International Sugar Journal

• • •

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

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

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

La XIXe Conférence Technique de la British Sugar Corporation Ltd. *p.* 227–228

On présente un rapport sur la Conférence Technique de la British Sugar Corporation Ltd. de 12–14 juin 1968, et donne des sommaires des communications présentées et des discussions sur cettes communications.

* * *

La marche d'une cristallisation normale à l'égard à l'effet de la teneur en non-sucres, substances colorées et cristaux. 1è-re partie. S. ZAGRODZKI. *p.* 229–231

On a fait des calculs d'une cristallisation théorique du saccharose pur dans un appareil à cuire et a comparé les valeurs calculées avec les valeurs observées. On a calculé aussi les coefficients de retardement de la cristallisation sous l'influence de (i) la teneur en non-sucres, et (ii) la teneur en substances colorées, exprimée en fonction de l'extinction. Des tables des coefficients démontrent leurs changements pendant la cristallisation.

* * *

La production d'une suspension de semaille-cristaux pour la cristallisation de sucre dans un appareil à cuire. S. C. GUPTA et S. K. D. AGARWAL. *p.* 233

On décrit une nouvelle méthode rapide pour la production d'une suspension dans laquelle les cristaux du saccharose, précipités avec l'alcool à partir d'une solution de sucre, sont broyés dans un moulin à boulets.

* * *

La raffination du sucre—Remarques sur les procédés individuels. 4-ème partie. L'affination. F. M. CHAPMAN. *p.* 234–237

Dans la première section de cet article l'auteur, en s'appuyant sur sa grande expérience dans la raffination du sucre, considère les facteurs qui ont influence sur l'affination. Il présente le schème d'une station à affination idéalisée, comme aussi des observations sur le rapport entre la quantité de l'eau de clairçage et le rendement du sucre, et sur l'effet de l'affination sur les cristaux.

Die 19. Technische Konferenz de British Sugar Corporation Ltd. *S.* 227–228

Man berichtet über die 3-tägige Technische Konferenz der British Sugar Corporation Ltd. in Juni 1968, und gibt Zusammenfassungen der vorgelegten Vorträge und deren Eröterungen.

* * *

Der Verlauf einer normal geführten Kristallisation mit Berücksichtigung des Einflusses des Gehalts an Nichtzuckern, Farbstoffen und der Kristallmenge. Teil 1. S. ZAGRODZKI. *S.* 229–231

Man hat Berechnungen der theoretischen Kristallisation von Reinsaccharose in einem Kochapparat durchgeführt und die berechneten Werte mit beobachteten Werten verglichen. Die Koeffizienten von Kristallisationshemmung (i) unterm Einfluss der Nichtzuckermenge, und (ii) unterm Einfluss der Farbstoffmenge, als Extinktionskoeffizient ausgedrückt, werden berechnet und in Tabellen gebracht, um ihre Anderungen während der Kristallisation zu zeigen.

* * *

Die Herstellung einer Impfkristallsuspension für das Zuckerkochen. S. C. GUPTA und S. K. D. AGARWAL. *S.* 233

Die Verfasser beschreiben eine neue Schnellmethode für die Herstellung einer Suspension, in welcher die mit Alkohol aus einer Zuckerlösung niedergeschlagenen Saccharose-Kristalle in einer Kugelmühle gemahlt werden.

* * *

Zuckerraffination—Anmerkungen über Einzelverfahren. Teil 4. Die Affination. F. M. CHAPMAN. *S.* 234–237

In der ersten Sektion dieses Aufsatzes benutzt der Verfasser seine beträchtliche Erfahrung in der Zuckerraffination, um die verschiedenen Faktoren, welche die Affination beeinflussen, zu betrachten. Er stellt das Schema einer idealisierten Affinationsstation dar, wie auch Anmerkungen über die Beziehung zwischen der Deckwassermenge und dem Zuckeranfall und über den Einfluss der Affination auf die Kristalle.

19a Conferencia Técnica de la British Sugar Corporation Ltd. *Pág.* 227–228

Se presenta una cuenta de la Conferencia Técnica de la British Sugar Corporation Ltd. durante 3 días de junio 1968, con sinópsises de los papeles presentados y discusiones sobre estos.

* * *

La cursa de cristalización normal con respecto al efecto de no-aúczar, material colorante y contenido de cristales. Parte I. S. ZAGRODZKI *Pág.* 229–231.

Cálculos se han hecho de cristalización teórica de sacarosa pura en un tacho, y los valores calculados se han comparado con valores observados. Coeficientes de inhibición de cristalización por (i) concentración de no-azúcar, y (ii) material colorante expresado en términos de extinción, se calculan y presentan en forma tabular, que demuestra sus variaciones con progreso de la cristalización.

* * *

Preparación de pasta de semillas para cocción de azcúar. S. C. GUPTA y S. K. D. AGARWAL. *Pág.* 233

Se dan detalles de un nuevo método rápido para preparación de una pasta de semillas en que cristales de azúcar, precipitado de una solución de azúcar con álcool, se muelen en un molino de bolas.

* * *

Refinación de azcúar—Notas sobre procesos unitarios. Part IV. Afinación. F. M. CHAPMAN. *Pág.* 234–237

En la primera sección de este artículo, el autor trata con varios factores que se conciernen en afinación, basado sobre su larga experiencia en la refinación de azúcar. La esquema de un estación de afinación "idealizado" se presenta, así como observaciones sobre la relación entre cantidad de agua de lavado y recuperación de azúcar, y el efecto de afinación sobre los cristales.

THE

INTERNATIONAL SUGAR JOURNAL

VOL. LXX | AUGUST 1968 | No. 836

Notes & Comments

Cuban sugar statistics.

Statistics of sugar movement in Cuba were recently published by the International Sugar Council[1] and are reproduced elsewhere in this issue. Some interesting points which arise from the figures have recently been discussed by C. Czarnikow Ltd.[2]:

"Production during the year is shown to have amounted to the high figure of 6,236,000 metric tons. Output during the 1966/67 crop had been stated to have reached 6,128,000 tons and, as it was known that this quantity contained a far larger tonnage produced during November/December 1966 than was subsequently produced in November/December 1967, it seems that, when final figures were checked, some adjustments must have been made.

"The quantity of 629,498 tons shown to have been consumed during 1967 would appear to require some explanation and no doubt this has been clarified to the International Sugar Council. On the basis of an estimated population in Cuba in 1967 of around eight million this would seem to indicate that a proportion of this tonnage has been allocated for industrial purposes.

"As might be expected from the high production figure, exports rose considerably in 1967 and, at nearly 5·7 million tons or 1·25 million tons more than in the previous year, reached the highest level since 1961. The USSR was as usual the major recipient of Cuban sugar and 2,473,000 tons were shipped to that destination in 1967, compared with only 1,815,000 tons the previous year. Deliveries to China and Czechoslovakia fell by about 50,000 tons in each case but there was a notable increase in shipments to Japan, to take the total to 542,000 tons.

"Shipments to Morocco amounted to 153,000 tons, which compares with 295,000 tons scheduled to be delivered under the agreement signed in 1965. It is interesting to note that it has been reported in May that 250,000 tons of the 565,000 tons originally scheduled to be delivered in 1966 and 1967 still remain to be shipped; this sugar will now be exported to Morocco during 1968 and 1969.

"Shipments to North Korea are shown to have grown from 21,000 tons in 1966 to 83,000 tons in 1967. This is nearly three times the customary level of consumption in North Korea and at first sight it seems somewhat strange that so much sugar should have been consigned to that destination. There have been reports of North Korean sugar reappearing on the market, however, and it may be that this country is joining the long list of those which are already importing sugar from Cuba and then re-exporting whites.

"Exports to Mali are also put at a figure well in excess of possible requirements, shipments of 119,000 tons contrasting strangely with consumption needs of about 30,000 tons which, according to the import statistics of that country, are usually met from countries other than Cuba. It is possible that some error has occurred in transmitting the figures, as no shipments are shown to Malaysia, but this cannot account for the whole quantity as total imports into that country from Cuba during the thirteen months from the beginning of January 1967 until the end of January 1968 amounted only to 59,000 tons.

"Stocks at 31st December 1967 are shown to be 286,000 tons. In view of the poor crop anticipated this year it must be expected that exports to most destinations will show an appreciable drop in 1968 compared with 1967."

* * *

Sugar exporters' meetings.

On the 8th July a series of meetings started in Geneva between Dr. RAUL PREBISCH, Secretary-General of UNCTAD, and the five sugar exporters Australia, Brazil, Cuba, South Africa and Taiwan. If the consultations go well, the full International Sugar Conference will reconvene on the 23rd September. Certainly there is some ground for optimism in that representatives of Australia, Brazil and South Africa at least have emphasized the importance of

[1] *I.S.C. Stat. Bull.*, 1968, **27**, (3), 32–33.
[2] *Sugar Review*, 1968, (868), 105.

reaching agreement, and it was understood that the quota offered to Cuba at the April/May Conference was close to its requirements. It is supposed that, if the major exporters are able to reach agreement on the size of the market open to them, Dr. PREBISCH could confer with the smaller exporters and hopes would then be high for reaching agreement in September.

But the size of the exporter is not a measure of the importance to it of reaching an agreement; of the total sugar produced—some 67 million tons—50 million tons remain within the country of production and half the remainder is traded under preferential prices. So only some 8–9 million tons reaches the free market and it is the proportion of a country's production which is part of this amount which governs the extent of the loss incurred by the industry of that country, and its incentive to reach an agreement whereby prices can be raised to perhaps double the present level of £20 per ton. A table, recently published by *The Times*[1], gives these proportions for a number of countries, based on 1967 export data, in metric tons, raw value.

	Total exports, 1967	*Free market exports*		*Imports*
	(tons)	*(tons)*	%	*(tons)*
Cuba	5,683,000	1,817,000	32	
Australia	1,910,000	1,380,000	72	
USSR	1,200,000	1,112,000	93	2,483,000
West Indies	1,089,000	164,000	15	
Philippines	1,003,000	0	0	
Brazil	1,001,000	538,000	54	
South Africa	816,000	765,000	94	
Dominican Republic	642,000	84,000	13	
Mexico	568,000	95,000	17	
Mauritius	561,000	139,000	25	30,000
Peru	431,000	62,000	14	
Czechoslovakia	426,000	426,000	100	188,000
Poland	380,000	380,000	100	23,000
Fiji	336,000	148,000	44	
China, Mainland	306,000	306,000	100	556,000
India	229,000	134,000	58	
Colombia	200,000	151,000	76	

* * *

US sugar quota, 1968.

On the 20th June the US Department of Agriculture raised the Overall Supply Quota by 100,000 short tons to 10,700,000 short tons, raw value. At the same time, a further deficit of 215,000 tons was declared in respect of the Puerto Rican Quota. Late on the 27th the Department announced a further increase of 100,000 short tons and, at the same time, declared a deficit of 100,000 short tons in the entitlement of domestic beet sugar producers.

Thus, in a week, the quantity of sugar to be supplied by foreign countries to the US has been increased by 385,000 tons, which one might have expected to give a boost to the sugar market, especially as several of the suppliers to the US market might be considered out of the world market for the rest of the year in consequence of their enlarged quotas.

UK Economic Development Committee for Agriculture Report.

The report, published on the 24th June, of the Economic Development Committee for the Agricultural Industry has raised a remarkable proposition. The reports covers aspects of agriculture generally in which potential savings in imports exist, and cover the period up to 1972/73. In the case of sugar, however, this period (set by the terms of reference of the Committee) is exceeded by consideration of the period up to 1974 until which year the Commonwealth Sugar Agreement is at present scheduled to run. The report recommends that: "consideration be given to an expansion of about 45,000 acres, linked to a new factory in the eastern counties of England, to come into operation after expiry of the existing term of the Commonwealth Sugar Agreement."

In a letter to *The Times*, Lord CAMPBELL OF ESKAN, Chairman of the Commonwealth Sugar Exports, wrote: "It is deeply disturbing to see that a report so valuable in its own context should, after 17 years of a balanced British sugar policy, assume the termination of the Commonwealth Sugar Agreement and go on to suggest that a new factory should be built to produce more beet sugar at the expense of traditional Commonwealth cane-growers. Desperately difficult international negotiations are at present going on towards a new world sugar agreement. A vital element therein is access for cane sugar into the developed beet sugar countries. It is a shock to find this British report calmly assuming the reverse: that the whole increase in home consumption for the next five years, and thereafter even more, should be met by domestic beet.

