlation coefficients were obtained. The relationship revealed the possibility of its use in selection work.

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Effect of different inorganic nitrogenous fertilizers and their methods of application on yield and quality of sugar cane. R. S. KANWAR and S. SINGH. *J. Res. Punjab Agric. Univ.*, 1967, **3**, 373–378; through *Soils and Fertilizers*, 1967, **30**, 518.—Broadcast and drilled applications of ammonium sulphate and nitrate, calcium ammonium nitrate, urea and ammonium chloride were compared. Calcium ammonium nitrate gave the best cane yield and net income while drilling the fertilizers was more efficient than broadcasting.

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Occurrence of pineapple disease on sugar cane in the Punjab. S. S. SANDHU. *Sci. Cult.*, 1966, **32**, 598–599; through *Rev. Appl. Mycol.*, 1967, **46**, 483.—This disease (*Ceratocystis paradoxa*) infected the variety Co 1111 in 1964, the first record on sugar cane for the Punjab.

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Varietal resistance to sugar cane smut caused by *Ustilago scitaminea* in the Punjab. S. S. SANDHU and N. S. MANN. *J. Res. Ludhiana*, 1966, **3**, (4), 410–413; through *Rev. Appl. Mycol.*, 1967, **46**, 483.—In inoculation tests and field trials during the period 1954–1965 the following varieties were resistant to *U. scitaminea*: Co 453, Co 617, Co 139 and CoL 9. A list of susceptible Co varieties is included.

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Lodging of sugar cane. C. B. AGNIHOTRI. *Indian J. Agron.*, 1965, **10**, 319–325; through *Soils and Fertilizers*, 1967, **30**, 518.—Percentage of the total area lodged by high wind was more than doubled by increasing the nitrogen rate from 80 to 160 lb/acre; applying P_2O_5 lessened the extent of lodging. Lodging reduced height, girth and weight of the main shoot. Extraction percentage and purity of juice was reduced by lodging and sucrose content of the juice decreased, especially in the bottoms of the canes below the bend. Lodging increased invert sugar content in top and bottom parts of cane. Heavy N also increased invert sugar levels.

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Cutting down cane losses from termites and shoot borer. A. N. KALRA. *Indian Farming*, 1966, **18**, (8), 28–29; through *Hort. Abs.*, 1967, **37**, 699.—To control termite damage to buds and setts the application of 5% BHC, "Chlordane" or "Aldrin" dust in the furrows at planting times is recommended. For combined control of shoot borers and termites γ-BHC, "Heptachlor" or "Telodrin" emulsion should be used at the rate of 1 kg a.i./ha in the furrows when planting. Higher rates of "Heptachlor", 2–3 kg a.i./ha, could be used to advantage.

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Inheritance of mosaic resistance in sugar cane. G. R. SINGH. *Current Science*, 1967, **36**, (4), 107; through *Rev. Appl. Mycol.*, 1967, **46**, 583.—The resistance of the U.S. variety U.S. 49–7 and its progeny to natural infection by sugar cane mosaic virus appeared to be dominant but not influenced by complementary genes as previously suggested.

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Sugar cane farms and the adoption of a suitable cropping pattern for increasing food production. ANON. *Proc. 21st Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 17–36.—A symposium on this subject with seven speakers taking part is recorded. Reference is made to the determination of the Government of Maharashtra State to grow more grain to alleviate food shortage and to impose a reduction of 25% in the area devoted to sugar cane in order to achieve this. The desirability of sowing grain on cane fields every fifth year when they are normally left fallow is advocated. Means of increasing cane yields in areas still devoted to the crop are discussed and the need for improved or more reliable irrigation facilities pointed out.

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Curvilinear study of yield with reference to weather: sugar cane. R. P. SARKER. *Indian J. Met. Geophys.*, 1965, **16**, 103–110; through *Hort. Abs.*, 1967, **37**, 468.—Weather during the tillering phase alone accounted for about 50% of the variation in yield; the weather in the combined tillering and elongation phases accounted for about 80% of the yield variation. A technique is suggested for predicting yield in terms of weather factors.

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Sugar cane conditioning stations—a promising outlook. J. S. GAYOL. *Cuba Azúcar*, 1966, (May-June), 15–25. A description is given of the method of mechanical trashing of sugar cane by means of an air blast after the hand-cut cane has been transported to the conditioning station. The great saving in labour caused by the elimination of hand trashing is stressed.

Sugar beet agriculture

Germination of sugar beet seed at low temperatures. V. Mego. *Biologia* (Bratislava), 1965, **20,** 663–670; through *Field Crop Abs.*, 1967, **20,** 156.—In order to determine the feasibility of earlier sowing, the germination of 8 varieties of sugar beet at 2·3–9·1°C was studied. Varieties from drier areas germinated more quickly, while polyploid varieties required higher temperatures in order to germinate.

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Resistance to sugar beet root aphid. Anon. *Research Rpt.* (Canadian Sugar Factories Ltd.)., 1964–65, 25. In tests at Lethbridge, Alberta, two varieties of sugar beet resistant to mites, G.W.674 and G.W.359, were found to be resistant also to sugar beet root aphid, *Pemphigus betae*, whereas nine others were susceptible. The results indicated the possibilities of developing a sugar beet variety resistant to the aphid.

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Sex attractant in sugar beet wire-worms. Anon. *Research Rpt.* (Canadian Sugar Factories Ltd.), 1964-65, 25.—Males of four wire-worms were attracted to extracts of virgin females, the species being: *Limonius californicus*, *Agriotes ferrugineipennis*, *Ctenicera sylvatica* and *Ctenicera destructor*. Each attractant was species specific. An olfactometer was developed that permits paper chromatograms of the extracts to be bioassayed for pheromone activity. R_f values of the attractants from the four species were compared.

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Comparative trials with root crops. L. Yllo. *Ann. Agr. Fenniae*, 1965, **4,** (3), 215–222; through *Biolog. Abs.*, 1967, **48,** 4124.—An account is given of trials in Finland with the American sugar beet variety H2. Under Finnish conditions it proved inferior to Hilleshög KL, the variety commonly grown, in yield and in other ways. The abundance of multiple roots made harvesting difficult and increased the dirt percentage of the yield.

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Effect of sugar beet on the mutual conversion of the nitrate and ammonium forms of nitrogen in lowland peat soil. V. M. Krykunets. *Mikrobiol. Zh.* (Akad. Nauk Ukr. S.S.R.), 1965, **27,** (4), 13–18; through *Biolog. Abs.*, 1967, **48,** 5049.—The effect of growing sugar beet on peat from a lowland cultivated peat bog was studied in regard to the nature of the nitrogen present. The interconversion of nitrate and ammonium nitrogen was studied, using ammonium nitrate labelled with isotope ^{15}N. The reduction of nitrate nitrogen to ammonium (partial denitrification) proceeded more intensively than the oxidation of ammoniacal nitrogen to nitrate (nitrification). The growing of sugar beet perceptibly enhanced the former process; no stimulating effect of the growing of sugar beet on the latter process was noted.

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Iron nutrition of the sugar beet plant in relation to growth, mineral balance and riboflavin formation. S. Nagarajah. *Soil Sci.*, 1966, **102,** (6), 399–407; through *Biolog. Abs.*, 1967, **48,** 5974.—Sugar beets were grown in culture solutions with iron as the variable. Symptoms of deficiency first appeared in the form of chlorosis of the centrally situated young leaves. Severely chlorotic leaf blades were completely bleached and developed necrotic spots. The critical iron concentration for sugar beet growth was regarded as 55 p.p.m. (dry basis), when based on the analysis of young and mature blades.

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Irrigated sugar beets in Oklahoma. Research Progress Report, 1964. R. N. Ford, B. Webb, R. M. Oswalt, R. S. Matlock and B. J. Ott. *Process Ser. Okla. Agric. Expt. Sta.*, 1965, 5pp; through *Plant Breeding Abs.*, 1967, **37,** 577.—Data on root and sucrose yield and juice purity are presented for 15 varieties grown at two localities.

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Using inter-varietal crossing in sugar beet: crossing with foreign varieties. B. Sládek. *Rostlinná Vijroba*, 1966, 921–934; through *Plant Breeding Abs.*, 1967, **37,** 577.—The performance of inter-varietal hybrids of 10 varieties was compared with that of Dobrovice A. The best results were obtained when the Czech variety Dobrovice V was used as the maternal parent. When foreign varieties were used as the maternal parent, the yield of roots decreased and the sugar content increased; the yield of sugar did not reach that of Dobrovice A.

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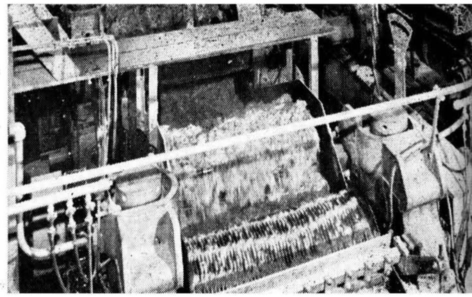
Physiological and technological properties of sugar beet polyploid varieties. I. F. Buzanov *et al.* *Sel'skohoz. Biol.*, 1966, **1,** 654–665; through *Plant Breeding Abs.*, 1967, **37,** 578.—Comparisons between various diploid and tetraploid beets and triploid hybrids showed the polyploids to have larger cells, shorter broader leaves and a slower rate of leaf development; the triploids had a considerably greater leaf area. Most of the monogerm hybrids were still inferior to the normal diploids in quality and in sugar yield.

Cane sugar manufacture



Pan circulation measurements using a radioactive isotope. P. G. WRIGHT. *Tech. Rpt. Sugar Research Inst. Mackay*, 1966, (77), 10 pp + 5 diagrams; through *S.I.A.*, 1967, **29**, Abs. 216.—The pattern and speed of massecuite circulation were investigated by recording the path of a radioactive capsule. Results obtained during a high-grade strike in a pan with a central downtake and a low-grade strike in a coil pan are given.

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Further pan circulation tests using a radioisotope. P. G. WRIGHT. *Tech. Rpt. Sugar Research Inst. Mackay*, 1966, (88), 22 pp + diagrams; through *S.I.A.*, 1967, **29**, Abs. 217.—Results of tests in six pans boiling high-grade and four pans boiling low-grade massecuites are reported[1]. The boiling conditions, circulation and eddy speeds of the massecuite and time spent in each type of movement are tabulated for the initial and final periods of high-grade boilings and the final periods of low-grade boilings. To enable the pans to be compared, the speeds are corrected to a standard temperature difference (across the tubes), vapour volume and viscosity for each type of massecuite. The effects of design features on the circulation are discussed.