"Ever since the Commonwealth Sugar Agreement was negotiated by a Labour Government and signed by a Conservative Government in 1951 it has been, in accordance with its provisions, extended year by year (except for last year, when its extension was not discussed owing to the expected timing of Common Market negotiations). It runs at present until the end of 1974. I cannot conceive that the British Government, for something of such marginal importance to British agriculture as a whole, would even consider ending or eroding a measure which has played an outstanding part in Commonwealth economic and social relations, which underpins the economies of so many countries in the Commonwealth and which has assured Britain of regular supplies of sterling cane sugar at prices comparing most favourably with other protected prices (both beet and cane)."

It is to be hoped that as soon as possible and, in any case, before the autumn meetings of its representatives with those of the Commonwealth Sugar Exporters, the British Government will make explicit its intentions in regard to extension or termination of the Agreement after 1974.

[1] 8th July 1968.

British Sugar Corporation Ltd. 19th Technical Conference

SUGAR technologists from twelve European countries, in addition to those from Britain, assembled during the 11th June at the Grand Hotel, Folkestone, Kent, where on the following morning, the 19th Technical Conference was opened by W. B. BOAST, Technical Director of the British Sugar Corporation Ltd. Mr. BOAST discussed the experiences of the Corporation during the two years since the 18th Conference and mentioned the steady advance in total slicing capacity of the 18 sugar factories which, although 58,269 tons/day on average in 1967/68 compared with 56,480 tons/day the previous campaign, was still not sufficient to cope with the ever-increasing tonnages of beet produced from the Government-controlled static area by reason of improvements in seed and cultural techniques.

As a result the campaign extends from September to the end of January when the deleterious effects of weather in a long campaign have resulted in severe reduction of beet quality and difficulties in processing. It is not possible to expand some of the BSC factories but capacities of the others are being increased; for example that of Wissington is to be raised to 7000 tons of beet per day by 1971 while it is also to be converted from raw to white sugar production. The trend toward higher bulk sugar sales continues; of the 640,000 tons of sugar produced in 1967, 310,000 tons was packeted, 120,000 in sacks and 210,000 tons was in bulk.

The first paper of the Conference, entitled "Comparison of sulphur dioxide and formaldehyde as bacteriostats in diffusers", was presented by J. F. T. OLDFIELD and J. V. DUTTON of the BSC Research Laboratories. This aroused considerable interest among Continental technologists and Dr. R. PIECK noted that work on the same lines had been carried out by M. SIMONART of Raffinerie Tirlemontoise S.A. who had not, however, reached the same conclusion that the SO_2 was less effective, less permanent and more expensive; in Belgium, however, SO_2 was added to fresh water to bring the pH to 5·2, and was added *before* the scalding trough and not to the juice as in the BSC experiments. He mentioned process benefits as: ease of regulation of the acidification, pH stabilization at 5·8–6·1 through the diffuser, reduction of formaldehyde usage resulting from the use of a higher temperature in the diffuser possible, when infection starts, as a result of pH stability, and the opportunity of increasing diffuser throughput without affecting extraction or pulp pressing quality.

There is no legislation in the UK on toxic limits in animal feedstuffs, and little information is available on toxic concentrations of various metals, cumulative and acute effects, physical and chemical forms, etc., so an investigation was started by the BSC Central Laboratories and was described by D. HIBBERT. Analytical techniques were developed for copper, lead, arsenic and vanadium and pulp examined from various British factories and from other countries, figures being obtained which were comparable with other feeds including oats, barley, maize, linseed cake and groundnut cake.

R. M. J. WITHERS, R. J. BASS and M. F. BRANCH then presented their paper which described the setting up of a mathematical model for a sugar factory which, by use of the BSC's IBM 360 computer, can be used to determine within a minute the effects on the factory operation and profits of changes in factors which, in a practical experiment, might not be capable of yielding a measurable result or might take a great deal of time. The accuracy of the model and rapidity of obtaining the results of changes makes it possible to optimize variable conditions in the factory so as to maximize profits.

Crop prospects for 1968/69 were discussed by R. TAYLOR, a Director of the BSC, who forecast a somewhat higher crop than produced from the same area in 1967/68. The campaign would probably start on the 23rd September and continue to the end of January. Representatives of the various other countries referred to their own prospects: in Austria a poor crop was expected owing to bad conditions during sowing and singling, while in Belgium a lower crop yield would be offset by a 15% rise in area. In Denmark and Finland the areas and conditions were similar to 1967/68 and the crops expected to be similar also. In France the beet area is increased by 12–15% and the crop consequently expected to be bigger. In North Germany it was anticipated that late germination would be caught up during the growing period while the beet area is somewhat reduced; in South Germany sowing conditions were good and the area unchanged so that a good crop is expected. In Holland the area was 1–2% higher and an average crop was expected, while in Italy the beet area was smaller and a crop reduction of 14% was expected. In Poland the beet area had been raised by 5% and production is expected to be 14 million tons of beet. In Sweden the area was restricted by the Government to the same level as in 1967; the crop yield per hectare had been increasing, so a slightly higher total crop was expected. No less than 97% of the Swedish crop is grown from monogerm seed. In Switzerland the area was 4% higher than 1967 but germination had not been so good so the crop was expected to be 400,000 tons.

In the next paper, P. W. VAN DER POEL of N.V. Centrale Suiker Mij. presented his paper on boiling schemes which is based on the use of Hattink diagrams for determining the amounts of dry substance which are processed in the vacuum pan station. The diagrams provide quick and reliable information which may be used for comparison of the amounts of dry substance handled in such schemes, these amounts being directly related to the costs incurred.

G. W. CRANE, Effluent Officer of the BSC, then described the present state of effluent treatment and water conservation in the Corporation in relation to present and anticipated legislation. Among the latest techniques studied were activated sludge treatment in a "Pasveer" Oxidation Ditch, the use of odour-masking sprays and surface aeration sprays.

The adoption of the mechanized Choquenet filter press for first carbonatation juice at Friesch-Groningsche Coöperatieve sugar factory in Holland was described by M. KEIJZER in a paper which led R. HULPIAU to mention a similar system in use at a sugar factory in Belgium where the presses were used in conjunction with G.P. filters.

The day concluded with a Conference dinner to delegates, given by the Corporation, in which visitors were welcomed by J. P. VAN DEN BERGH, Government Director of the Corporation. An entertaining speech of thanks, on behalf of overseas guests, was made by K. OBERHEIDE of Süddeutsche Zucker A.G., and the diners were then provided with a cabaret to close their evening.

Resuming the next morning, the Conference then heard Prof. Dr. W. RATHJE of the Institut für Zuckerindustrie, Berlin, discuss the mechanism of the extraction of sucrose from beet slices; this led to some discussion among members who seemed generally to be in agreement as to the facts concerned but differed as to the definitions employed.

Another paper from the BSC Research Laboratories followed, presented by J. F. T. OLDFIELD and J. V. DUTTON, on the effect on juice quality of draft and inversion in beet diffusers. Contrary to Polish experience, last cell juice did not fall below 70 purity, but Prof. S. ZAGRODZKI pointed out that retention time in the Polish experiments were about 2 hours, compared with 75 minutes in the BSC tests. A. J. DYKE mentioned practical measurements made in years past at Wissington where simultaneous sampling from the cells of a battery in operation showed a fall through the diffuser to about 60 in the last cell; on clarification of the sample, however, the purity rose to 73–75.

Corrosion problems in sugar factories were discussed by Prof. G. MANTOVANI of Ferrara University, with the aid of numerous photographs. He was asked by W. M. LANYON as to experience in Italy with "chloride corrosion" of stainless steel tubes in 4th evaporator effects; contrary to BSC experience, corrosion had only been found in 1st, 2nd, and occasionally, 3rd effects. P. MOTTARD referred to the production after 140 days of 200 lb of oxide scale in a stainless steel tank used for resins employed in the Quentin ion exchange process; this was attributed to chloride corrosion and was being countered by use of pure titanium. Replying to Prof. ZAGRODZKI, the author referred to successful use of plastics for protection of metal surfaces against corrosion.

After lunch, delegates formed three groups, one of which played golf, the second went on a guided tour of Canterbury Cathedral, and the third went on a similar tour of the city of Canterbury before having tea and returning to Folkestone.

On the following morning Dr. H. ZAORSKA presented a paper showing the overriding effect of juice level in evaporators on colour increase; this can be restricted to 50–60% within the station by maintenance of low juice levels but may reach 200% if the level is excessively high.

A technique for two-stage active carbon treatment of thick juice and remelt liquor was described by Prof. ZAGRODZKI: this involved precoating a bag filter with cellulose and then a Polish carbon "Carbopol Extra Z" which was sweetened-off and regenerated by heat, using steam at 500–600°C, losses being more than made up by carbonization of the cellulose and organic non-sugars not removed by sweetening-off. The technique permits a greater yield of white sugar as well as better quality. Decolorization of over 80% could be achieved and purity rise was one unit for a contact time of 15 minutes (reduced to 10 minutes for light-coloured liquors). J. K. ALDRIDGE mentioned that in the CAL carbon columns used at York sugar factory the purity rise was usually 0·1 units and never higher than 0·25 for a contact time of 4 hr. The cost of the "Carbopol" in Poland was the equivalent of $0.50 per kg, but a price for export might well be lower. Ash in the carbon was found in the laboratory to have risen by about 10% after 20 regenerations of the carbon.

Power in beet sugar factories was the theme of the last paper by W. M. LANYON, who discussed his survey of the possibilities of using industrial gas turbines and diesel engines for power generation in beet sugar factories which have a need for heat (usually as waste gases) to dry beet pulp. He concluded that on a new installation, turbines and diesels presented no advantage, while in the case of inadequate power generating capacity coupled with insufficient capital for a new boiler installation, it would be economical to install a diesel engine. The author also discussed the influence of the ready availability of cheap natural gas as a fuel for turbines and diesels.

Mr. BOAST then closed the Conference with a valedictory speech in which he mentioned his impending retirement from the post of Technical Director, and introduced his successor, N. M. ADAMS, who is well-known to delegates to the Technical Conferences as an author of numerous papers.

The course of normal crystallization with regard to the effect of non-sugar colouring matter and crystal contents

By S. ZAGRODZKI

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

PART I

THE crystallization process is closely connected with sugar production, and for this reason detailed investigations[1] have been carried out over a number of years with the aim of explaining all elements[2] of the process. As a result the mechanism of crystallization is now clearly understood. We have only to mention studies on the effect of individual components in impure solutions[3–7], the effect of surface area [4,8–10], the effect of viscosity and temperature [11–14], and the influence of circulation rate[15] and of agitation[9,16] to see how many parameters are already known[17]. The effects of the non-sugar content on crystallization rate[7,18] and of the colouring matter content[19] in the solution have also been determined. Various methods of growing crystal nuclei[16,20] in prepared solutions have been examined as have injection methods and methods for accurate determination of size and number of nuclei[21,22]. On the basis of this earlier work, it is now possible to carry out efficient crystallization and maintain the more important parameters within optimum limits.

From the results of the earlier investigations we find that there is considerable discrepancy between theoretical calculations of the crystallization rate of sugar and the practical values found by crystallization in vacuum pans. To establish the causes of these differences, it was necessary to investigate changes in crystallization rate at separate stages of inoculation with nuclei throughout the complete process. Despite maintenance of the largest number of basic parameters at the same optimum level, it is impossible to achieve uniform increase in crystal weight at individual stages during crystallization, so that the crystallization rate is subject to ever-present variation.

On this basis we find that the crystallization rate, expressed as a function of the total surface of all crystals, agrees with laboratory test results only in the initial stages, even when the basic parameters are maintained constant. Later during crystallization, when the crystals become larger, the crystallization rate falls significantly relative to the initial rate. In order to substantiate the differences between the crystallization rate in vacuum pans and the theoretical rate at individual periods of time, comparative calculations were made for a normal crystallization.