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Motzorongo factory is expanding. ANON. *Bol. Azuc. Mex.*, 1967, (212), 18–23.—Central Motzorongo started operations as a small-scale producer of panela and piloncillo sugars but has been enlarged over the years to its present capacity of 7500 t.c.d. It has a turbine-driven 40 × 84 inch Farrel mill tandem, installed three years ago, and information is presented on this and the other plant installed.

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Electronic computation for the distribution of sugar. ANON. *Bol. Azuc. Mex.*, 1967, (212), 28–33.—An account is given of the use of an electronic computer for the distribution of sugar in Mexico, whereby the cost to the producers' organization UNPASA is minimized.

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What Louisiana raw sugar mills can do to improve the quality of their raw sugar. J. N. FORET. *Sugar Bull.*, 1967, **45**, 247–248.—The six factors discussed include: raw sugar temperature during storage (this should be no more than 100°F), the moisture content of the stored sugar (no more than 0·280 safety factor), its grain size, ash content, filtrability and invert content.

The improvements in the Supanburi sugar factory of Thailand. S. Y. CHIU. *Taiwan Sugar*, 1967, **14**, (2), 18–21, 30.—The improvements mentioned include raising 1st carbonatation pH from 9·8–10·5 to 10·5–11·0, with an end-point of pH 10·5, and decreasing the retention time from 12–15 min to 10 min; raising the 2nd carbonatation temperature from 50–55°C to 70–75°C; heating syrup to 80°C before filtration and cooling to 60°C before sulphitation (formerly the syrup had been filtered at 60°C *after* sulphitation); rearranging the *B*- and *C*-sugar centrifugals to give a double-cured *C*-sugar of 98 purity compared with 85 purity previously and a single-cured *B*-sugar of 99·0–99·5 purity compared with 90 purity previously. *A*-massecuite is now boiled on remelt from these sugars plus syrup and has a purity of 90–92 instead of 84–86 previously. Other improvements refer to quality control in pan boiling and centrifugals and to changes in the steam system.

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Development of the sugar industry in Taiwan. R. H. TSENG. *Taiwan Sugar*, 1966, **13**, (6), 21–23; 1967, **14**, (1), 17, 27–29; (2), 22–26.—A survey is presented of cane agriculture and of cane sugar production in Taiwan, with tabulated data concerning the sugar factory capacities, process (whether defecation or carbonatation), whether raw or white sugar is produced, annual bagasse production and annual molasses consumption by various industries. Diversification schemes and various aspects of the Taiwan sugar economy are also discussed.

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Continuous diffusion: a revolution in the milling and extraction of sugar. ANON. *Bol. Azuc. Mex.*, 1967, (213), 28–33.—A description of the Silver ring diffuser for cane, its operation, advantages and comparative estimated data for a 1000 t.c.d. unit and a milling tandem are presented in connexion with the Silver unit recently installed at Ingenio Eldorado, Sinaloa, Mexico.

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Maximum extraction from a Silver diffuser through press juice treatment. D. M. SABIA and B. SILVER. *Sugar y Azúcar*, 1967, **62**, (7), 29–31.—Press water from exhausted bagasse at Pioneer is treated in a "RapiDorr" clarifier and is recycled to the discharge end of the Silver ring diffuser. The underflow from the clarifier is treated by an Oliver-Campbell rotary vacuum filter, converted to handle top-fed material in order to obtain satisfactory filter cake. The filter

[1] *See also I.S.J.*, 1966, **68**, 372.

handles the mud from 3000 t.c.d. and gives a pol loss in cake of 0·5% at a cake moisture content of 86·2%. The cake amounts to 2·7% and the filtrate to 19·5% on press water. For new factories equipped with Silver diffusers, a top-fed horizontal rotary filter is advocated for press water treatment. This consists of a circular pan divided into a number of wedge-shaped sections covered with perforated screen. Since gravity helps cake formation and filtrate separation, vacuum requirements are low.

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Ingenio Los Mochis—15,000 tons cane per 24 hours. F. Serna Silva. *Sugar J.*, 1967, **30**, (1), 36–38. Details are given of equipment at Los Mochis sugar factory and refinery, which is the second largest sugar factory in Mexico.

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U.S.A's Audubon factory provides "sugar college" training. M. K. McClelland. *Sugar y Azúcar*, 1967, **62**, (7), 31–34.—A description is given of the equipment and facilities at Audubon sugar factory for the training of chemical engineers and sugar technologists.

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Guatemala's El Salto cane mill and refinery. Anon. *Sugar y Azúcar*, 1967, **62**, (7), 35–36.—Information is given on this sugar factory and refinery which crushes 2500 t.c.d., later to be increased to 3500 t.c.d., and produces about 25% of the country's sugar requirements for home consumption and export.

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The significance of non-centrifugal sugar. H. Niemann. *Zeitsch. Zuckerind.*, 1967, **92**, 361–365.—Data are tabulated showing the production and consumption of non-centrifugal sugar in 23 countries. Panela and sugar analyses are compared and information is given on the panela processes used in Colombia.

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Cane cleaning stations—a promising outlook. J. Suarez G. and R. Henderson. *Cuba Azúcar*, 1966, (May/June), 14–23.—An illustrated description is given of the "centros de acopio" which are machines for dry-cleaning hand-harvested cane. The cane is cut mechanically into billets which are transported by one conveyor to a cross-conveyor delivering to a railcar. As the cane falls from the first conveyor to the second, a blast of air is directed at the cane, blowing off the dirt and trash which is thus not carried to the railcar. As the cane cut manually does not need to be stripped of trash, the cane cleaning stations permit a higher output per man, while the stripping of trash and dirt removal increase the railcar cane carrying capacity. The history of mechanization in Cuba is presented, from the introduction of harvesters in 1962; these were not very successful, but the cane cleaning stations may make their use practical. Cane loaders were introduced in 1963 and 3700 used in 1966, all but 200 being imported from the USSR. Other cut-load harvesters were introduced from the USSR, 570 being used in 1966 to cut and load a million tons of cane.

The performance of sugar factories in 1966. J. Dupont de R. de St. Antoine. *Ann. Rpt. Mauritius Sugar Ind Research Inst.*, 1966, 123–127.—A summary is presented of overall performance and of modifications to equipment and to processing in Mauritius sugar factories. Crushing data, milling results, syrup, massecuite and molasses data and losses and recoveries are tabulated for the years 1962–1966 inclusive. Higher molasses purities and yields in 1966 at certain factories were attributed to drought conditions.

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Industrial application of enzymatic removal of starch from juice. E. C. Vignes and S. Marie-Jeanne. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1966, 127–135.—Results obtained by enzymatic removal of starch from cane juice at four Mauritius sugar factories demonstrate the effectiveness of the method in raising raw sugar filtrability. The data are discussed in detail.

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Curing low-grade massecuite in a BMA "K 1000" continuous centrifugal. E. Piat and M. Abel. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1966, 136–139.—Although a BMA "K 1000" continuous centrifugal at Britannia sugar factory operating at 1750 r.p.m. had a *C*-massecuite throughput of 56 cu.ft./hr compared with 24 cu.ft./hr in a 1500 r.p.m. Broadbent batch machine, the latter centrifugal yielded molasses having a purity 0·7 units lower than that from the BMA machine. The temperature of the mother liquor after the BMA reheater was about 4°C higher than that of the mother liquor heated by the Broadbent reheater.

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Unidentified yeast-like micro-organism causing trouble in a mixed juice tank. C. Ricaud. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1966, 145 + 1 fig.—In a sugar factory using enzymatic juice clarification in conjunction with air flotation, profuse growth of an unidentified micro-organism occurred in the flotation tanks, up to 5 tons of the organism accumulating in one week-end. Development occurred where the juice from the heaters had a temperature of 45–50°C instead of a required 70°C. The micro-organism is fibrous and resembles an accumulation of bagasse particles, although the strands are of closely-growing parallel fungal hyphae.

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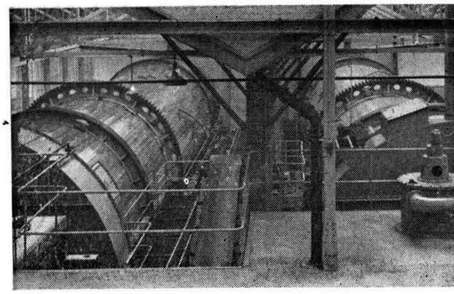
Clarification studies on four sugar cane juices at San Carlos during 1964-65 crop. C. M. Madrazo and V. B. Tonolete. *Sugarland*, 1966, **3**, (11), 20–27. Tests with a "RapiDorr" clarifier showed that under San Carlos conditions juice from POJ 3016 cane variety has better clarification characteristics than juice from three other varieties (H 37–1933, N:Co 310 and Co 440 in order of preference). Results are given in graph form.

Beet sugar manufacture



A new way of improving sugar quality. I. Uscatu. *Ind. Alimentara*, 1966, **17**, 464–467; through *Abs. Rom. Tech. Lit.*, 1967, **3**, Abs. 494.—A scheme is suggested in which sugar from the 1st strike of a 3-boiling scheme is remelted and added to one-third of the thick juice and boiled to produce an "export" grade of sugar. The remaining thick juice is used to produce the first crop sugar for remelting. Advantages of the scheme are mentioned.

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Acceptance of sugar beet by sugar content. P. Staticescu *et al.* *Ind. Alimentara*, 1966, **17**, 566–570; through *Abs. Rom. Tech. Lit.*, 1967, **3**, Abs. 495.—Investigations by the Food Research Institute in Rumania indicated the advantages of beet payment on the basis of sucrose content, but also demonstrated considerable variations in sucrose content with soil and differences in beet growing and handling. Variation was lowest in the period October 15th–30th. Efforts are being made to provide units with the sampling equipment necessary for tarehouse analysis.

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Bulk storage of sugar in silos. S. Gawrych. *Gaz. Cukr.*, 1967, **75**, 129–132.—The effect of moisture on the keeping quality of white sugar stored in bulk is discussed, particularly with reference to the three forms in which moisture occurs in the sugar, i.e. surface moisture, moisture trapped between the crystals, and moisture included in the crystals. Preconditioning of sugar and storage conditions are considered, and silo design and dust explosion risks are briefly mentioned.

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General evaluation of the performance of the first multi-factory undertaking in the (Polish) sugar industry. R. Psikus. *Gaz. Cukr.*, 1967, **75**, 132–135.—Campaign results for 1966/67 obtained within the Malbork factory group are discussed. This group is administered centrally from Malbork sugar factory and also comprises Nowy Staw, Pelplin, Pruszcz, Stare Pole and Ketrzyn sugar factories. It is the prototype of multi-factory groups into which the Polish sugar industry has been reorganized and is shown to have increased sugar yield and reduced sugar losses with increased overall and daily throughput.

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The sugar industry in Chile. B. Szatynski. *Gaz. Cukr.*, 1967, **75**, 140–142.—Information is given on three BMA beet sugar factories and results from the 1964 campaign are tabulated for each factory.

Effect of withering on the quality of stored sugar beet. J. Zahradníček, L. Schmidt and A. Havránek. *Listy Cukr.*, 1967, **83**, 145–148.—Investigations over a 3-year period in which lifted beet were left on the ground before storage in small clamps and then in factory piles, up to a total period of 56 days, showed that there was close relationship between the extent of withering and the fall in the technological value of the beet. Apart from general deterioration, the sugar losses in the withered beet were about double those in fresh beet.

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Progressive coagulation of organic matter in beet juice by means of counter-current feeding of coagulant. J. Vašátko and A. Dandár. *Listy Cukr.*, 1967, **83,** 149–153.—The fundamentals of counter-current liming are explained and equations given for calculation of the progress in alkalinity in a vertical preliming tower in which milk-of-lime is fed at four horizontally spaced ports, corresponding to the four compass points, located just below a horizontally rotating propeller mounted on a central shaft. The juice is fed through four corresponding ports at the bottom of the column and overflows through a discharge port at the top of the column.

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Stabilization of sugar solutions with an anion exchanger on the sulphite cycle. K. Langer, J. Buriánek amd D. Marešová. *Listy Cukr.*, 1967, **83,** 153–158. Tests were conducted on sulphitation of factory thin juice by passing part of it through "Amberlite IRA 401 S" anion exchanger regenerated with sodium sulphite. The method permits the colouring matter to be stabilized without any change in pH or ash content; the maximum amount of sulphite passing into solution is determined by the total anion content in the juice. Decolorized liquors, having a lower anion concentration, should be treated with calcium peroxide after sulphitation and the excess peroxide removed by passing the liquor through the anion exchanger. Polarograms are presented showing the oxygen and sulphite contents in sulphited thin and thick juice.

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The Moroccan sugar industry. Anon. *Zucker*, 1967, **20**, 410–416.—Information is given on the Moroccan sugar industry, with particular mention of the Tadla sugar factory erected by Braunschweigische Maschinenbauanstalt A.G., Buckau R. Wolf A.G. and Lucks & Co. G.m.b.H. Most of the white sugar is sold in the form of 2-kg loaves. The daily slice of the factory is 3600 tons of beet. Future plans for the industry include erection of a number of beet factories, with provision for inter-campaign processing of cane.

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Application of process computers in the sugar industry—tests at Rain/Lech sugar factory in the 1966 campaign. W. Scherer and C. C. Stelzig. *Zucker*, 1967, **20**, 431–436.—Preliminary tests on control of diffusion in a Buckau-Wolf tower at Rain-am-Lech sugar factory with a Siemens 3003 P computer are reported. Results have shown that while it would be practical to apply computer control to diffusion, with the advantage of greater uniformity in the process, many problems have yet to be overcome. The standard mechanical, electrical and control equipment with which the diffuser is provided is considered inadequate. An interlocking system of measurement and control was developed which could be applied to conventional units; this involves the beet slicers, pre-scalder, the tower itself, pulp presses and dryers and, to a certain degree, the boiler house.

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Change in the reaction of a medium caused by electrodialysis with ion exchange membranes. R. Ts. Mishchuk and I. M. Litvak. *Sbornik Pishchev. Prom.*, 1967, (5), 50–52.—While demineralization by electrodialysis has been found generally to cause a drop in pH of the treated solution, in experiments with a multi-cell dialyser the pH of the solution was raised. The cation exchange membranes alternating with the anion exchange membranes were replaced with electrically conducting but cation-impervious plates. Although these plates did not complete a circuit, they prevented passage of the cations while allowing the anions through into the next cell under the action of the electric field.

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Examination of the effect of certain factors on sucrose crystallization rate. A. L. Sokolova. *Sbornik Pishchev. Prom.*, 1967, (5), 72–82.—Data calculated for massecuites of 40% and 50% crystal content showed that the quantity of sucrose in solution adhering to the crystals per unit crystal surface area differed with crystal size and massecuite crystal content. Further studies confirmed the suggestion of Savinov that the sucrose crystallization rate was dependent on the total weight of sucrose in massecuite adhering to crystal unit surface area.

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Investigation of heat exchange with optimum hydrodynamic conditions of operation of evaporator boiling tubes. N. Yu. Tobilevich, I. I. Sagan' and O. A. Tkachenko. *Sbornik Pishchev. Prom.*, 1967, (5), 135–143.—Tests with an experimental vertical single-tube evaporator operated under varying conditions of steam pressure, piezometric level, heat flow and circulation rate in the range 0·1–0·01 m/sec or lower are discussed, the results being expressed in graph form.

Regeneration of MR-500 decolorizing anion exchange resin. G. A. Chikin, L. M. Buravleva, V. I. Tyagunova and V. A. Loseva. *Sakhar. Prom.*, 1967, **41**, (6), 16–19.—Tests showed that a fall in the decolorizing properties of the resin, used to treat 2nd carbonatation juice, to 50% of its initial efficiency could be prevented by regenerating it first with NaOH followed by NaCl. The results of the tests are expressed in graph form covering both decolorizing and colouring matter desorption.

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Effect of saponin on foam formation in beet sugar products. V. A. Nagornaya. *Sakhar. Prom.*, 1967, **41**, (6), 24–26.—While the quantities of colloids, albumins, pectins and saponins in raw juice were 0·529, 0·141, 0·288 and 0·031 g/100 g, respectively, the corresponding quantities in foam which had not dispersed after 19 hr were 1·370, 0·283, 0·520 and 0·180 g/100 g, respectively. The three most active as regards foam formation are: saponins $<$ albumins $\lessdot$ pectins. Tests during two campaigns showed that the saponin content rose considerably with processing of unripe and of deteriorated beet, leading to foaming up to and and including the pan station.

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Structural defects in vacuum filters and reasons for high sugar losses in filter mud. P. S. Maksimuk. *Sakhar. Prom.*, 1967, **41** (6), 27–29.—The design and performance of Soviet B-40 vacuum filters used to treat 1st carbonatation juice are examined, and recommendations given on the basis of the investigations.

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Screw pump for transferring molasses to a tank. I. G. Tsemokh. *Sakhar. Prom.*, 1967, **41**, (6), 42. Details are given of an electrically-driven screw pump which transfers 50–60 tons of molasses per hr to a storage tank.

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VR-20 rotary water separator. Yu. F. Tsyukalo, V. T. Rud' and U. S. Cherkas. *Sakhar. Prom.*, 1967, **41** (6), 43.—The design and performance of a Soviet VR-20 beet water separator are outlined.

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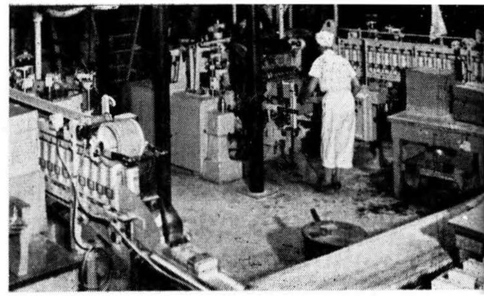
Experiment in forced ventilation and artificial irrigation of (beet) piles. A. I. Prudnikov and N. M. Ignatov. *Sakhar. Prom.*, 1967, **41**, (6), 44–46.—Steel tubes 700 mm in diameter placed above ground level below beet piles were used to supplement underground concrete ventilation ducts. Results showed that the daily sugar losses were lower in the ventilated beet, stored for 145 days, than in unventilated beet, stored for 141 days, while the weight losses and losses through wilting and rotting were also lower. The daily sucrose losses in beet piles, the surfaces of which were sprayed with water from a rotary sprinkler during hot and dry weather, were also lower than in unsprayed piles. The sprayed piles were also sprinkled once every 5–7 days with milk-of-lime.

Sugar refining



Ways of improving the quality of sugar. I. PATRASCU and S. ASLAN. *Ind. Alimentara*, 1966, **17**, 13–17; through *S.I.A.*, 1966, **28**, Abs. 857.—Two different sugar boiling schemes are described with mass balance diagrams. The first, described in more detail, is a 3-massecuite system with melting of *B*-sugar. Elimination of *C*-sugar affination is not recommended. The second, aimed at producing sugar of export quality, is a 2-massecuite scheme with affination, melting and decolorization of the 1st product and boiling of 2 refinery massecuites. The 2nd refined sugar is used for domestic consumption. The fuel consumption in the second scheme is nearly 50% greater than in the first scheme.

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Examination of an experimental counter-flow adsorber for sugar solution decolorization. YA. O. KRAVETS, A. K. KARTASHOV, YU. D. GOLOVNYAK and M. V. OSTAPENKO. *Sakhar. Prom.*, 1967, **41**, (1), 22–26. Decolorization tests with three different types of granular active carbon were conducted on syrup, of approx. 50–60°Bx and colour contents of approx. 18–116°St., passed through a vertical adsorption column at $4{\cdot}17$–$16{\cdot}7 \times 10^{-4}$ m/sec. The temperature in the column, which was designed on the basis of fluidization tests[1], was maintained at 75–80°C, and spent carbon was removed periodically (the small dimensions of the column not permitting continuous discharge). AGS-3 carbon, in 2·7–5·5 mm granules, had a maximum decolorizing efficiency of only 40% at a relatively low flow rate (5–$7{\cdot}5 \times 10^{-4}$ m/sec). While reducing the flow rate would increase the efficiency through increased contact time, it would also entail having an unpractically high column. AG-5 carbon, in 1–1·5 mm granules, had high adsorption properties and at a flow rate of $4{\cdot}17$–$5{\cdot}0 \times 10^{-4}$ m/sec a decolorizing efficiency of 60–70% (occasionally 85–90%) was obtained, depending on initial syrup colour content. However, these flow rates are limiting values for AG-5 carbon and with an upward flowing current of syrup having a kinematic viscosity of $3{\cdot}5$–7×10^{-6} sq.m./sec, as tested; under these conditions some channelling occurs and there is considerable bed expansion. Exceeding the critical fluidization rate for this carbon (6–7×10^{-4} m/sec) disturbs the bed sufficiently to retard the process and to reduce the decolorizing efficiency. Hence AG-5 carbon is recommended only where a high decolorizing efficiency is required at low throughput. The best of the three carbons was AG-3, in 1·5–2·7 mm granules, which had a decolorizing efficiency of 47–55% at an optimum flow rate of $12{\cdot}5 \times 10^{-4}$ m/sec; this flow rate is 150–200% higher than with AGS-3 carbon.