Theoretical course of crystallization

The following hypotheses were assumed in the determination of changes in the values:

Crystallization is carried out in a vacuum pan of 50 tons capacity, at a constant low temperature of 70°C, a constant supersaturation of 1·10 and steady, good circulation, giving a theoretical crystallization rate of 7000 mg/sq.m./min. The pan was fed with 150×10^9 crystals, each nucleus weighing an average of $6{\cdot}66 \times 10^{-9}$ g; hence 1000 g of sugar having an initial surface of 225·5 sq.m. was injected.

It is assumed that during crystallization all crystals grow but that no new crystals are formed. As theoretical calculations show, after less than 60 min 30 tons of sugar will have crystallized on the surfaces of the injected crystals, so that the resultant massecuite contains more than 55% crystals. Assuming a certain weight of all crystals in the massecuite at a given period of time, it is possible to calculate the total surface area of all crystals as well as the time

---

1 SMOLENSKI and ZELAZNY: *Gaz. Cukr.*, 1934, **74,** 303; *I.S.J.*, 1935, **37,** 318.
2 ZAGRODZKI: *Wiad. chem.*, 1959, **13,** 185.
3 VANHOOK: *Ind. Sacc. Ital.*, 1966, **59,** 201.
4 MANTOVANI: *Ind. Sacc. Ital.*, 1961, **54,** 73.
5 MANTOVANI and FAGIOLI: *Gaz. Cukr.*, 1964, **72,** 278; *Zeitsch. Zuckerind.*, 1964, **13,** 559; *Cukoripar*, 1966, **19,** 37.
6 MANTOVANI: *Zeitsch. Zuckerind.*, 1964, **14,** 202.
7 ZAGRODZKI and ZAORSKA: *I.S.J.*, 1965, **67,** 300, 337.
8 KUKHARENKO: *Cbl. Zuckerind.*, 1922/23, **31,** 1001.
9 VANHOOK *et al.*: *I.S.J.*, 1959, **61,** 167.
10 VANHOOK: *Ind. Sacc. Ital.*, 1962, **55,** 217.
11 DUBOURG and SAUNIER: *Bull. Soc. Chim. France*, 1939, **6,** 1196.
12 DE VRIES: *Chem. Weekblad*, 1935, **32,** 36; 1947, **6–7,** 82, 99. [Ref. by VANHOOK: "Principles of Sugar Technology," Vol. II. Ed. P. HONIG. (Elsevier, Amsterdam), 1959, pp. 158, 166.]
13 MÖLLER and SCHMIDT: *Zeitsch. Zuckerind.*, 1963, **13,** 501; *I.S.J.*, 1964, **66,** 127.
14 KAGANOV and ZHIGALOV: *Sakhar. Prom.*, 1964, **38,** 409.
15 ZAGRODZKI and MARCZYNSKI: *Kristall Technik*, 1966, **1,** 299.
16 VANHOOK: "Principles of Sugar Technology, " Vol. II. Ed. P. HONIG. (Elsevier, Amsterdam), 1959, pp. 151-152.
17 BURIÁNEK: *Listy Cukr.*, 1965, **81,** 225.
18 SKRIPKO and POPOV: *Sbornik Pishch. Prom.*, 1965, (2), 54.
19 ZAORSKA: Paper presented to the 13th Congress CITS, 1967; *I.S.J.*, 1968, **70,** 99-103.
20 ZAGRODZKI and NIEDZIELSKI: *Paper presented to Int. Conf. Chem. Tech. Sugar* (Lodz), 1962; *I.S.J.*, 1963, **65,** 29.
21 SCHIWECK: *Zucker*, 1967, **20,** 33.
22 WERNER: *Zeitsch. Zuckerind.*, 1963, **13,** 193.

required for crystal growth up to the moment when a corresponding total weight is obtained. Under the conditions set out above, this time would be 56·83 min. It is also possible to calculate the average increase in weight of crystallized sugar in kg/min with constant parameters giving a crystallization rate of 7000 mg/sq.m./min. The theoretical data are given in Table I.

crystallization. From precise measurements[23] we have calculated the individual stages in sugar crystallization (Table I).

The results are for crystallization of pure sucrose solutions. For crystallization of solutions in sugar factories the retarding effect of non-sugars in the syrups must be considered.

Table I

Comparison of theoretical and true crystallization rate. An initial rate of 7000 mg/sq.m./min is assumed at 70°C and 1·10 supersaturation. It is also assumed that a maximum of 30 tons of sugar will crystallize in a vacuum pan holding 50 tons of massecuite. The vacuum pan was injected with 150 × 10^9 seed crystals, the weight of each grain being 6·66 × 10^{-9} g, i.e. a total of 1000 g of sugar with an initial total surface area of 225·5 sq.m.

		Theoretical crystallization time				*True crystallization time*		
Amount of crystallized sugar (kg)	*Total crystal surface (sq.m.)*	*in given time interval (min)*	*from start (min)*	*Theoretical sugar crystallization rate (kg/min)*	*Crystallization inhibiting coefficient (h)*	*in given time interval (min)*	*from start (min)*	*True crystallization rate (kg/min)*
1	225·5		0				0	
		0·266		1·88	1·0	0·266		1·88
1·5	296·2		0·266				0·266	
		0·552		2·72	1·0	0·552		2·72
3	470·5		0·818				0·818	
		0·705		4·25	1·0	0·705		4·25
6	746·5		1·523				1·523	
		0·895		6·70	1·0	0·895		6·70
12	1167		2·418				2·418	
		1·125		9·60	0·999	1·126		9·59
24	1877		3·543				3·544	
		1·425		16·85	0·998	1·428		16·82
48	2973		4·968				4·972	
		1·78		27·00	0·997	1·785		26·92
93	4730		6·75				6·757	
		2·16		42·4	0·994	2·17		42·1
187·5	7380		8·91				8·93	
		2·83		66·4	0·988	2·86		65·5
375	11730		11·74				11·79	
		3·52		103·5	0·977	3·60		101·2
750	18630		15·26				15·39	
		4·44		169·0	0·960	4·62		162·3
1500	29620		19·70				20·01	
		5·58		269·0	0·920	6·03		247·8
3000	47050		25·28				26·04	
		7·04		426·0	0·840	8·39		358
6000	74650		32·32				34·43	
		8·95		670	0·693	12·96		464
12000	116700		41·27				47·39	
		6·32		950	0·520	12·16		493
18000	154400		47·59				59·55	
		5·00		1200	0·370	13·50		444
24000	187700		53·59				73·05	
		4·22		1420	0·250	16·86		355
30000	217600		56·81				89·91	

True course of crystallization

In practice it is impossible to obtain theoretical results even in pure sucrose solutions, since, as demonstrated in recent tests[23], the increasing quantity of crystallized sugar has an inhibiting effect on the crystallization rate. The value of the "coefficient of retardation" h falls with increasing quantity of crystallized sugar from 1·00 in the initial stage to 0·250 in the final period of crystallization. As a consequence, the crystallization period for 30 tons of sugar in pure solution increases from the theoretical 56·83 min to 89·91 min. Moreover, the rate of increase in weight of the sugar crystallizing per min is smaller over individual time sections, particularly at the end of crystallization.

Course of crystallization in impure solutions

During crystallization the concentration of the mother liquor increases and, as is well-known, the inhibiting coefficient η_1 is a function of the non-sugar concentration[7]:

$$\ln \eta_1 = -0{\cdot}1015 \text{ non-sugars} \qquad (1)$$

Further, we have calculated the changes in value of the retardation coefficient with changes in the non-sugar concentration during progressive crystallization in a vacuum pan. If we assume an initial syrup

[23] Zagrodzki: *Paper presented to the 13th Congress C.I.T.S.*, 1967; *I.S.J.*, 1968, **70**, 120.

purity of 94, the non-sugar content in the solution will be $Nz_0 = 6$ (on Brix). In consecutive stages of crystallization the non-sugar content (%) rises to a final value of $Nz_n = 15$, at which the final mother liquor purity is therefore 85. Calculated values of the retardation coefficient η_1 are given in Table II. The results enable the crystallization rate in vacuum pans during individual stages of the process to be calculated.

Table II

Value of crystallization retarding coefficient η_1, which characterizes the effect of the non-sugars, during the course of crystallization. An initial purity of 94, decreasing as crystallization proceeds, is assumed. The non-sugar content in the mother liquor increases during crystallization; at the start $Nz_o = 6\%$, at the end of crystallization $Nz_n = 15\%$. The coefficient η_1 is a function of non-sugar concentration:

$$\ln \eta_1 = -0{\cdot}1015 \times \text{non-sugars}$$

Quantity of crystallized sugar (kg)	*Non-sugars in mother liquor (% dry solids)*	ln η_1	log η_1	η_1
1	6·0	—0·6090	0·2640	0·544
93	6·0	—0·6090	0·2640	0·544
187·5	6·022	—0·6112	0·2654	0·543
375	6·045	—0·6136	0·2664	0·542
750	6·090	—0·6181	0·2680	0·540
1500	6·181	—0·6273	0·2720	0·535
3000	6·380	—6·476	0·2810	v·524
6000	6·820	—0·6922	0·3005	0·501
12000	7·90	—0·8018	0·3550	0·442
18000	9·37	—0·951	0·4130	0·386
24000	11·52	—1·169	0·5080	0·311
30000	15·00	—1·522	0·6625	0·217

Parallel calculations were carried out to determine the coefficient η_2, which inhibits the crystallization rate through the effect of colouring compounds present in the initial solution. The increase in the specific extinction of the solution with increasing colouring matter concentration in the mother liquor as a result of sugar crystallization in the individual stages must be considered. From the measurements we assumed a specific extinction of the initial solution of $E_{560} = 0{\cdot}320$. With increase in the non-sugar concentration the extinction value also rises, reaching a value of $E_{560} = 0{\cdot}800$ at the end of crystallization. In recent work[19] the extent to which changes in the value of η_2 depend on the specific extinction was determined

$$\Delta \log \eta_2 = -1{\cdot}187 \; \Delta \log E_{560} \quad \ldots\ldots\ldots\ldots (2)$$

It was found, however, that the calculated value refers exclusively to high purity solutions. As the mother liquor purity falls, the inhibiting effect of colouring matter also falls, so that at 55 purity $\eta_2 \simeq 1$. In this connexion, the relationship takes the following form

$$\log \eta_2 = -0{\cdot}187 \frac{(45 - \text{non-sugars})}{45} \Delta \log E_{560} \ldots (3)$$

Moreover, equation (3) permits calculation of η_2 in solutions of varying purity (Table III).

Table III

Value of crystallization inhibition coefficient η_2, which characterizes the effect of the colour content, during the course of crystallization. The initial colour of the solution corresponds to a specific extinction of $E_{560} = 0{\cdot}320$, decreasing in the mother liquor as crystallization proceeds. For the sake of simplicity, it is assumed that the colour increases in proportion to the non-sugar concentration. As a result the specific extinction in the final crystallization period would be $E_{560} = 0{\cdot}800$. It is assumed that the coefficient inhibiting crystallization under the effect of colouring matter agrees with the equation

$$\log \eta_2 = -0{\cdot}187 \frac{(45 - \text{non-sugars})}{45} \Delta \log E_{560}$$

Quantity of crystallized sugar (kg)	*Non-sugars in mother liquor (% dry solids)*	*Coefficient of specific extinction (E_{560})*	*log η_2*	η_2
1	6·0	0·320	—0·2283	0·591
93	6·0	0·320	—0·2284	0·591
187·5	6·022	0·321	—0·2285	0·591
375	6·045	0·322	—0·2291	0·590
750	6·090	0·325	—0·2293	0·590
1500	6·181	0·330	—0·2299	0·589
3000	6·380	0·341	—0·2306	0·588
6000	6·820	0·364	—0·2321	0·586
12000	7·90	0·421	—0·2351	0·582
18000	9·37	0·500	—0·2366	0·580
24000	11·52	0·615	—0·2358	0·581
30000	15·00	0·800	—0·2234	0·598

As accurate calculations show, η_2 decreases despite considerable increase in the colour of the mother liquor except in the initial stages of crystallization. In later stages the inhibiting effect of colouring matter becomes gradually smaller.