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First silo for refined sugar took two weeks to build. ANON. *S. African Sugar J.*, 1967, **51**, 37.—A description is given of the 15,000-ton refined sugar silo built at the new sugar mill/refinery at Malelane, Transvaal. It is circular, of prestressed concrete, and was built by continuous operation over two weeks using sliding formwork on climbing jacks. The silo tower is provided with a lift, and the outside is covered with insulating plastic foam sheets finished with a coat of synthetic plaster. A complete dust removal plant is included. The sugar is carried in the elevator tower to a conveyor belt feeder at the top of the silo, and is recovered through openings in the floor which feed a conveyor belt system. The silo cost about £250,000.

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Weighing cane raw sugar in automatically-controlled charging and discharging of hoppers. V. I. LITVYAK. *Sakhar. Prom.*, 1967, **41**, (2), 32–33.—Details are given of the operation of two hoppers at Odessa refinery, each of which is filled with 10 tons of raw sugar reclaimed from the warehouse. When the hopper is full, the operator receives a signal, makes a precise weighing, and presses a button to discharge the hopper contents, after which the discharge gate closes automatically and the cycle is repeated.

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(Automatic control) raises output 25–35%. G. SYVERSON, R. TIMMER, J. VAN SCHEPEN and F. GERGEN. *Food Eng.*, 1966, **38**, (8), 68–70; through *S.I.A.*, 1966, **28**, Abs. 1068.—Automatic control of filter press cycles in two installations at an American sugar refinery is briefly described. Each stage of regeneration lasts for a pre-set time. One installation is for filtering clarified liquor and the other for filtering the clarification scums.

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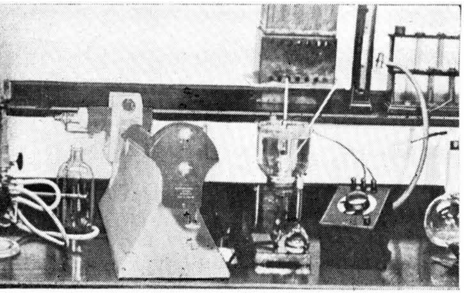
The Luisita sugar refinery. ANON. *Sugar News*, 1966, **42**, 734.—A brief account is given of the Luisita refinery at San Miguel, Tarlac, Philippines, which uses a phosphoric acid-lime process for clarification in conjunction with colour removal with Norit granular active carbon. Capacity is 750 tons of raw sugar per day, and the refinery represents an investment of 35 million pesos.

[1] *I.S.J.*, 1966, **68**, 211.



Laboratory methods & Chemical reports

Some tests to compare the quality of defoliated, scalped or topped beets. J. Henry, R. Vandewyer and R. Pieck. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967.—Experiments showed that scalped beets (partially topped) contained 1·02 and defoliated beets 1·07 times the non-sugar content (% on sugar) in normally topped beets. Since the difference between the beet price and the income from sugar (both white and molasses) in the case of scalped beets was only slightly lower than in the case of topped beets, scalped beets are considered a passable alternative to topped beets in Belgium, where there have been increasing difficulties in obtaining well-topped beets. In studies of the effect of root size on beet quality, retention of the crowns was found to have greatest effect with small beets and least effect with large beets.

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The effects of molecular sizes of colorants in cane raw sugars and refinery liquors on their behaviour in sugar refining processes. T. Yamane, K. Suzuki and Y. Takamizawa. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967.—Colouring matter isolated from affined sugar and refinery liquors by ion exchange was fractionated by gel filtration on "Sephadex" columns. No significant differences were found between the high molecular and low molecular fractions as regards empirical formulae, infra-red absorption spectra and U.V. absorption curves. The higher molecular colouring matter occurred abundantly in affined sugars, while the lower molecular fractions were plentiful in refinery liquors at later purification stages.

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The viscosity of highly concentrated sugar syrups. F. Schneider, A. Emmerich and D. Finke. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967.—The rheological behaviour of samples of beet and cane molasses and syrups having a high pectin content was studied at 20–50°C using a Hakke "Rotovisko" rotary viscometer, the values obtained being used to construct flow curves by the least squares method. All the beet molasses and some of the cane molasses exhibited Newtonian behaviour. One of the cane molasses samples showed structural viscosity at all temperatures, while another exhibited it only at higher temperatures. This type of viscosity is very probably caused by gas bubbles occurring as a result of the Maillard reaction n the molasses. Therefore crystal- and gas-free molasses are generally to be considered as Newtonian fluids. Two of the beet syrups also exhibited structural viscosity, although the deviation from Newtonian behaviour was only slight.

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Isolation of colouring matter fractions from beet molasses. F. Schneider, E. Reinefeld, D. Schliephake, M. Siadat, J. Müller and K. Westphal. *Paper presented to the* 13*th Congr. C.I.T.S.*, 1967.—A 30°Bx molasses solution treated with decolorizing resin in Cl^- form yielded a colouring matter solution which was electrodialysed and the dialysate subjected to gel filtration on "Sephadex G-50" to give two fractions of 6,000 and 13,000 mean particle weight, respectively. Precipitation with acid before gel filtration considerably reduced the higher molecular fraction, and this was used as a means of separation to yield a fraction of 16,000 mean particle weight. The higher M.W. fraction was richer in carbon. Acid hydrolysis showed differences in the amino acid constituents. Fractionation of beet molasses direct on "Sephadex G-10" yielded three colouring matter fractions, with particle weights probably below 700. A strongly coloured high molecular fourth fraction was eluted together with polysaccharides. This fraction was separated on "Sephadex G-75" into a polysaccharide fraction (56%) and a colouring matter fraction (44%). Colouring matter from thick juice was also separated into four fractions on "Sephadex G-10". This technique enables sucrose to be separated from the basic colouring matter constituents. The portions of the total extinction corresponding to the colour fractions indicate that larger molecules are present at an early stage in sugar production. In thick juice the higher molecular fraction is responsible for the greatest part of the total extinction.

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Constituents of cane molasses. I. Separation and identification of the nucleic acid derivatives. T. Hashizume, S. Higa, Y. Sasaki, H. Yamazaki, H. Iwamura *et al. Agric. Biol. Chem.*, 1966, **30**, 319–329; through *S.I.A.*, 1967, **29**, Abs. 133. —Ion exchange and gas-liquid chromatography showed the presence of cytidine, uridine, adenosine, adenine, inosine, guanosine, guanine, 5′-inosinic acid (5′-IMP), 5′-guanylic acid (5′-GMP), 5′-adenylic acid (5′-AMP), cytosine, hypoxanthine, xanthine and thymine. The composition and amino acid analysis of an Okinawa final cane molasses are tabulated. The total amino acid content was 1·2%, corresponding to 0·14% of N (on 81°Bx molasses). The nucleotide contents of

Okinawa, Taiwan, Hawaii, and Louisiana molasses were as follows (ranges only): 5'-IMP, 42–102 p.p.m.; 5'-GMP, 46–128 p.p.m.; 5'-AMP, 0–10 p.p.m. Most of the molasses N compounds (total N = 0·9%) remain unidentified.

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Effect of glycerol on the rate of movement of simple sugars on silica gel and cellulose thin layers. E. J. SHELLARD and G. H. JOLLIFFE. *J. Chromatog.*, 1966, **24,** 76–83; through *S.I.A.*, 1967, **29,** Abs. 189.—The presence of 10–50% of glycerol in 1% aqueous solutions of 14 mono-, di-, or trisaccharides seriously affected the rate of movement and the shape of many of the sugar spots. Sucrose was retarded in the presence of 40 or 50% glycerol on buffered silica gel (solvent—3:1:1 methyl ethyl ketone:glacial acetic acid:methanol), and in the presence of 30–50% glycerol on cellulose (solvent—60:25:20 ethyl acetate: pyridine:water). For sugar spots moving more slowly than glycerol, their sides tended to move faster than their centres, particularly on cellulose. It is recommended that when glycerol is present (as when it is used to preserve sugars in biological fluids), the solution be diluted to contain only 10 or 20% glycerol, and chromatographed on silica gel.

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Non-aqueous sugar solvents: a new series. C. J. MOYE and B. M. SMYTHE. *Carbohydrate Res.*, 1965, **1,** 284–289; through *S.I.A.*, 1967, **29,** Abs. 205. The ω-methoxy derivatives of ethanol (i.e. methyl Cellosolve), propanol and butanol are better solvents for sugars than are the related simple alcohols or ethers. Liquids containing a cyclic or acyclic ether grouping in the β-position to an alcohol OH group are generally good sugar solvents. It is suggested that they readily form hydrogen bonds with the sugar OH groups. Sucrose solubilities were determined at 80–140°C in a range of solvents: the solubilities in methyl Cellosolve and tetrahydrofurfuryl alcohol increased from ~1–2% at 80°C to ~10–20% at 140°C. Mixed methyleneglycerols (in which the methylene group bridges any 2 OH groups) were the best solvents studied (4% at 80°C) but decomposed above 100°C.

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The effect of basic lead acetate in clarification of extraction juice analysis samples. W. RATHJE. *Zeitsch. Zuckerind.*, 1967, **92,** 298–300.—Tests in which basic lead acetate or nitrate was added to various amino and other organic acids are discussed. The pH was adjusted by adding NaOH and the results were expressed in terms of the amount of acid co-precipitating with the lead oxide formed. It was found that while the oxide adsorbed some of the di- and higher basic acids studied, it did not adsorb all of the monobasic acids. Optimum adsorption occurred at pH 6·7, and the amount of acid adsorbed depended on the original concentration. The lead oxide, charged with lead ions, can be regarded as an anion exchanger with respect to divalent and multivalent anions.