(*To be continued*)

Correspondence

The Editor,

The International Sugar Journal.

Dear Sir,

CANE SUGAR EXTRACTION

In a letter published in the March 1968 issue of the *International Sugar Journal* Mr. F. A. Seaford draws attention to a feature of the new cane diffusion or lixiviation techniques which he apparently suspects to be characteristic for them. He says:" Cases have been reported in which an increase in extraction appears to have been accompanied by an extremely disconcerting drop in Boiling House performance." And somewhat further: "In order to assist the industry to evaluate the overall performance that may be associated with diffusion and lixiviation processes, I would like to propose the collection and correlation of information about the overall performance of cane sugar factories in which the extraction is achieved by milling plants. This would form a base from which to judge the performance of newer systems." With a view to the above I offer the following remarks.

In the first place I would like to point out that the phenomenon of falling Boiling House Recovery figures with increasing extraction percentages is not restricted to diffusion only. If we could compare two milling tandems crushing the same canes, one of them attaining 97% extraction and the other one 94·5%, we would find that, if the juices were processed in exactly the same way, of the sucrose in the juice from the 97% extraction tandem a greater proportion would be lost in final molasses than from the 94·5% tandem. But not so much more that the Overall Recovery figure would be lower. The difference in Overall Recovery in favour of the 97% tandem would most likely be big enough to make its operation an economical proposition.

However, if we would compare the 97% tandem with an even more powerful one, which would attain an extraction of 97·8% (crushing the same cane!) we might very well find that the Overall Recovery would be only 0·3% higher and would not justify the cost of operating the heavier tandem.

Depending on the particular circumstances prevailing, there is an economic optimum of extraction which should not be exceeded. What exactly this economic optimum is must be decided on the strength of the circumstances. Among the variables that are to be considered, the phenomenon of falling B.H.R. at higher extraction percentages must not be forgotton. The decisive factor in this problem is the amount of non-sucrose which is extracted simultaneously with the sucrose, and its melassigenic power. The more of this non-sucrose and, consequently, the more *harmful* non-sucrose constituents extracted, the more sucrose will be lost in final molasses, and the lower will be the B.H.R. figure.

There is some conflicting evidence about the purity at which, at high extraction levels, the last parts of sucrose are extracted. Whilst the purity of the last expressed juice may not be so very low, it has been found that the purity of the residual sucrose in final bagasse from tandems achieving high extraction is very low indeed, viz. lower than 60. It is clear that of the sucrose gained at this purity level a considerable proportion will be lost in final molasses. This latter fact is not always sufficiently appreciated.

In deliberations of this nature the actual method by which the sucrose is extracted is not essential. Achieving 97% extraction by diffusion will most likely also be more economical than achieving 94·5% extraction by straight milling, but when we come in the region of very high extractions we have to be careful. The crucial question is obviously: does diffusion, in comparison with straight milling, extract more harmful non-sucrose when achieving the same sucrose extraction percentage from the same cane?

I am of the opinion that insufficient information is available to answer this question decisively. In fact, it should be answered for a series of extraction percentages.

We are at the moment in a situation where, for the correct economic comparison of straight milling with diffusion, insufficient technical information is available. Mr. SEAFORD proposed in his letter to provide "the base from which to judge the performance of the newer systems". He wants to do this by "the collection and correlation of information about the overall performance of cane sugar factories in which the extraction is achieved by milling plants". He believes that "it should be possible, from an examination of a large number of world wide performance reports to predict standard overall recoveries obtainable from cane of different technical qualities."

The first problem to be solved is how to define "the technical quality" of cane. Mr. SEAFORD will probably use the figures for the fibre percentage of the cane and the purity of the juice extracted from it. However the loss of sucrose in final molasses depends also on the composition of the non-sucrose. Will this be taken into account? Not according to the list of required data given at the foot of Mr. SEAFORD's letter.

Then there is another question. The most extensive set of milling and processing control figures ever collected and studied was probably produced in Java, in the twenties and thirties, from more than 180 factories. These figures have been extremely useful and the superiority of the Java techniques (of that time!) was largely based on them. But every sugar technologist who worked with them knew very well that they could be applied reliably only if many other factors which could not easily be expressed in statistical data were also known. The figures were definitely not a simple key to be used without a certain amount of inside information which in the well-organized Java industry was available. How does Mr. SEAFORD expect to get this type of information from factories all over the world?

In the third place the graphs and tables Mr. SEAFORD plans to produce will depict the "global average factory". Do not the conditions in different countries differ so much that the applicability in individual factories of the data reflecting the "average" factory is limited?

Cane sugar technologists are known to be reluctant to have their data compared with those of other countries, and to apply in their factories processes developed overseas before they have been fully tested in their own country. This reluctance, although perhaps not quite free from an emotional element, cannot—on the other hand—be characterized as completely devoid of experience. Therefore, will the tables and graphs, which will require an enormous amount of work to be prepared, be as acceptable to the individual mill manager as Mr. SEAFORD hopes?

Fourthly, I believe that the Overall Recovery figure will play a dominant rôle in the proposed method of evaluating extraction processes, but is it the most suitable figure? What we actually want to know is: do we lose more sucrose in final molasses, either by producing more of this product, or due to a higher purity, if we apply diffusion. The Overall Recovery is influenced, in addition to the loss in final molasses, by the Undetermined Loss and the loss in filter cake. The latter losses can hardly be imagined to depend on extraction techniques and for this reason it seems better not to base our judgment on the Overall Recovery, but to be guided by the loss of sucrose in final molasses only.

Sir, in the beginning of this letter I have been trying to explain that the typical difference between extraction by milling and by diffusion is the amount and the nature of the non-sucrose which is also extracted. If we really want to evaluate the comparative value of the two extraction methods, laboratory and factory investigations should be conducted in which the extraction of non-sucrose constituents is properly examined.

Although I do not deny that Mr. SEAFORD's proposal is of general interest, I am of the opinion that the problem which it aims to solve can more directly and better be solved by intensive laboratory research.

Yours faithfully,

K. DOUWES DEKKER

El Atabal, Puerto de la Torre,

Málaga, Spain.

Preparation of Seed Slurry for Sugar Boiling

By S. C. GUPTA and S. K. D. AGARWAL

THE use of seed slurry is a generally accepted technique in boiling final massecuite and is helpful in obtaining a satisfactory exhaustion. Various non-aqueous solvents have been utilized as suspension media during the preparation of slurry by breaking down the powdered sugar in ball mills of different specification in order to obtain finer and finer grains as far as possible. The work of GILLETT and KENDA[1] and that of POLLARD[2] can especially be mentioned in this respect. Later modifications suggested by other workers[3] were essentially to improve the technique of dispersion by grinding in different media and employing various types of ball mills and the number and size of balls used. The time generally required for preparation of slurry by these methods varied from 1 to 2 days. A new method for preparation of seed slurry has been evolved for obtaining uniform and well-grown crystals in a very short interval of time. Use is made of the extremely low solubility of sucrose in alcohol, which is employed for precipitation of sucrose from a solution.

The slurry is prepared by taking about 100 ml of distilled rectified spirit in a laboratory model ball mill*. Sugar solution corresponding to the solubility at 55°C, i.e. 280 g per 100 g of water is prepared by dissolving 21 g sugar in 7·5 ml of water. This solution is poured at 70°C, with the help of a funnel, directly into the alcohol contained in the ball mill. The mill is run for 30 minutes, during which period the sugar crystallizes out in the form of a slurry. This slurry is taken out of the mill and allowed to stand for 10 to 15 minutes, after which the supernatant alcoholic layer is replaced by a fresh layer of alcohol. The alcohol and sugar crystals are returned to the ball mill and the latter then run for a further 10 minutes. The slurry may thus be prepared within one hour. It is ready for use and may be employed for up to two days before any adverse influence of keeping becomes apparent. For storing for longer durations, the alcoholic layer is again replaced with distilled alcohol and the slurry may then be stored safely even for 1 to 2 months.

The miscibility of castor oil with alcohol was utilized for preparation in a yet simpler way. The need for replacement of the aqueous alcoholic layer was done away with by addition of 25% of castor oil after running for an initial period of 30 min after addition of the sugar solution to the alcohol.

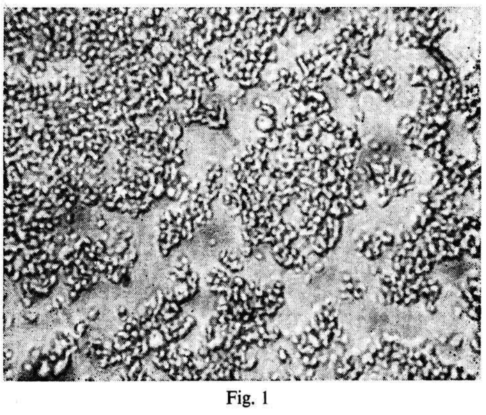


Fig. 1

The slurry prepared by the above methods is found to be very regular in size and shape as may be seen from the photomicrograph (Fig. 1). The crystal size was found to vary from 3 to 5μ on average.

[1] *I.S.J.*, 1950, **52**, 365, 394.
[2] *ibid.*, 1952, **54**, 39.
[3] GUPTA *et al. Proc. 20th Conv. Deccan Sugar Tech. Assoc. (India)*, 1965, 161–170; *I.S.J.*, 1966, **68**, 275.
* Supplied by Baird & Tatlock Ltd., Chadwell Heath, Essex, England.

Sugar Refining - Notes on Unit Processes
Part IV. Affination

By F. M. CHAPMAN (Chapman-Associates, Vancouver, B.C., Canada)

Introduction

AFFINATION is the first step in refining. As a controller of costs it is possibly the most important process, because impurities not eliminated in affination remain to plague the refiner with surplus syrup which is often a more difficult proposition than are the impurities in the original raw sugar. An idealized affination station is illustrated in Fig. 1.

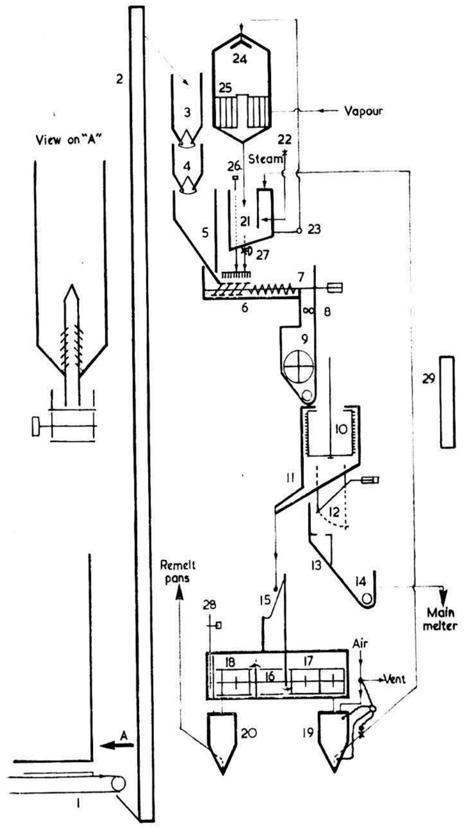


Fig. 1. KEY: (1) Variable-speed feeder, e.g. a sugar gate, oscillating plate feeder, rotating table, or steel band, etc.—a side-feed screw is *not* suitable for variable-speed control; (2) Constant-speed elevator, preferably with a fluid coupling, which feeds a surge bin (3) having a minimum capacity equal to the fill of the elevator (in case of breakdown) and a normal capacity of about half the dump of the weigher (4) which is lined with PTFE to reduce variations in tare weight; (5) Dump hopper with a restricting door in the base to even sugar flow—alternatively a plate feeder can be used; (6) Mingler with paddles at the feed end and a close-pitched scroll at the discharge end—residence time is 5 min and tip speed 250–300 f.p.m.; (7) Adjustable weir; (8) Provision for differential-speed tearing rollers; (9) Feed trough with easy access for occasional cleaning to remove debris, a large agitator and a small paddle in the bottom—residence time is 5–10 min; (10) **800–1000** *g* centrifugals which *must* have the valve in the basket bottom and which require covers; (11) Steeply sloping syrup gutter to avoid washing out grain deposits; (12) Sugar chute with anti-windage door; (13) Washed sugar receiver-conveyor which allows easy inspection of the underside of the centrifugals for variations in colour of sugar and leakage of magma or syrup; (14) Wet or dry conveyor; (15) DSM or other screen suitable for strings, etc; (16) Affination syrup tank—centre section protects mingler supply; (17) Mingling syrup section fed via underflow baffle; (18) Surplus syrup section fed via overflow baffle; (19) Montejus (or pump) of capacity 60% of melt rate; (20) Montejus (or pump) of the same capacity for liquidation to remelt; (21) Mingling syrup supply tank having a normal capacity of 5 minutes' supply; (22) Emergency start-up steam supply to assist pump (23); (24) Reaction distributor to deluge calandria (25) with syrup—the calandria has a heat transfer rate of 40 C.H.U./sq.ft./hr/°C; (26) Syrup dosing valve operating in unison with the gate on (4); (27) Emergency syrup valve operated by overload on the drive of (6); (28) Oscillating or rotary agitator to prevent settling of grain in (16); (29) Information-communication panel, generally similar to that of Inland Sugar Co., Chicago.