Flame photometric determination of K, Na and Ca in impure sucrose solutions. J. DRAGO, A. AWAD and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1967, **92,** 301–303.—An acetylene-air flame was used to determine potassium at 768 nm, sodium at 589 nm and calcium at 620 nm in standard solutions and in molasses solution untreated or treated with cation exchange resin in H^+ form. Na and Ca affected the determination of K, and K affected the Na reading, while K and Na affected the Ca determination. The corrections to be applied at different concentrations are tabulated for each of the three components. Because of considerable dilution of the molasses, saccharides, other non-ionic matter and anions had negligible effect on the determinations. Only in the case of the Ca standard solution was sucrose added in an equivalent quantity to that in the molasses samples.

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Comparative colour contents in sugar factory products. P. DEVILLERS, M. LOILIER and J. C. CHARTIER. *Sucr. Franç.*, 1967, **108,** 155–157.—The colour contents of 2nd carbonatation juice, syrup and molasses were measured at a number of French sugar factories in 1965/66 and 1966/67. The data are tabulated for comparison between factories and between campaigns and show the effects of process variables (sulphitation, high boiling temperatures, etc.) and of the variation in beet quality and process improvements from year to year. Reasons are given for the differences between factories where there is only slight increase in the colour content from syrup to molasses and where the increase is considerable.

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The relationship between first expressed, primary and absolute juice. J. P. GALEA. *Rev. Agric. Sucr.* (Mauritius), 1967, **46,** 88–94.—The relationships between (i) first expressed juice and absolute juice, and (ii) primary juice and absolute juice, as regards Brix, pol and purity, are expressed in terms of equations derived for each of a number of Mauritius sugar factories. Relationship (i) is also expressed in graph form, straight lines being found for each of the three factors by the least squares method. While in some cases the ratio between average factory 1st expressed or primary juice and average factory absolute juice has been found to give results not markedly different from those given by the equations, in other cases use of the ratio introduces quite a considerable error in the sucrose % absolute juice value.

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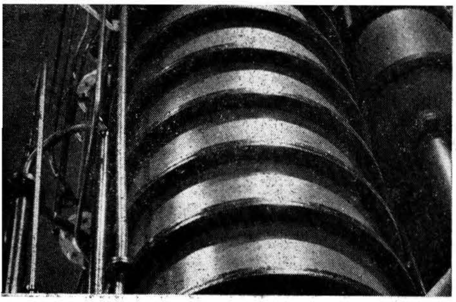
Purity—indicator of the technological quality of sugar beet. L. SCHMIDT and M. LOŠANOVÁ. *Listy Cukr.*, 1967, **83,** 125–127.—Results of tests on beet samples representing 19 different varieties have indicated the importance of purity as an indicator of processing quality. It is recommended to express purity as

$$\frac{\text{sugar content}}{\text{dry solids} - \text{marc}} \times 100.$$



By-products

Cattle feed from bagasse and uncrystallizable molasses. Anon. *Bol. Azuc. Mex.*, 1967, (211), 35–36.—Plant has been installed at El Mante sugar factory in Mexico for the production of 110-kg bales of surplus bagasse, 15,530 tons of which were sold in 1965/66 to a cellulose factory. A liquid feed "Nutromante Liquido B" is made from final molasses, urea and phosphoric acid, while a solid feed "Nutromante M.B.80–20" contains 80% of molasses and 20% dried bagacillo. The latter is packed in 40-kg paper sacks and is produced at the rate of 24 tons/day, while 17 tons/day of the former is produced and sold in 200-litre drums or supplied through pipelines or by tank cars.

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Media for industrial fermentations. C. T. Calam. *Process Biochemistry*, 1967, **2**, (6), 19–22, 46.—While large-scale fermentations originally used media consisting of solutions of natural materials, e.g. wort used in brewing, the development of new fermentation processes necessitates optimizing the yield by selecting different media. The constitution of media based on carbohydrates or on proteinaceous sources is considered, including a sucrose-containing medium for citric acid production[1] and a medium containing beet molasses for baker's yeast production[2]. The fermentation times and yields are given. The main factors to be considered in developing a new medium are discussed under the following headings: aeration and agitation, organism requirements, biosynthesis, fermentation dynamics, economics and application and statistics. The economics involved in scaling-up from pilot-plant production to full-scale production are also considered.

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Diffusion of citric acid in molasses solution—possibilities of technical application in surface fermentation processes. K. G. Wendel. *Zucker*, 1967, **20**, 238–246. Conductivity measurements showed that after its formation or escape from the mycelium, citric acid diffuses only very slowly in the molasses solution. This reduced diffusion velocity causes stratification of the acid, which has a decisive effect on the metabolism, whereas the toxicity of the acid and the resultant restriction of activity were insignificant in practice. Results given in graph form have been used to study the possibility of improving the relationship between diffusion rate and rate of metabolism. Test data and a new continuous surface process, not yet realized in practice, are discussed.

A profitable and hygienic method of disposal of distillery spent wash. P. N. Soman. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 158–165.—For 1 part of alcohol 17 parts of spent wash are produced. Its disposal is often a problem. It is dilute, acidic and has an offensive smell on standing. Nevertheless, it contains valuable plant food, notably N,P,K and trace elements. The method described consists basically in drying the spent wash in the hot, dry season on dried filter mud, bagasse and boiler ash. Average composition of the manure is 94% N, 1% P_2O_5 and 2·5% K_2O. In the wet season the spent wash has to be disposed of on fallow fields.

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Some derivatives of sucrose. III. Technical properties of sucrose-N-*n*-alkyl urethanes. W. Gerhardt. *Tenside*, 1966, **3**, 141–144; through *S.I.A.*, 1967, **29**, Abs. 158.—The surface-active properties of long-chain (C_8–C_{16}) sucrose-N-*n*-alkyl urethanes were investigated; results are tabulated. 0·01–1% solutions had low surface tensions. The compounds had good colloid stabilizing and soil suspending properties. Foaming power was low. Detergent power was greater at 60–80°C than at lower temperatures; it was hardly affected by water hardness. The C_{12} and C_{14} derivatives showed the optimum properties. In tests in an automatic washing machine, the detergent power of the unbuilt compounds was poor; addition of alkaline builders markedly improved it, and the detergent power of built sucrose-N-*n*-tetradecyl urethane was similar to that of commercial heavy-duty detergents.

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Studies on the decomposition of raffinose in beet molasses by α-galactosidase. H. Suzuki, Y. Ozawa and O. Tanabe. *Hakko Kyokaishi*, 1964, **22**, 445–459; through *S.I.A.*, 1967, **29**, Abs. 479.—A study was made of the decomposition of raffinose in Steffen molasses into galactose and sucrose by *Streptomyces olivaceus*, which produced α-galactosidase and did not invert sucrose. *Streptomyces* was incubated in diluted molasses solution (5%). Additions of wheat bran, rice bran or fish meal were required; addition of corn steep liquor was unsuitable. Wheat bran (0·8% on molasses) was added to the molasses solution. *Streptomyces* was inoculated and incubated for 72 hr. 80% of the raffinose was decomposed, and an increase in sucrose content was observed. Addition of only 0·2% of wheat bran on molasses was sufficient.

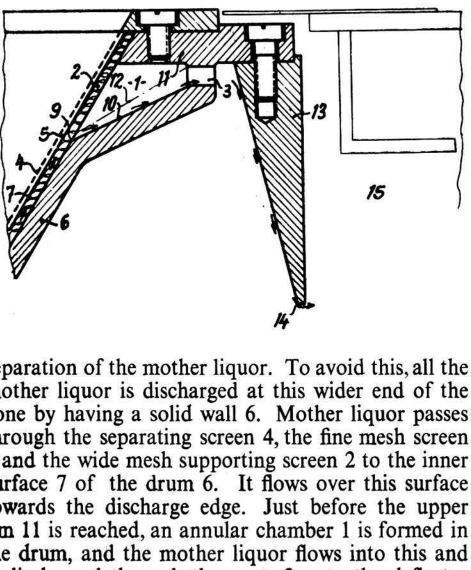
[1] Shu & Johnson: *Ind. Eng. Chem.*, 1948, **40**, 1202.
[2] Pyke: "Chemistry and biology of yeasts" (Academic Press, New York), 1958.

Patents

UNITED KINGDOM

Continuous centrifugal. MASCHINENFABRIK BUCKAU R. WOLF AG, of Grevenbroich, Germany. **1,075,003.** 3rd February 1965; 12th July 1967.

A certain amount of sugar separated by a continuous centrifugal is broken up by rubbing into a dry powder which passes through the separating screen and may collect in the liquid side at the widest part of the cone and block the discharge, causing inefficient



separation of the mother liquor. To avoid this, all the mother liquor is discharged at this wider end of the cone by having a solid wall 6. Mother liquor passes through the separating screen 4, the fine mesh screen 5 and the wide mesh supporting screen 2 to the inner surface 7 of the drum 6. It flows over this surface towards the discharge edge. Just before the upper rim 11 is reached, an annular chamber 1 is formed in the drum, and the mother liquor flows into this and is discharged through the ports 3 onto the deflector ring 13 and over its edge into the chamber 15. Any sugar powder is carried with the mother liquor and the flow is sufficiently great to prevent any accumulation.

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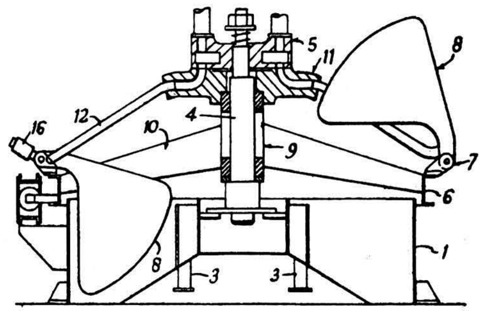
Filters. G. GAUDFRIN, of Paris 16e, France. **1,075,785.** 14th July 1964; 12th July 1967.

The filter comprises a tank 1 divided into separate cells by means of vertical radial partitions, each cell having an overflow 3 to maintain a constant level. A central vertical shaft 4 serves as a pivot for a rotary unit which carries a distribution head 5 ground to a collector ring 11 which is connected to each of the filter elements by flexible pipes 12. The elements consist of plates 8 which pivot about axes supported in bearings 7 mounted on the supporting ring which is held by arms 9 carried on the shaft 4.



The plates 8 can thus be in the lower position (shown left) where they are immersed in the liquor to be filtered, or raised (shown right) so that they are out of the way during rotation of the shaft 4. This raising and lowering is obtained by means of a pneumatic or hydraulic cylinder acting on each plate and is interlocked with the rotation mechanism so that rotation can only take place with the plates raised, and the raising and lowering can only take place when the shaft 4 is stationary.