Wash Water Quantity and Sugar Yield

An average raw sugar contains about 2% of non-sucrose solids. The impurities are concentrated in a film of molasses on the crystal surface and it is possible by washing to remove about 75% of these impurities at the cost of dissolving about 10% of the sugar, i.e. 100 parts of raw sugar of 98 purity are converted into 90 parts of washed sugar of 99·5 purity and 10 parts of affination syrup of about 85 purity.

These are average figures; some raws have a larger proportion of ash occluded within the crystal and others have mixed grain which will purge poorly. The more soluble impurities—invert, organic matter and potassium and sodium salts, etc.—will pass readily into the run-off syrup, while silica and the less soluble salts of calcium and iron, etc., will tend to remain with the crystal.

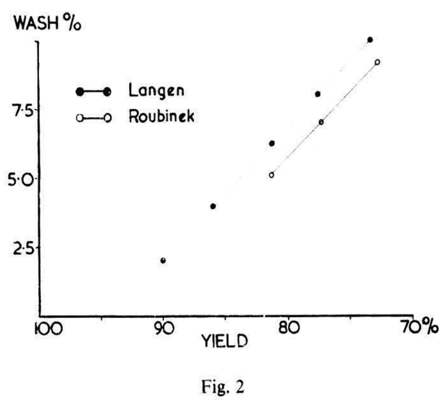


Fig. 2

Basic work was done by ROUBINEK and by LANGEN, and their results are plotted in Fig. 2. As would be expected, the yield of washed sugar varied linearly with wash water quantity, indicating that the clairce made by washing was always saturated. ROUBINEK found that, when using saturated (73·5°Bx) mingling syrup of 84 purity, to the extent of 50% on weight of raw sugar, the temperature of the syrup (45°, 60° or 80°C) had little effect on the yield. When he used mingling syrup of 72·5°, 68° and 67°Bx he showed conclusively that 73°Bx was the optimum, lower Brix diminishing the yield without any corresponding advantage.

EFFECT OF AFFINATION ON THE CRYSTALS

An investigation in Australia showed that:

(1) affination improved all the main grain sizes of a raw sugar to the same extent;

(2) improvement by affination of conglomerate grain—aggregates are the worst features of a raw sugar—was as much as 40% lower than in the case of single crystals;

(3) there was no benefit from segregating the grain sizes of raw sugar since the smaller grained sugar was always of lower quality and worse filtrability both before and after affination;

(4) mixing raw sugars before affination was detrimental, giving a decrease in filtrability below the calculated average of 34% before and 23% after affination; the subject was complex, involving five criteria and 14 variables.

Selective removal of impurities was evident in every case, with 87% removal of invert sugar on average, and 69% of the ash and other organic matter; these figures were very close to results of affination experienced at Plaistow Wharf.

Impurity distribution in raw sugars

In 1955, H. E. C. POWERS carried out fundamental work of great value by investigating the distribution of invert, ash and colour in the crystal proper and in the surrounding film of syrup. He employed two methods: (i) double affination with pure sucrose liquor, and (ii) percolation of pure sucrose liquor through a column of raw sugar. Results with the first method are given in Table I.

Table I

	Original		*Double affined*		*Residual %*	
	Invert	*Ash*	*Invert*	*Ash]*	*Invert*	*Ash*
Origin	%	%	%	%		
Mauritius	0·55	0·35	0·056	0·104	10	30
Australia	0·25	0·26	0·046	0·09	18	34
Cuba	0·51	0·38	0·038	0·11	7	29
Fiji	0·31	0·23	0·027	0·05	9	22
BWI	0·66	1·03	0·025	0·15	4	15
Beet	—	1·12	—	0·07	—	6
1st crop sugar	0·19	0·12	0·055	0·07	29	58

POWERS concluded from his tests that the maximum degree of purification possible was 95% removal of invert sugar, 73% removal of ash and 80% of colour from cane raws, and 94% removal of ash and colour from beet raws. Ash (the most objectionable impurity) in affined sugar varied from 0·03 to 0·18%.

He also worked with synthetic magmas of raw sugars, and concluded that, with a straight spin and no wash, the impurities left on the crystals are directly proportional to the surface area, i.e. halving the Mean Aperture (MA) doubles the ash of the sugar. When washing is employed, the effect of decreasing grain size is even more severe; mother syrup is trapped at more points of contact and halving the MA may increase the retained impurities eight-fold. A small proportion of fine grain can be very damaging, as is illustrated in Table II and Figs. 3 and 4.

Table II

Working tem-perature	*MA of raw sugar*	*Wash %* 0	3	6	9
(°C)	(*inches*)	*Ash in washed sugar* (%)			
20	0·042	0·10			
		0·085	0·034	0·0023	
		0·09	0·037	0·033	
		0·07	0·024	0·0185	
	0·011	0·48			
		0·33	0·25	0·12	0·10
		0·27	0·19	0·11	0·10
		0·24	0·12	0·08	0·06
	0·042 + 10% dust	0·38	0·19	0·11	
40	0·040	0·043	0·018	0·015	
	0·010	0·160	0·080	0·060	0·030

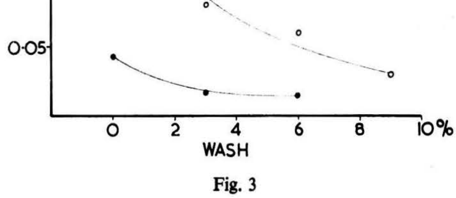


Fig. 3

G. CONNOR in 1963 made a comprehensive investigation into the affinability of British beet raw sugars. He found, as illustrated in Fig. 5, that ash increased as grain size increased; the coefficient of variation (CV) was bad in all the sugars examined but there was no correlation between the CV and the ash removed by affination. He took samples of three deliveries from the same factory which responded quite differently to affination (Table III); their ash/grain size relationships are recorded in Fig. 6.

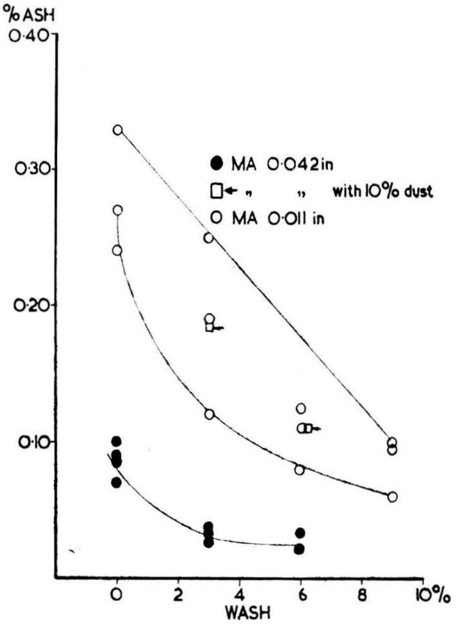


Fig. 4

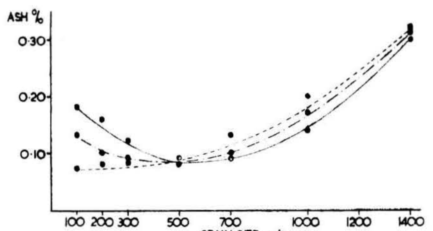


Fig. 5

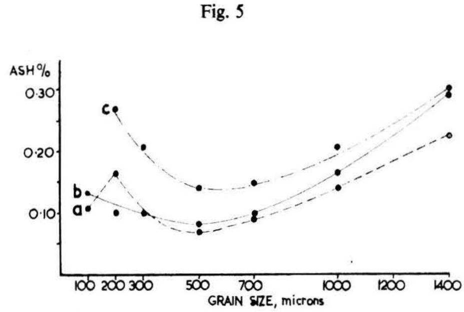


Fig. 6

Table III

Sugar	*Original ash (%)*	*Ash (%) after affination*	*% removal*
a	0·72	0·11	85
b	0·73	0·15	78
c	0·73	0·25	66

Typical curves for sugars showing good affination and bad affination are recorded in Figs. 7 and 8 in which are plotted ash and colour *vs.* grain size. In each there is an obvious valley, and sugar outside the 300–700 micron size bracket should be remelted. The reasons for such differences in shipments are not apparent and the subject would justify more study.

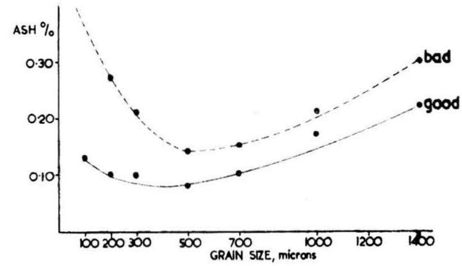


Fig. 7

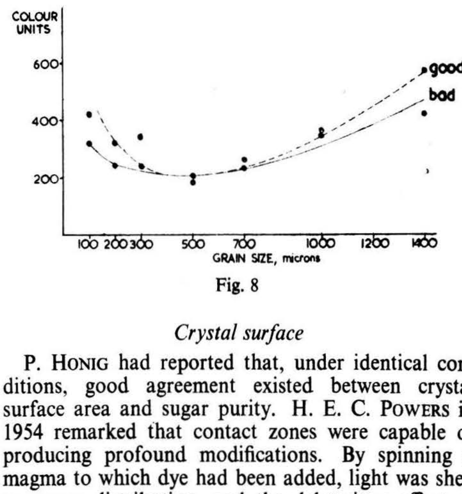


Fig. 8

Crystal surface

P. Honig had reported that, under identical conditions, good agreement existed between crystal surface area and sugar purity. H. E. C. Powers in 1954 remarked that contact zones were capable of producing profound modifications. By spinning a magma to which dye had been added, light was shed on syrup distribution, and the deleterious effect of surface irregularities demonstrated. The variation of surface area with changes in MA and CV of the crystals is illustrated in Table IV. As may be seen, the MA is the factor causing the greater differences; the influence of the CV is rather small.

Table IV

MA (in)	*CV*	*Specific surface (sq.m./g)*
0·040	25	4·6
0·025	20	6·9
	30	7·5
	40	8·1
0·0125	45	16·7
0·006	50	37·6
0·001	50	230·0

Mingling

Before raw sugar can be charged and spun in a centrifugal it has to be fluidized by the process of mingling, which is a compromise between conveying and mixing. A secondary purpose of mingling is to reduce the viscosity of the film of molasses on the crystals. Molasses by definition has an impurity:water ratio of 3 or more and at room temperature is so viscous that it cannot be removed by any centrifugal force which can be applied. But, if diluted with three times its own weight of raw sugar clairce (made by washing) the resulting 85 purity syrup may be 97% eliminated.