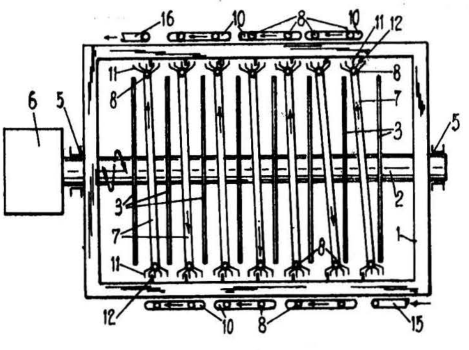
The various cells are used for the different stages of the filtration—precoating, filtering, etc.—and the last is for discharge of the cake. If the filtration is carried out under vacuum, the latter is produced inside the plates by way of head 5; if pressure filtration is used, the entire apparatus is located within an airtight housing.

* * *

Crystallizer. WERKSPOOR NV, of Utrecht, Holland. **1,075,919.** 24th May 1966; 19th July 1967.

The crystallizer comprises a trough 1 having a semi-cylindrical lower half. A shaft 2 runs longitudinally through the trough, journalled in suitable bearings 5 and provided with seals to prevent leakage. The shaft carries a series of plates 3 which may be triangular, with 180° rotary displacement from adjacent plates, and of such a size that the edges pass close to the semicircular bottom of the trough as the shaft rotates under the action of drive 6.

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).



Between each plate is a stationary cooling element in the form of a flat-sided box 7 with tubular ends 8 which are curved so that they hook over the sides of the trough. The ends of the hooked tubes 8 are connected by flexible hoses 10, the end hoses 15 and 16 being connected to a source of cooling water and an outlet point, respectively, so that cooling water travels from one end of the crystallizer to the other through each cooling element in turn. The elements are located at an angle to the plates 3, the angle being adjustable by selecting which spaces between teeth 11 at the ends of the elements are to be engaged with ribs 12 on the inside of the trough.

Massecuite entering the trough at the drive end is carried along by rotation of plates 3 and is brought into close contact with the cooling elements so that its temperature is reduced during its passage along the trough to the discharge end where it leaves through a port which is not shown.

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Beet harvester. T. CAMPBELL, of Blyth, Northumberland, England. **1,076,461.** 31st March 1965; 19th July 1967.

* * *

Preparation of pressed sugar tablets. AMERICAN SUGAR COMPANY, of Wilmington, Del., USA. **1,078,780.** 13th April 1966; 9th August 1967.—Moist pressed sugar tablets are prepared having a water content of 1·6–2·8% and are brought rapidly to 200–230°F by means of infra-red radiant energy under such conditions of energy intensity and time (1–2 min) that no significant caramelization occurs. Immediately thereafter the temperature of the hot tablets is reduced to 150–180°F by controlling the rate of decrease of the infra-red radiant energy. The time of residence of the hot tablet (1–4 min) is sufficient to reduce the water content to less than 1%, when the tablets are cooled [by means of forced cool dry gas (air) (at 40–90°F)] to below 130°F (90–110°F) at such a rate that hard tablets are produced. The total heating and cooling time is between 5 and 10 minutes.

Cane harvesters. MASSEY-FERGUSON (AUSTRALIA) LTD., of Sunshine, Victoria, Australia. **1,079,562—4.** 5th October 1964; 16th August 1967.

* * *

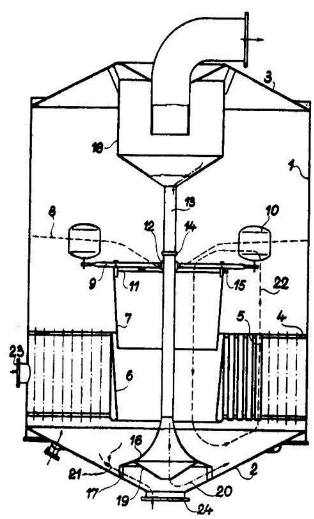
Distillery waste treatment to produce animal fodder. LESAFFRE & CIE., of Marcq-en-Baroeul (Nord), France. **1,081,718.** 22nd October 1964; 31st August 1967. Nitrogen constituents for fodder and potassium-containing substances which can be used as fertilizers are separated from distillery waste by substitution of K^+ ions by NH_4^+ ions using a cation exchanger (in the form of a cation selective membrane formed by cation exchange and anion exchange resin sheets) which is regenerated by a solution of ammonium phosphate. The treated waste gives a protein concentrate containing 5–6% of organic N and all the original glutamic acid, while the regeneration liquor contains 4–8% of ammoniacal N, 10–20% P_2O_5 and 10–20% of K_2O.

* * *

Separation of fructose and glucose. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, NSW, Australia. **1,083,500.** 28th December 1964; 13th September 1967. Predetermined volumes of a syrup containing glucose and fructose (an invert syrup) and water are sequentially admitted to a column charged with a water-immersed bed of an alkaline earth metal (calcium) salt of a cross-linked nuclearly sulphonated polystyrene cation exchange resin [crosslinked with (2–8%, 4%) divinyl-benzene] [having particle sizes in the range 20–100 (35–70) US standard sieve mesh]. The effluent is separated into fractions: (i) sweet water I consisting of dilute glucose-rich solution, (ii) concentrated glucose-rich solution, (iii) recycle I consisting of concentrated glucose-rich solution highly contaminated with fructose, (iv) recycle II consisting of concentrated fructose solution highly contaminated with glucose, (v) concentrated fructose-rich solution and (vi) dilute fructose-rich solution [and (vii) a very dilute fructose-rich sweet water]. To the column are then sequentially admitted: recycle I, a predetermined volume of fresh syrup, recycle II, [fraction (vi)], and a predetermined volume of water. The steps from separation of the original effluent are then repeated in a cyclic manner. The predetermined volumes are obtained by experiment; greater volumes of syrup will give reduced efficiency of separation and *vice-versa*, so that the volumes must be adjusted to give the required product purities. The apparatus for the process includes appropriate storage tanks, pumps, etc., and heating means are fitted to the tanks and insulation to the column to minimize heat losses and maintain an elevated temperature (e.g. at which the syrup viscosity is such as to permit adequate flow rates of the syrups). The glucose-rich and fructose-rich fraction (ii) and (v) are concentrated by evaporation and seeded with crystals to yield crystallized products.

Vacuum pan. LÁNG GÉPGYAR, of Budapest XIII, Hungary. **1,083,579.** 7th July 1966; 13th September 1967.

The pan 1 is provided with a calandria having a centre downtake 6. A movable downtake 7 is arranged within the fixed downtake 6 and rises and falls with the level of the massecuite, being supported on arms



9 from 3–6 adjustable closed floats 10 which hold the upper level 11 of the moveable downtake 7 at a fixed distance below the level 8 of the massecuite. The inner ends of the arms 9 are connected to a guide bush 12 which moves up and down the centre drain pipe 13, and movement of the downtake 7 is held between upper and lower limits by a stop ring 14 on pipe 13 and a baffle plate 15 on the upper end of downtake 7.

A deflector 16 at the bottom centre of the pan aids the streamline flow of the massecuite in the direction indicated by line 22. Entrainment collected from the vapour by separator 18 drains inside pipe 13 and returns to the massecuite from under the deflector, following line 20. When the boiling is finished the pan contents are emptied through the bottom port 24 in the direction of lines 21.

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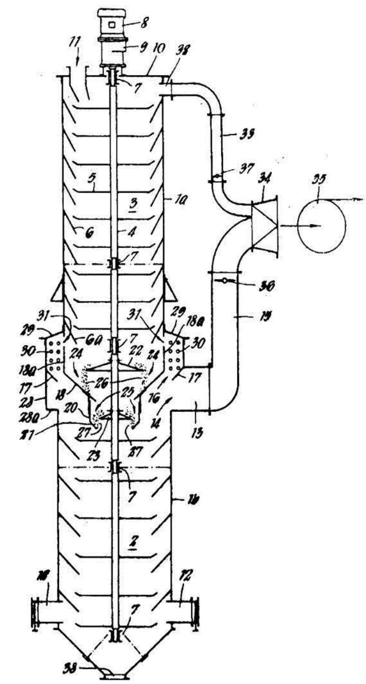
Sugar dryer and cooler. MASCHINENFABRIK BUCKAU R. WOLF AG, of Grevenbroich, Germany. **1,084,728.** 25th November 1964; 27th September 1967.

The dryer-cooler is in the form of a cylinder in two parts 1a, 1b, in which are the drying and cooling zones 3, 2, respectively. Down the centre of the cylinder passes a shaft 4 driven by motor 8 through gearbox 9 and provided with bearings 7 at intervals. Sugar admitted through inlet 11 falls onto the top plate 5 which is mounted on the rotating shaft 4 and is thrown over the edge by centrifugal force, to strike the top stationary conical baffle 6, mounted on the inside of the cylinder, which guides the sugar onto the second plate 5. In this way the sugar passes



downwards through the drying zone until it is directed onto the plate 22 from which it falls in a stream 24 onto cone 18 and so on to plate 23. This directs it through the annular gap 27 onto the first of the plates 5 in the cooling zone. From this it progresses through the cooling zone 2 until it reaches the bottom when it is discharged through outlet 38.

Cooling air is admitted through ports 12 at the bottom of zone 2 and is drawn upwards in counter-current to the falling sugar until it reaches the annular chamber 28 at the junction between the two zones. Here part of the air stream 14 enters the pipe 13 and passes by pipe 15 to a branched exhaust pipe 34, the flow being governed by flap 36. The exhaust fan 35 then directs the air to a dust separation unit. Part of the air from the cooling zone passes in the direction 16 and is heated by elements 30, e.g. in the form of steam pipes, and enters the drying zone through the annular duct 31, rising in counter current to the falling sugar and being eventually withdrawn through port 32 and pipe 33 to branched exhaust pipe 34, the flow being governed by flap 37.

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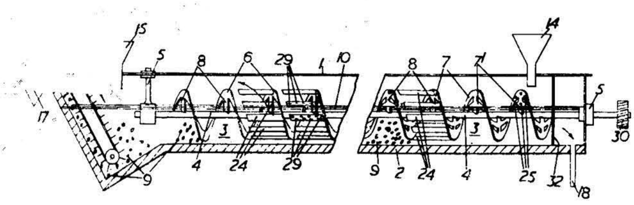
Extraction apparatus (beet diffuser). INDUSTRIE-WERKE KARLSRUHE AG, of 75 Karlsruhe, Germany. **1,084,828.** 3rd March 1966; 27th September 1967.

The diffuser includes a trough 2 in which rotates a shaft 4 driven through gear wheel 30 and carrying



a worm 3 either in the form of a single blade 6 directly mounted on the shaft or connected to it by webs 8, or in the form of inner and outer blades 7′, 7. The shaft is supported in bearings 5 and conveys solid materials, including beet slices, along from their feed inlet 14 to the discharge elevator 16 against a counter flow of extraction fluid admitted through pipe 15 and maintained at a constant level 10 within the trough. The extraction liquid passes through the filter plate 32 at the end of the trough and leaves the latter through port 18. Movement of the slices is aided by scoops 24 mounted on the outside blade 7 of the worm, which are provided with perforations 29.

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Beet thinner. LA RECTIFICATION NAMUROISE, of Jambes-Namur, Belgium. **1,085,669.** 28th August 1964; 4th October 1967.

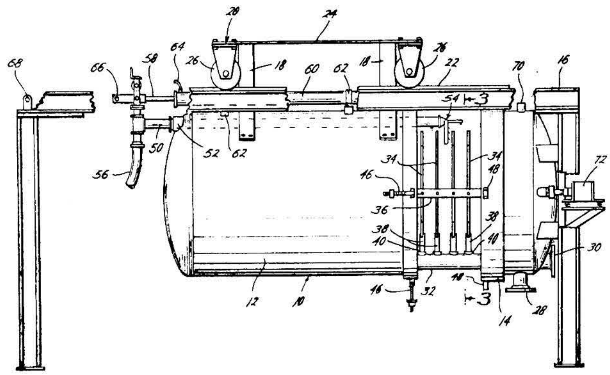
* * *

Production of pure glucose and fructose. C. F. BOEHRINGER & SOEHNE GMBH, of Mannheim-Waldhoff, Germany. **1,085,696.** 2nd August 1966; 4th October 1967.—An aqueous solution (up to 60°Bx) of sucrose or sucrose-containing invert sugar (at 50–70°C) is passed [at 0·5–3 (1–2) ml/sq.cm./min] over a (cross-linked sulphonated polystyrene) cation exchanger which has been charged at room temperature as fully as possible with Ca^{++} ions [by the use of a Ca salt ($CaCl_2$) solution at pH < 8] but which still contains 1–30% free acid groups. The sucrose is fully inverted by this procedure, while the glucose and fructose are substantially separated from each other in the emerging fractions.

* * *

Filter. SPARKLER MANUFACTURING COMPANY, of Conroe, Texas, USA. **1,086,746.** 24th November 1964; 11th October 1967.

The filter comprises a movable tank 12 supported on a trolley 18 fitted with wheels 26 which run along the bearing surfaces 22 of a housing 16. At one end of the housing is located the stationary end 14 of the filter against which the movable tank abuts. Also stationary and attached to the end 14 is a series of filter leaves 34 which are provided with connexions 38 which deliver filtrate from their interiors to a collector pipe 32 which extends through the end 14 to a port 30. Material to be filtered enters the closed tank through port 28 in the end and filtration is carried out in the usual way with the building of a cake of insoluble matter on the surface of the leaves. This cake is removed by washing with a spray header 54 on the end of a conduit 50 which is fitted with a packing gland 52 where it enters through the end of the movable tank. The conduit is supplied with water under pressure through hose 56 which also supplies a hydraulic ram 58, so that as water is fed to the header it is simultaneously withdrawn along the closed tank, washing each leaf in turn.



At the end of its stroke, the hole 66 on the end of the ram can be engaged with a hole 68 on the housing by means of a pin when, by actuation of the ram in the other direction, the tank 12 is withdrawn from the end 14 after unlatching bolts 46 from lugs 48. Reversing the procedure, by operating the ram in the original direction, the tank is returned over the leaves and after locking the bolts 46 on lugs 48 and disconnecting the pin in holes 66, 68, the reversal of the ram causes it and the header to move towards the end 14 again. A vent 70 is provided in this end to prevent fluid locks in the vessel, and a vibrator 72 to help removal of the cake from the leaves. This discharged cake is either removed through port 28 or by opening of the tank, as described.

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Beet topper. S. A. SOCIETER, of Orp-le-Grand, Belgium. **1,087,358.** 5th November 1964; 18th October 1967.

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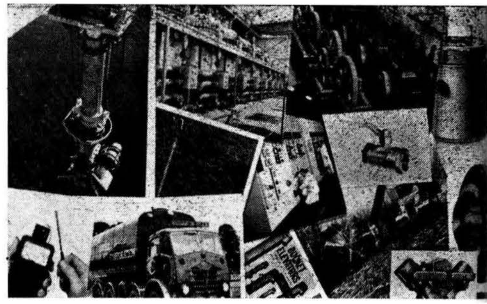
Beet harvester. M. W. VERPLANKE, of Ijzendijke, Holland. **3,087,998.** 9th September 1966; 18th October 1967.

Trade notices



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

Metering pump. Metering Pumps Ltd., 49–51 Uxbridge Rd., Ealing, London W.5, England.

The "Q" type variable-stroke "Metripump" is now available as a multiple-ganged assembly; up to six pumps, each having two pumpheads and, if necessary, different stroking rates, can be ganged and powered from a single motor, thus providing a unit of up to 12 heads with individual outputs per head from 0·1 to 200 gal/hr. Precise metering is ensured at pressures up to 20,000 p.s.i. The length of stroke and hence the output of each pump can be automatically controlled with provision for manual override for stroke adjustment in case of breakdown in the automatic systems. A digital indicator on each pump shows the stroke setting as a percentage of the total stroke length. The assembly can be powered from an external drive attachment. The pumpheads can be made from various materials according to requirements, enabling the pumps to handle any kind of free-flowing liquid including viscous fluids and slurries.

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"Gloquat C" bactericide. Glovers (Chemicals) Ltd., Wortley Low Mills, Whitehall Rd., Leeds 12, Yorks., England.

"Gloquat C" is a 50% active alkylaryl trimethyl ammonium chloride solution in 47% water and 3% *iso*-propyl alcohol and is applicable as a bactericide in a varied number of liquid and powdered formulations, being readily diluted with water and miscible with methanol, ethanol, *iso*-propanol, triethylene glycol and other water-soluble solvents. It can be blended with non-ionic, ampholytic and certain specialized anionic surface-active agents to improve the properties for special applications, advice being freely obtainable from the manufacturers. The bactericidal properties of "Gloquat C" are at least comparable to those of pharmaceutical grades of quaternary ammonium compounds and even surpass them in some cases.

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New recording spectrophotometer. Perkin-Elmer Ltd., Beaconsfield, Bucks., England.

Details are announced of the Model 402 U-V recording spectrophotometer which covers the spectral range 190–850 nm and uses the patented "Flowchart" recording system, in which individual charts are preprinted on a continuous roll of paper which is precisely synchronized with the monochromator of the instrument. The Model 402 is a double-beam, optical null instrument incorporating adjustable wavelength limit stops to allow specific wavelength intervals to be scanned, three scan times of 2, 10 and 40 min being provided. The ordinate scale is linear in absorbance from 0 to 1·5 A and a five-fold ordinate expansion system is provided to expand any 0·3 absorbance units over the full scale.

* * *

CROFTS RADIATION GEARED MOTORS. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire, England.

Publication No. 658 gives specifications, rating tables, dimensions, etc. of the twelve sizes of "Radiation" combined spur and worm double-reduction geared motors which cover powers up to 50 h.p. and ratios from 300 to 30:1.

* * *

CANE SUGAR MACHINERY & EQUIPMENT. Mitsubishi Heavy Industries Ltd., 10 Marunouchi 2-chome, Chiyoda-ku, Tokyo, Japan.

A 35-page brochure gives information on the cane sugar equipment offered by Mitsubishi Heavy Industries Ltd., which ranges from cane field transport, unloading, reception and preparation, through milling and diffusion (the Silver ring system), to sugar drying and steam and power generation, etc. A list is given of the 32 cane sugar factories, 17 beet sugar factories and 15 refineries built by Mitsubishi.

* * *

Stork-Werkspoor equipment for Ethiopia.—Stork Werkspoor Sugar NV have received an order for equipment to be installed in the new HVA cane sugar factory at Metahara, in Ethiopia. The equipment includes a complete cane unloading installation, cane carriers, cane cutters, and a tandem of three 84 × 36 in 3-roller mills, to be used in conjunction with a De Smet cane diffuser. Nine juice heaters and a quintuple-effect evaporator are also included in the order.

* * *

Broadbent centrifugals.—Thomas Broadbent & Sons Ltd. have recently received orders worth more than £350,000 for automatic centrifugals and ancillary equipment to be delivered to Belgium, Portugal, Ethiopia, South Africa, Colombia and Thailand.

* * *

UCMAS beet sugar factory[1].—UCMAS (Union des Constructeurs Belges de Matériel de Sucreries) have received an order from Morocco for the supply of a turnkey beet sugar factory of 3600 tons/day capacity. The factory, costing 900 million Belgian francs, is to be erected at Beni-Mellal (Tadla), and should start operations in mid-May 1969. The raw sugar, to be produced at the rate of 50,000 tons annually, will be refined in Casablanca.

[1] *Zeitsch. Zuckerind.*, 1968, **93**, 131.

US Sugar Imports[1]

	1967	1966
	short tons, raw value	
Hawaii	1,249,534	1,201,998
Puerto Rico	705,461	711,658
Virgin Islands	—	5,405
Philippines	1,112,212	1,189,667
Argentina	65,759	58,641
Australia	195,460	184,150
Belgium	2,959	—
Bolivia	6,220	4,681
Brazil	669,739	546,548
British Honduras	14,038	12,761
Colombia	114,280	103,085
Costa Rica	63,190	71,387
Czechoslovakia	1,186	—
Dominican Republic	674,387	607,725
Ecuador	75,888	69,411
Fiji	42,849	39,586
French West Indies	58,193	57,582
Guatemala	62,455	59,699
Haiti	28,530	26,415
Honduras	10,949	—
India	75,817	73,087
Ireland	5,361	5,361
Malagasy	8,395	8,780
Mauritius	18,626	16,718
Mexico	543,494	504,689
Nicaragua	52,242	19,457
Panama	33,068	12,900
Peru	408,786	395,141
Poland	6,472	5,803
Salvador	36,923	46,414
South Africa	85,569	65,343
Swaziland	7,170	6,990
Taiwan	80,052	77,720
Thailand	16,347	17,945
UK	10	4,381
Venezuela	29,973	24,808
West Indies	185,936	177,698
Other countries	56	63
Total	6,757,586	6,413,697

Cane fertilizer application.—An Australian cane grower is applying nitrogenous fertilizer by releasing it into his irrigation spray line from a 44-gal drum equipped with a system of hoses and control valves. Enough fertilizer is dissolved in the drum to satisfy the requirements of the cane plants in one setting of the spray line, and flows through a hose connecting the base of the drum with the suction pipe of a centrifugal pump which mixes it with incoming irrigation water. Another hose connects the outlet pipe of the pump to the drum and flow through it is controlled by a ball valve floating on the top of the drum, so that as the level of dissolved fertilizer in the drum falls, the valve opens and water is pumped back into the drum through the return hose. This continuous circulation ensures that the fertilizer is fed through the irrigation system over a reasonably long period to give uniform distribution over the whole crop.