In 1934 Bogstra made a comprehensive investigation[1] from which he concluded that:

(i) 80–90% equilibrium between the syrup on the crystals and the mingling syrup is rapidly achieved, but beyond these limits it becomes progressively slower; fresh sugars, because of the higher purity of the syrup envelope, reach equilibrium with mingling syrup more rapidly than do older sugars;

(ii) best results are obtained by mingling with saturated syrups of the highest purity since it is not possible to obtain unwashed syrups with a syrup film of higher purity than that of the mingling syrup;

(iii) undersaturated mingling syrups dissolve sugar and so increase both the crystal surface per unit weight and the quantity of syrup retained on the grain; for the same reason, mingling syrups should not be heated to above the saturation temperature of the magma to be spun;

(iv) because sugar quality is a function of the quality of the residual syrup it appears that countercurrent step affination is a sound principle, but as in the separation of "green" and "wash" syrups, the complication and multiplication of the plant is a major difficulty.

Many minglers have two types of conveyor-agitator. Tip speeds can be 200–250 f.p.m. Raw sugar drops onto a ribbon which conveys it for 6–8 feet and passes it to a paddle section which is almost invariably arranged for recirculation. In the USA much use is made of "cut flights" where gaps in the edge interrupt the conveyor action. In the UK paddles are generally used because if a paddle is bent it is more easily replaced. To prevent "logging", any mixing/conveying system *must* break the surface and, because breaking the surface beats air into the magma, mixing time should be short (3-10 minutes). Splashing is a problem when paddles are used, and minglers should then be covered.

To get consistent magma, most refineries use weirs; a weir may be about shaft level and in it may be a pair of bolted covers to provide ports if modification is necessary. Surmounting the weir may be a grating of ½ in × 1½ in flat at about 1½ in centres. In the bottom of the weir there must be a drain gate.

Magma making is not critical, the main purpose being to make a mixture which will form a uniform wall within the centrifugal basket, and to demolish lumps. The worst fault a magma can have is to be "light" and inconsistent. Light magma is dangerous to the centrifugals and, with open-bottomed centrifugals, to the melter also, so that it is best for security and good washing to have bottom valves on all baskets. It (light magma) is often the result of a subterfuge to increase the amount of wash per ton of raw sugar.

The need for consistency is obvious since it helps the charging mechanism and ideally it may be achieved by arranging that the raw sugar scale drops a constant volume so that the *weight* is nearly constant; modulation of the syrup is then rare. It is best to aim for about 89°Bx magma and a temperature of about 45°C.

Plant arrangements

The raw sugar input *must* be weighed, and if an accurate bulk weigher is mounted above the mingler and arranged also to dose the mingling syrup, the savings in labour and the uniformity of the magma will pay for the weigher. In the author's opinion, none of the inferential methods of control (power, torque, conductivity, etc.) are as satisfactory as simple proportioning by weight. Many refiners interpose between the weigher and mingler some sort of feeder such as a roller, band or plate feeder, to even out the flow of sugar, but these are liable to spill sugar, need maintenance, and require an additional drive which, by adding a link to the chain, decreases the reliability of the system.

Power consumption

For an input of 100,000 lb of sugar per hour and a tip speed of 200 f.p.m., it seems appropriate to allow for a power consumption of about 11–15 kW for mingling. Too much power may churn air into the magma and also damage the crystals. Prolonged stirring is often accompanied by poor work at the centrifugals. A mingler should always be driven from the discharge end; this puts the shaft in tension and, if the inboard end bearing is capped, there need be no gland leak.

If, following the mingler, magma is heated by a Stevens coil, it will be sensible to allow for a normal power consumption (in the coil and in the circulating water pump) of 25–30 kW, with peaks of 40–50 kW if the magma is cold or stiff.

Mashing rollers

With the passing of raw sugar in bags, the rollers ahead of the mingler have disappeared, but many refineries still use tearing rolls downstream of the mingler. It is general for these to run at differential speeds in a ratio of 1:1·5 and one gear must be able to "climb" the other to avoid breakage due to tramp iron. These rollers are frequently about 10 inches in diameter and covered with pyramidal studs, and their function is obviously to crush any lump which has passed through the mingler proper.

(To be continued)

[1] *Archief Java Suikerind.*, 1934, deel II, meded. (8), 265–278.

Sugar cane agriculture

Soil conservation on an unirrigated plantation. I. Yonemitsu. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 47–50.—Measures adopted on a Hawaiian sugar cane estate are described. Steep slopes, stony and erodable soils, summer droughts and high intensity winter rains were some of the difficulties to be faced. The conservation methods adopted have resulted in increased yields and reduced expenditure on rehabilitation after storm damage.

* * *

Results of slag experiments. E. C. Spillner. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 96–102.—The field experiments reported were carried out at Grove Farm Estate, Kauai, Hawaii, the slag being a by-product of the recovery of phosphorus from rock phosphate by the electric furnace process. Visual response in the cane treated was outstanding and the effect on ratoons was lasting. It was considered that silicon was somehow responsible.

* * *

The rôles of calcium silicate slags in sugar cane growth. H. F. Clements. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 103–126.—It is pointed out that the essential materials in slag are calcium and silicate and that it has several possible functions. It may change soil pH as does coral or limestone. Slags also contain various contaminants any one of which may, under certain conditions, have a positive or beneficial effect on cane growth. The results of experiments with slag at various centres in Hawaii are discussed, as is the effect of slag in increasing phosphate uptake and in reducing tissue manganese, which is responsible for freckling or bronzing in sugar cane.

* * *

Evaluation of D-767, D-732 and "Tordon" experimental herbicides. H. W. Hilton. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 144–146.—Field testing in sugar cane of the two Du Pont uracil herbicides D-767 and D-732, and the Dow herbicide "Tordon" ("Picrolam") is described and their advantages and disadvantages discussed.

* * *

Effects of chemicals on ripening of sugar cane. L. G. Nickell and T. T. Tanimoto. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 152–166.—Work on the chemical ripening of sugar cane in various parts of the world is reviewed and the conflicting nature of the results pointed out. Work carried out so far in Hawaii is discussed, over 200 chemicals having been tested. A list of these is given.

Notes on the natural history, behaviour and control of the Polynesian rat, ***Rattus exulans*****.** W. R. Smythe. *Rpts.* 1965 *Meeting Hawaiian Sugar Tech.*, 167–171. The Polynesian rat problem is discussed at some length. Its food habits differ from the other common rats (Norwegian and Alexandrine rats) rendering poisoning more difficult. The writer considers that the problem may only be solved through the efforts of scientifically trained people who must be well versed in ecology, ethnology and other life sciences.

* * *

Fertilizing of sugar cane (Réunion). J. Fritz. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1966, 51–60.—Experiments were concerned with N, P, K and with sulphur. Adverse factors such as cyclones and drought unfortunately affected some experiments. Details are given of the results obtained at various centres in the island.

* * *

Sugar cane diseases. M. Hoarau. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1966, 65–97. There were no notable changes in the disease position with sugar cane in Réunion as compared with the previous year. Work and observations on gummosis are discussed at some length. The cyclone Denise was an efficient agent in spreading the disease. Reaction of 40 different sugar cane varieties to gummosis is discussed and tabulated. Other diseases reported on include leaf scald and chlorotic streak.

* * *

Introduction to Réunion of the borer parasite *Diatraeophaga striatilis*. J. Etienne. *Ann. Rpt. Inst. Recherches Agron. Trop. Réunion*, 1966, 101–112.—Work reported in the previous annual report[1] was continued and further success in breeding the parasite is reported. Difficulties are outlined. The borer in question is *Proceras sacchariphagus*.

* * *

Soil compaction, its causes and effects and practices to minimize it. Anon. *Victorias Milling Co., Expt. Sta. Bull.*, 1967, **14**, (5 & 6), 4–5, 7.—Soil compaction in Philippine cane fields is discussed. It has been shown that cane roots will not penetrate heavily compacted soil and that the ill effects of soil compaction is felt mainly in ratoon crops. Preventing soil compaction is often unpractical as the cane crop must be tilled and harvested, but the adverse effects of compaction may be minimized if the right machin-

[1] *I.S.J.*, 1967, **69**, 240.

ery is used and only when soil moisture is low. Practices which help minimize soil compaction are discussed.

* * *

Low planting density and wide rows produce as much as high planting density and narrow rows. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1967, **14**, (5 & 6), 5.—Results of experiments on planting densities and furrow spacings are discussed. The object of these was to find the optimum rate of planting and the optimum distance between rows for economic sugar production under unirrigated and deep ploughing conditions.

* * *

Broadening the genetic base to improve sugar cane for Louisiana. P. H. DUNCKELMAN and R. D. BREAUX. *Sugar Bull.*, 1967, **46**, (2), 12–15.—The use now being made of wild species of sugar cane or sugar cane allies, such as clones of *Saccharum spontaneum*, in breeding new canes for resistance to disease, notably mosaic disease, is discussed. The new germ plasm afforded by the wild canes may also be of value in breeding cane for greater cold or drought resistance and possibly for rapid cool weather growth. The latter would be a major deterrent to the takeover of cane fields by grass and weeds during cool, wet periods.

* * *

Combating cane smut in São Paulo. ANON. *Brasil Açuc.*, 1967, **70**, (3), 15–17.—The combined activities or united efforts of various organizations concerned with sugar cane in an attempt to control or reduce the damage caused by cane smut (*Ustilago scitaminea*) in São Paulo are discussed. Reduction in cultivation of the more susceptible varieties is one line of attack.

* * *

Fibre content of new varieties of sugar cane (in Brazil). B DANTAS, J. G. AMORIM, M. M. DE MELO, M. S. RAMOS and F. P. REGO. *Brasil Açuc.*, 1967, **70**, (3), 42–51.—Results are given of an investigation of fibre content of 19 varieties of sugar cane, some of which may replace the widely cultivated and predominant variety Co 331. Significant differences were associated with the month when samples were taken for analysis.

* * *

Pests of sugar cane causing serious damage and advice on their control. F. MARIOTA T. and J. MALDONADO C. *La Ind. Azuc.*, 1967, **73**, 263–265.—The great damage caused by the borer *Diatraea saccharalis* in Puerto Rico is referred to and the pest discussed. Four species of white grub are of economic importance, these being *Phyllophaga guanicana*, in the south east part of the island, *P. citri*, abundant on the north coast, *P. vandinei* on the east coast and *P. portoricensis*. The use of the Surinam toad, *Bufo marinus*, in controlling these pests is discussed. Other insect pests dealt with include *Diaprepes abbreviatus*, *Mocis repanda* and *Laphygma frugiperda*. Pests of minor importance are also mentioned.

Nematode investigation of sugar cane in Iraq. J. M. ALLOW and Z. A. KATCHO. *Plant Disease Reporter*, 1967, **51**, 809.—The presence of nematodes in sugar cane in Iraq is reported, believed to be for the first time. Patches of stunted and chlorotic cane (variety N:Co 310) were found to have the following nematodes, in order of frequency: *Longidorus sylphus* (needle nematode), *Helicotylenchus dihystera* (spiral nematode), *Pratylenchus zeae* (lesion nematode) and *Tylenchorhynchus* sp. (stylet or stunt nematode).

* * *

Farms with 100-500 acres of cane produce highest yields. G. R. TIMMONS. *Sugar Bull.*, 1967, **46**, 10–12. An analysis of yields on Louisiana cane farms revealed two interesting facts—(1) yields increase with the size of farm up to a point but then decrease as the size of the farm increases; and (2) farms between 100 and 500 acres usually show the highest yield per acre. Likely explanations are discussed. On farms under 100 acres the level of technology applied is usually low. On farms over 500 acres supervision may be the limiting factor. With farms of the 100–500 acre category the owner of the cane is usually the supervisor.

* * *

Common sugar cane diseases of the world. K. V. SRINIVASAN. *Sharkara*, 1966, **8**, 152–154.—The list is admitted to be partly based on the book "Sugar Cane Diseases of the World" Vol. 1 by J. P. MARTIN *et al.*[1]. The diseases are listed according to the nature of the causal agent, e.g. fungi, bacteria, unfavourable environment, etc. Eight parasitic plants (Phanerogams) are also included. A diagrammatic chart shows the part of the sugar cane plant affected, the names of diseases present in India being underlined.

* * *

Effect of farmyard manure and inorganic fertilizers on quality of sugar cane juice and cane yields. R. PRASAD, B. A. LAKHDIVE and B. B. TURKHEDE. *Indian Sugar*, 1967, **17**, 339–345.—In India a common practice among cane growers is to apply a half to two-thirds of the nitrogen in organic form (farmyard manure) and the rest as inorganic nitrogen (ammonium sulphate). The experiments described were to test the validity of the practice. Results obtained indicated that the balanced inorganic fertilization was the only way to secure high yields of sugar cane, with juice of good quality leading to high commercial sugar cane yields.

* * *

Blowers and chopper harvesters. L. G. VALLANCE. *Australian Sugar J.*, **1967**, **59**, 347–351.—Blower attachments to chopper harvesters have proved very satisfactory in Queensland cane fields in reducing extraneous matter in bin cane. Most of the successful blowers have been made and fitted by the growers themselves. Some of these are described and illustrated.

[1] *I.S.J.*, 1962, **64**, 85.

Johnson grass—a two-edged sword. G. ARCENEAUX. *Sugar J.*, 1967, **30**, (5), 9–12.—The menace of Johnson grass (*Sorghum halepense*) as a cane field weed in Louisiana and its potential danger in harbouring some strains of sugar cane mosaic disease are discussed. It is a favoured host of the insect vector *Aphis maidis*. The writer suggests the possibility or practicability of prolonged fallow flooding of Louisiana cane fields to control Johnson grass (destroy seeds) and reduce the mosaic danger. This kind of flooding has been regularly practised in Guyana cane fields for many years.

* * *

Sugar cane varieties for West Pakistan. O. J. MIAN. *Sugar J.*, 1967, **30**, (5), 37–40.—The unusual and exacting cane growing conditions that prevail in the Peshawar valley, with frosts in the cold season, are referred to. Trials with numerous new varieties, with a view to supplanting Co 622 at present grown, are described. The conclusion reached was that, with early high sugar content so important, the varieties CP 48/103, N:Co 310 and CoS 321 showed most promise. Trials were carried out at the Mardan Sugarcane Research Station.

* * *

Leaching in sands and its effects on nitrogen recovery by young cane. R. A. WOOD. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 137–142.—Details are given of a greenhouse experiment to study the effects of leaching and delayed nitrification on nitrogen uptake by young cane on two coastal sands in Natal. The effect of leaching was to reduce yield and nitrogen recovery from all fertilizer treatments on both soils. Certain factors were found to affect greatly the degree of leaching and nitrogen uptake by the plant. These were—(1) amount and time of water application, (2) type of fertilizer applied, (3) the use of "N-Serve", a nitrification inhibitor and (4) pH and texture.

* * *

The simultaneous growth of sugar cane roots and tops in relation to soil and climate. J. GLOVER. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 143–159. Results are given of work carried out with the aid of the new root observation laboratory at the Experiment Station at Mount Edgecombe in Natal. Root growth may be observed in different soils through transparent windows below the surface of the soil. This article is in the nature of a preliminary report, the work being not yet completed. The beneficial effect of disturbing the soil on sugar cane root growth was clearly shown.

* * *

The estimation of cane root development and distribution using radiophosphorus. G. H. WOOD and R. A. WOOD. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 160–168.—An account is given of the application of radioisotope techniques as applied to sugar cane root growth on sandy soil on the Natal coast throughout the life of the plant crop and early stages of the ratoon crop. Initial root development was mainly confined to the surface foot of soil, but after 20 weeks roots had reached a depth of 5 feet. Drought stimulated further root development to a depth of 7 feet. This explains the drought resistance of cane grown on the coastal sands.

* * *

The effects of herbicides on *Cyperus* spp. J. M. GOSNELL and G. D. THOMPSON. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 169–177.—Work previously carried out on chemical control of sedges in sugar cane, i.e. watergrass or nutgrass, *Cyperus esculentus* and *Cyperus rotundus*, is reviewed and results are given of recent experiments with some of the newer herbicides. "Gramoxone" was most effective when sprayed on both species of *Cyperus* at a rate of 2 or 3 pints per acre, 2 to 4 weeks after weed emergence. The addition of some 2,4-D improved efficiency. The uracils were consistently successful but the toxicity of "Hyvar X" and "Sinbar" to sugar cane limited their usefulness. "Afalon" gave fairly good control of *C. esculentus* but did not control *C. rotundus*.

* * *

Field populations of *Numicia viridis*. A. J. M. CARNEGIE. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 178–180.—Results of field studies on the green leaf sucker, first recorded as a cane pest in 1962, are given. It is now regarded as a pest of inland irrigated cane rather than of coastal areas where numbers have been small. It has been established that three generations per annum occur on cane, as is the case with indigenous grasses.

* * *

Four years of *Numicia* survey. J. DICK. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 181–183. The information collected during four annual surveys on the distribution of the green leaf sucker (*Numicia viridis*) in South African cane growing areas is analysed and discussed. Regarding varietal susceptibility, it was found that percentage incidence was slightly higher in N 50/211 than in N:Co 310. In N:Co 376 incidence was consistently somewhat lower than in N:Co 310.

* * *

Notes on diseases of sugar cane at Hippo Valley Estates Ltd., 1962 to 1967. M. J. P. KOENIG. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 202–205.—This large sugar estate (150,000 acres) with 24,000 acres under cane in the south eastern lowveldt of Rhodesia has an annual rainfall of 20 inches and irrigation is extensive. The dry climatic conditions favour sugar cane smut (*Ustilago scitaminea*). This and leaf scald (*Xanthomonas albilineans*) are the two serious diseases. Other diseases recorded are gumming, brown spot, pineapple disease, pokkah boeng, red rot of leaf sheath, red spot of leaf sheath, and leaf galls.

Studies of parasitic fungi on the cane pest *Numicia viridis*. G. Roth. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 184–189.—Reasons why it is thought large numbers of the green leaf sucker perish every year because of infection from a parasitic fungus or fungi are given. Attempts to isolate the parasite or parasites are described. A species of *Mucor* and *Entomophthora* are implicated. So far the *Entomophthora* has not been induced to sporulate.

* * *

Aluminium and silica relationships in growth failure areas. R. T. Bishop. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 190–196.—An investigation is reported of two soils with high aluminium and silica contents known to be associated with poor cane growth. Applications of lime were found to decrease the levels of soluble Al and increase the levels of soluble Si but did not improve yield. Although poor growth is associated with high levels of Al it may not be caused by it but by other deficiencies (Ca, Zn or trace elements) occurring simultaneously.

* * *

A nutrient survey of cane on T.M.S. soils in Natal. K. E. F. Alexander. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 197–200.—Results are given of a controlled survey of nutrient status as determined by analysis of leaf samples, the 188 samples having been taken from cane of the same variety and age and growing on Table Mountain Sandstone soils. Results indicated a fairly widespread zinc deficiency. Some samples were low in copper, their soils being regarded as marginally deficient in that element. Determination of boron and molybdenum levels are planned for the future.

* * *

The effects of hot air treatment and hot water treatment on the germination of 12 commercial sugar cane varieties in Natal. G. M. Thomson. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 206–212.—Much variation was apparent in varietal reaction to the two types of treatment for control of virus disease. Average overall germination was 47%. In some varieties germination after heat treatment was low, especially in the variety CB 36/14. With most varieties, treating whole stalks instead of setts with hot water brought no serious problems in germination.

* * *

New grab-loader developed at Nkwaleni. Anon. *S. African Sugar J.*, 1967, **51,** 847.—This new grab-loader for cane, developed by C. J. Laing in Zululand, is described and illustrated. It is mounted on a crawler tractor, the loader push-raking the cane, with the grab lifting bundles of approximately 600 lb. An interesting feature is the guiding device which centres the grab-arm above the push-raked bundle.

* * *

Herbicide application—a new approach. G. J. F. Wardle. *S. African Sugar J.*, 1967, **51,** 861–867. During the last two years Illovo Sugar Estates in Natal have embarked upon a comprehensive chemical weed programme in view of labour shortage. A notable feature has been the adaptation of orchard sprayers, or low-volume mist blowers, for use in sugar cane. How adaptation was successfully carried out is fully described.

* * *

Plant parasitic nematodes associated with sugar cane production in Rhodesia. G. C. Martin. *Plant Protection Bull.*, 1967, **15,** (3), 45–58.—A review of recent nematological work in relation to sugar cane in Rhodesia is given. A survey revealed the presence of many nematodes in cane fields in Rhodesia. These are listed. The root knot nematode (*Meloidogyne javanica*) is considered to do most damage to sugar cane and is widespread, especially in light, sandy soils. Results of successful trials with soil fumigants, overall and row treatments, with some soil fumigants on both plant and ratoon cane, are reported (ethylene dibromide, DD, "Nemagon" and "Dorlone"). The use of "Nemagon" in overhead sprinkler lines was not successful. The use of molasses and filter press mud, from 20 to 40 tons per acre on light soils, was very successful. Twenty cane varieties were found susceptible to nematode attack. Only one (Co 290) showed some tolerance.

* * *

Studies on the irrigation of sugar cane. R. A. Yates. *Australian J. Agric. Sci.*, 1967, **18,** 903–920.—Results are given of eleven replicated irrigation trials carried out in the Bundaberg region of southern Queensland during the four seasons 1961–62 to 1964–65. Growth, and therefore growth response to irrigation, was severely curtailed when mean temperatures fell below 70°F. Soil temperature appeared to be a critical factor. Yield responses to irrigation varied greatly with different soil types. On a deep red volcanic loam they were ten times as great as those on heavy alluvial clay. Probable reasons for this are given.

* * *

Longevity of *Meloidogyne javanica* under conditions of bare fallow in Rhodesia. G. C. Martin. *Rhodesia Agric. J.*, 1967, **64,** 112–114.—Experiments on three common soil types showed that this nematode, which may attack sugar cane, could persist for longer than $4\frac{1}{4}$ years in fallow soil. Soil infestation remained high for two years and then declined slowly.

* * *

Wet and dry seasons and their effects on rain-fed sugar cane in Natal. G. D. Thompson and R. A. Wood. *Trop. Agric.*, 1967, **44,** 297–307.—More than 85% of the sugar cane crop in Natal is grown under rain-fed conditions and average annual rainfall is only 38 inches. Yields consequently vary widely from year to year depending upon amount and distribution of rainfall. In two successive seasons yields were 44·2 and 18·4 tons/acre of cane. The advantages of a trash layer for conserving moisture under the prevailing conditions are discussed.

The tolerance of sugar cane to alkaline conditions and its related response to fertilizers. G. R. SAINI. *Trop. Agric.*, 1967, **44**, 309–313.—Results are given of a study of alkaline sugar cane soils in the Jagadhri factory zone in the Punjab. Cane yields from sample plots indicated that the variety Co 453 was tolerant to alkaline conditions. No significant correlation was found between soil pH and yield of the crop but correlations between pH and expected sugar recovery and between pH and commercial cane sugar per acre were significant. Nitrogen was found to increase the cane yield significantly but not the commercial cane sugar. The effects of phosphorus and potash and the interaction between nitrogen, phosphorus and potash on the yield of cane and commercial cane sugar were not statistically significant.

* * *

Weeds of Mauritius. No. 15 ***Setaria barbata*****; No. 16** ***Setaria pallide-fusca*****.** E. ROCHECOUSTE and R. E. VAUGHAN. *Mauritius Sugar Industry Res. Inst. Leaflet*, 1967, (11), 6 pp.—These two grass weeds, which are common in Mauritius, are described and their ecology and distribution discussed. They both seed freely, can increase rapidly and may be troublesome in cane fields in Mauritius. Chemical control measures are discussed.

* * *

The struggle in Natal against the American bramble. K. EGBERINK. *Farming in South Africa*, 1967, **43**, 27. This weed (*Rubus cuneifolius*) was introduced to Natal in 1900 and was proclaimed a noxious weed in 1962. Experiments in chemical control are described, "Picrolam" having so far shown most promise.

* * *

Varietal resistance to sugar cane smut in Kenya. J. M. WALLER. *East African Agric. Forestry J.*, 1967, **32**, (4), 399–403.—The reaction of 80 cane varieties to sugar cane smut (*Ustilago scitaminea*) was determined in the field at Nyanza and in laboratory tests. The results are tabulated. Correlation was not very good. It was concluded that *in vitro* tests tended to underestimate field susceptibility.