* * *

Iran cane sugar expansion.—Hawaiian Agronomics Company (International), a subsidiary of C. Brewer & Co. Ltd., has signed two contracts with the Government of Iran; under the terms of one contract, the Company will provide consulting services by both resident and non-resident consultants in all aspects of the Haft Tappeh Cane Sugar Project's operations for the next five years. The second contract covers technical and engineering services related to the expansion programme to double the size and production of the project which is expected to be completed within four years at a cost of approximately $30,000,000. H.A.C. (International) has been associated with the Haft Tappeh Project since its inception in 1958, and currently maintains a staff of seven resident consultants. The project is now operated and managed by trained Iranian personnel. The most recently completed crop produced over 42,000 metric tons of refined sugar and returned a substantial profit to the Iran Government.

Brevities

Spanish sugar factory.—A new sugar factory has come into operation in Valladolid, Spain, so increasing the country's output capacity. The plant was inaugurated by the Minister of Industry, Sr. LOPEZ BRAVO, who announced that very soon Spain would have another three factories which would increase the domestically-produced proportion of the country's sugar consumption, at present 80%. Of the three plants to be constructed, two are being built already and the third has received the appropriate authorization.

* * *

Czechoslovakian beet diffuser[2].—During the 1967/68 beet campaign Czechoslovakia's first continuous horizontal diffusion system was put into operation at Syrovátka sugar factory. This Chepos unit had a capacity of 1200 tons of beet per 24 hr but was found to be able to handle 1400–1500 tons, meeting the most exacting requirements.

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Cuban exports of dextran[3].—Dextran became a new export of Cuba in 1967, a total of 55 metric tons having been supplied to East Germany. Production plans for 1967 were 225 metric tons, to be increased to 300 tons in 1968. Its manufacture began in 1965. Dextran is produced principally for use in the cigarette, detergent, thread, fur and cosmetic industries, while a small amount is used in candy production.

* * *

Duty-free sugar for non-food use in the UK.[4]—When presenting his Budget proposals to the UK Parliament on the 17th March, the Chancellor of the Exchequer announced his intention of including in the Finance Bill provisions which will enable sugar to be used for some industrial purposes without surcharge having to be paid. He said this would help a number of manufacturers whose competitors abroad are able to use sugar bought at world prices. Although there are various chemical processes which are likely to benefit, the most important of the new outlets which this measure will open will be in the cattle feed industry. It is calculated that at present only about 10,000 tons are used by the feed industry but the way would now seem clear for a substantial expansion. Before 1962 users for non-human consumption purposes were allowed to claim repayment of any duty and sugar surcharge paid on imports of sugar. This facility was withdrawn when import duties on molasses and Commonwealth sugar polarizing below 99° were repealed.

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Pest control problem in Australia[5].—A side-effect of "Dieldrin" used for soldier fly control has been encountered by the Bureau of Sugar Experiment Stations in its efforts to overcome this pest. On "Dieldrin"-treated fields on a Gin Gin farm it was discovered that heavy moth borer infestations had occurred whereas there was virtually no borer infestation in the fields that had not been treated. The infestations are attributed to the destruction by the "Dieldrin" of the natural enemies of the moth borer and it seems that ants were the chief enemies involved. A comprehensive survey of the Bundaberg district is being carried out and, in case it becomes necessary to take control measures against the moth borer, its life cycle is being studied at Meringa.

[1] C. Czarnikow Ltd., *Sugar Review*, 1958, (857), 59.
[2] *Czech. Heavy Industry*, 1968, (3), 21.
[3] *Cuba Economic News*, 1967, **3**, (29), 10.
[4] C. Czarnikow Ltd., *Sugar Review*, 1968, (858), 61.
[5] *Australian Sugar J.*, 1968, **59**, 592.

Brevities

Cuba bulk sugar exports[1].—Exports of sugar in bulk from Cuba passed the 2,000,000 metric tons mark in 1967, making Cuba the biggest exporter of bulk sugar in the world. It is planned to export 3·9 million metric tons in bulk during 1968, including 1·7 million tons from the Cienfuegos terminal in Las Villas, 1·0 million tons from the Matanzas terminal and 1·2 million tons from the Guayabal terminal. In the Sugar Plan for 1970 bulk sugar exports are scheduled to be expanded to 5 million tons, including 2·2, 1·2 and 1·6 million tons from the three terminals, respectively.

* * *

Afghanistan sugar plans[2].—During the Five-Year Plan for 1967–72, special attention is to be paid by Afghanistan to increasing sugar production. The sugar beet crop amounted to 56,000 tons in the 1966/67 campaign and yielded 5000 tons of sugar, while 2500 tons of sugar were obtained from the 51,000-ton cane crop. By the 1971/72 campaign it is planned to produce 89,000 tons of beets and 62,000 tons of sugar cane, to yield 14,200 and 7300 tons of sugar, respectively. In spite of this increase it is anticipated that 32,400 tons of sugar will need to be imported in 1971/72 by comparison with 36,800 tons in 1966/67, as it is planned that per caput consumption will rise during the period from 2·9 to 3·2 kg per year. Beet acreage is to be extended by 630 hectares to 5500 ha, and eventually it is expected to cultivate 6000 ha, from which 134,000 tons of beets should be harvested. In addition to the higher area, beet production will be increased by special attention to improvement in beet seed, employment of fertilizers, pest control and mechanization. The area devoted to cane is to be unchanged at 2000 hectares and cane crop increase is to be achieved through the use of improved varieties, with a final target of 82,000 tons of cane. To process this cane, a sugar factory is to be constructed at Helmand-dal during 1970–72.

* * *

Emergency store for molasses[3].—When closure of the Suez Canal resulted in a world shortage of bulk liquid tankers, serious problems arose in regard to storage of molasses production pending availability of shipping. In Fiji, the Colonial Sugar Refining Co. Ltd. provided emergency storage for about 3000 tons of molasses by using an envelope of polyethylene sheet resting in a pit dug in the earth. This was of extra-tough outdoor-grade "Visqueen" film of which one sheet was used to line the earth pit to prevent seepage of the molasses into the soil and a second sheet was used as a "floating roof" to prevent dilution by rain water. The edges of the second sheet were secured by sandbags when the pit was full.

* * *

Niger Republic sugar factory plans[4].—It is reported by the Government of Niger that a cane sugar factory is to be constructed with a daily processing capacity of 1000 tons and a total production per year of 10,000 tons of sugar. The plant is to be put into operation at the end of 1970. Costs will amount to about 2 billion CFA francs (£3,300,000). Present sugar requirements, amounting to some 9500 tons, raw value, are covered by imports, especially from France and Belgium, but these are expected to rise to 15,000 tons by 1975.

* * *

Japanese study on Nigerian sugar expansion[5].—Technical experts from Japan were expected to arrive on the 2nd March to study the possibility of establishing a second sugar cane dlantation and industry in Nigeria.

Peruvian sugar statistics[6].—Initial stocks of sugar in Peru in 1967 were 179,328 metric tons, raw value, and production 731,171 tons, giving availabilities of 910,499 tons for the year. Of this, domestic consumption took 345,262 tons, and exports amounted to 431,472 tons (including 337,984 tons to USA, 66,912 to Chile, 10,294 to Iran, 10,192 to South Vietnam, 4309 to West Germany and 1781 to Switzerland). Final stocks were 133,765 tons. Latest unofficial estimates indicate that in 1968 production in unlikely to exceed 750,000 metric tons, while internal consumption needs will account for about 350,000 tons. After allowance has been made for fulfilment of the US quota, which is likely to be augmented by shortfall distributions as the year goes by, the tonnage of sugar available for shipment to world market destinations will therefore be lower this year than in 1967 and 1966 unless stocks are drastically reduced.

* * *

New USSR sugar factory[7].—Construction of the largest sugar factory in Kazakhstan has been completed at Shansugurov in the Taldy-Kurgan district. The plant is to process 3000 tons of beet per 24 hours and will produce, in addition to sugar and molasses, feeds from pulp and also alcohol. Machinery and equipment for the factory were supplied by Czechoslovakia. Sugar production in Kazakhstan has increased in recent years from 169,300 tons in 1965 to 167,900 tons in 1966 and 189,900 tons in 1967.

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US sugar quota imports, 1968[8].—The US Dept. of Agriculture has removed limitations on the quantity of raw sugar imported into the USA during the second quarter of the year[9]. The removal is expected to increase offerings of raw sugar for arrival at the beginning of the season of heavy sugar consumption since the remaining sugar within the annual supply quota of each foreign country may now be imported at any time.

* * *

Israel sugar imports ,1967[10].—Imports of sugar into Israel in 1967 totalled 55,860 metric tons, tel quel, including 11,455 tons from Poland, 11,336 tons from Turkey, 9618 tons from the USA, 7133 tons from Rumania, 5118 from the USSR, 3656 tons from Hungary, 2521 tons from Yugoslavia and 5023 tons from other countries. In 1966, imports totalled 70,290 tons, including 25,640 tons from Turkey, 18,791 tons from Poland, 13,706 tons from the USSR, 8798 tons from Hungary and 3355 tons from other countries.

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1 *Cuba Economic News*, 1967, **3**, (29), 10.
2 F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (7), 7–8.
3 *Producers' Review*, 1968, **58**, 31.
4 F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (7), 6.
5 *Barclays Overseas Review*, March 1968, 65.
6 C. Czarnikow Ltd., *Sugar Review*, 1968, (858), 62.
7 F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (7), 5.
8 *Public Ledger*, 6th April 1968.
9 See *I.S.J.*, 1968, **70**, 128.
10 C. Czarnikow Ltd., *Sugar Review*, 1968, (860), 72.