* * *

Economics of phosphate and potash application to sugar cane in Nellikuppam Tract. V. RANGANATHAN, L. M. GHOUSE and T. A. GOVINDAIYER. *Indian J. Agric. Sci.*, 1966, **36**, 210–219; through *Hort. Abs.*, 1967, **37**, 471.—Experiments are described in which N, P and K were applied at 112, 24·5 and 93 kg/ha and at double these quantities respectively. Data are tabulated on soil analysis, N, P and K contents of the cane leaf, sheath moisture values and C.C.S. percentages. Results indicated that P and K were not limiting factors for economic cane production in these soils but that N alone determined the yield and quality. At the higher levels of N the moisture in the crop was increased and it became necessary to delay harvest to maintain quality.

Some correlated traits in sugar cane. S. R. RANGANATHAN and R. NARASIMHAN. *Indian J. Agric. Sci.*, 1967, **37**, 270–272.—An account is given of an attempt to correlate the height of the sugar cane plant at the pre-monsoon stage with the final height of the sugar cane stalk, also tillering at the pre-monsoon stage with the final millable stalk population. Ten locally popular varieties of sugar cane were used. It was thought that the pre-monsoon data on height and tillering obtained might serve as a good index of the final data and be of use in selection.

* * *

Contributions to the study of sugar cane borers in Réunion. J. G. POINTEL. *Agronomie Tropicale*, 1967, **22**, 1053–1077.—This study is concerned with four stem borers of sugar cane in Réunion: *Proceras sacchariphagus*, *Sesamia calamistis*, *Argyroploce schistaceana* and *Opogona sacchari*. Borer attack is correlated with reduced yield. The general effects of borer attack on the sugar cane plant and the reaction of different sugar cane varieties in Réunion are discussed. The work was undertaken by the author to enable him to advise planters in Réunion regarding choice of variety for any particular site.

* * *

Occurrence of banded chlorosis of sugar cane in Puerto Rico. L.-J. LIU, T. ROSARIO and F. MÉNDEZ-ROIG. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 76–81; through *Hort. Abs.*, 1967, **37**, 472.—A survey showed that the incidence of chlorotic banding varied with locality and temperature. No causal agent was found and it was thought the malady may be caused by high air temperatures.

* * *

On the bionomics and ecology of ***Heteronychus licas*****, a new pest of sugar cane in Nigeria.** T. A. TAYLOR. *Bull. Entomol. Res.*, 1966, **57**, 143–158.—Suggestions for controlling the pest are made; these include cultural practices—time of planting, controlled irrigation, biological control (six predators are known) and chemical control.

* * *

Evapotranspiration and sugar cane yields in Barbados. J. S. OGUNTOYINBO. *J. Trop. Geog.*, 1966, **22**, 38–48; through *Hort. Abs.*, 1967, **37**, 468–469.—Potential and actual evapotranspiration (PE and AE) of sugar cane crops were determined for various regions over the period 1940–62 when B 37161 was the main variety grown. Generally no moisture deficiency occurred in any region during the wet season. In the dry season AE/PE fell below the critical level of 0·73 in 60%, 46% and 15% of crop cycles in the areas of low, medium and high rainfall respectively. As it was shown experimentally that a cloud cover may have a beneficial effect on the growth of cane, cane yields may depend on cloudiness as well as rainfall. Cane yields could be improved by irrigation if the underground water resources of the island were adequate.

Sugar beet agriculture

Sugar beets in Arkansas. A. M. Davis. *Bull. Ark. Agric. Exp. Sta.*, 2967, (721), 3–21; through *Soils and Fertilizers*, 1967, **30,** 607.—Results of sugar beet trials on various soil types are discussed. Crusting, wind erosion and severe cracking when dry, causing damage to roots, are discussed. The soil termed Sharkey clay was considered to have the best production potential.

* * *

Some investigations on the occurrence of virus diseases in sugar beet in Chile. W. Steudel and S. Arentsen. *Zucker*, 1967, **20,** 325–330.—An advisory trip to Chile lasting 3 months is described, the object having been to observe and report on virus diseases of sugar beet (yellow wilt, virus yellows and mosaic). It was concluded that yellow wilt may constitute a serious threat. Virus yellows was found over all the growing area but in general infections were light. Beet mosaic occurred sporadically, the recommendation being made that the cultivation of seed beets be separated from beets for sugar production.

* * *

Effects of four methods of mechanical incorporation on the phytotoxity of "Pyrazon". G. A. Lee and H. P. Alley. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14,** 248–253.—"Pyrazon" is recognized as an effective pre-emergent herbicide for weed control in sugar beet when properly applied (physically mixed with the soil). Experiments are described which were undertaken to determine the effects of mechanical incorporation of the phytotoxicity of "Pyrazon". The herbicide PEBC was similarly tested. The power driven "Roto-tiller" was the most effective of the four methods tried. The thinner-weeder was also efficient.

* * *

Fungicidal control of sugar beet leaf spot. L. W. Carlson. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14,** 254–259.—Three years of fungicide evaluation for control of leaf spot (*Cercospora beticola*) are described. "Duter" at 1·5 lb/acre gave the most effective control, the best timing being mid-July to late August with 3 to 5 applications. Control of leaf spot generally increased beet and sugar yields.

* * *

Small doses of D-D soil fumigant to control free-living nematodes injurious to sugar beet. A. G. Whitehead and D. J. Tite. *Plant Pathology*, 1967, **16,** 107–109. Fumigating all the top soil of a field to kill nematodes can be very expensive. Recent field experiments are described which made field fumigation more practical and effective. Field experiments showed that small controlled doses of D-D (dichloropropane/dichloropropene mixture) controlled the needle nematode (*Longidorus attenuatus*) and stubby root nematode (*Trichodorus*). The fumigant is dribbled into alternate plough furrows in winter, the position being indicated by drilling winter wheat. This allows of the sugar beet being sown only in the fumigated bands of soil.

* * *

The effect of soil fumigation on the growth of sugar beet. D. N. Greet. *Plant Pathology*, 1967, **16,** 111–116.—Four trials are described on sandy soils where sugar beet had previously grown poorly. Soil fumigation with D-D and chloropicrin was carried out but only slight improvements in growth and yield resulted. The so-called Docking disorder of sugar beet may have been a factor involved. The nematode population is discussed.

* * *

Some aspects of competition for light in potatoes and sugar beet. P. M. Bremner, E. A. L. el Saeed and R. K. Scott. *J. Agric. Res.*, 1967, **69,** 283–290. Sugar beet plants (variety Sharpes 9156) were grown in 5-gallon containers under different conditions of spacing. It was concluded that the relative growth rate was 10% less with closely spaced plants because net assimilation rate was greatly decreased. Leaf area ratio was increased. Increasing competition for light decreased mineral nutrient uptake.

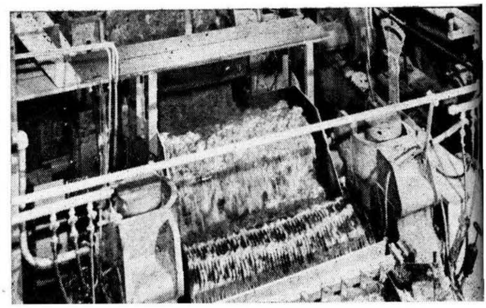
* * *

Investigations on sugar beet singling procedures under the influence of differences in field emergence. R. Schildbach. *Zucker*, 1967, **20,** 399–404.—The experiments discussed were carried out on the same soil type (para brown earth) in two seasons (1964–1965) showing quite different climatic conditions. Variations in field emergence may be due to several factors, especially temperature and sowing technique. Manual singling gave the highest yields. In favourable seasons "Stolls Selecta" gave approximately the same yields as manual singling, but lower in unfavourable seasons.

* * *

The care of harvesters and cleaner-loaders. P. Freed. *British Sugar Beet Rev.*, 1967, **36,** (1), 35–37.—The correct servicing and treatment for beet harvesters and cleaner-loaders, to be carried out as soon as the season's work is over, is explained.

Cane sugar manufacture



Chemical cleaning of steam generators. N. H. OKIMOTO. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 5–15.—Various aspects of chemical cleaning of boiler waterside surfaces are discussed in the light of experience at Hawaiian Electric Co. Inc.

* * *

Polyelectrolyte for boiler sludge conditioning. P. L. YOUNG. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 16–18.—In tests on boiler sludge dispersion, a synthetic polyacrylate condition was found to give excellent results when added to the concentrated water at 40–100 p.p.m. Above 100 p.p.m. not only was deposition prevented, but earlier deposits were removed, while at 40 p.p.m. excellent results were still obtainable. Since the chemical is safe to handle and is not injurious to health, determination of polyacrylate residue in the water is considered unnecessary.

* * *

The Honiron "Hi-Extraction" process. J. W. BERSCH. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 74–79. In the process described, prepared cane is delivered to the top of an inclined rinsing hopper designed to consolidate the cane. Once the hopper is full, multiple screw presses continuously discharge the bagasse from the bottom. Juice is pumped through the cane, during its downward passage, from inlet chambers located on the upper side of the hopper, and drains through screens on the lower side. The advantages of the unit, which is manufactured by Honolulu Iron Works Co., over conventional cane mills and diffusers are discussed. Using three units in series, an extraction of 98% may be achieved during a total retention time of 20 min.

* * *

Resistance heaters for low-grade massecuite. H. IDEHARA and K. KAI. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 80–85.—Tests with a 30-kW resistance heater designed and built at Pioneer sugar mill using design parameters established on the basis of work reported by WRIGHT[1] are discussed. At a throughput of 110 lb/min, massecuite was heated from 115–122°F to 145°F, molasses purity rise being generally below 0·40% up to 11·5°F above saturation temperature. Temperature was maintained to within ±1°F as measured by a thermocouple installed at the iris valve controlling massecuite flow from heater to centrifugal.

1966 investigations on the diffusion operation at Pioneer Mill Co. Ltd. J. H. PAYNE, G. E. SLOANE and B. S. SILVER. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 86–91.—Performance of the Silver ring diffuser at Pioneer during 1966 is discussed. At an average dilution of 15·22% on absolute juice, average extraction was 97·51%. Cane bed depth was 4–5 ft and diffuser speed 13 r.p.h. The cane was limed on entering the diffuser, and juice was sent direct from the diffuser to evaporators at an average turbidity of 28. Heater and evaporator scaling presented no problems. Of the three factors investigated for their effect on juice coloration, leaf trash content was found to be the most significant, reducing light transmittancy by 50%, while temperature increase from 160° to 190°F reduced it by 33% and cane liming by 20%. Bagasse treated by French screw presses had an average moisture content of 47·85%.

* * *

Digital computer applications for the factory. E. J. LUI. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 92–99.—Five possible applications for digital computers in a sugar factory are discussed, viz. steady-state and dynamic simulation, steady-state optimization, direct digital control, and routine calculations.

* * *

Chelating agent for boiler treatment. J. SCHANTZ. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 100–104. The use of chelating agents for boiler feed water treatment is discussed with particular reference to nitrilotriacetate (NTA) and ethylenediamine tetra-acetic acid (EDTA) and the effect of such factors as average feed water hardness, feed water oxygen content and proper water control. Experiments with EDTA have shown no evidence of corrosion due to the agent, while removal of old scale has been observed. NTA is said to be more effective than EDTA at pressures up to 800 p.s.i. and about equal to EDTA at 1200 p.s.i., while EDTA appears to be more effective at 1500 p.s.i.

* * *

Pneumatic transportation of bagasse from factory to storage or steam generator. A. F. ASHDOWN. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 107–113.—At Oahu Sugar Co. tests were conducted on a pneumatic bagasse conveying system supplied by Combustion Engineering Inc. and comprising two units, each having a capacity of 10 tons/hr, which fed the bagasse

[1] *I.S.J.*, 1965, **67**, 368–371.

to two opposite corners of the boiler, whence it was injected tangentially into the furnace. Apart from improved furnace conditions, the system permitted steadier bagasse flow, with no problems from cold air, plugs in the air line or tramp iron. A Rader Pneumatics wood chip reclaimer was tested on removal of bagasse from the storage pile. It was found to be adaptable to the pneumatic system or to drag conveyor systems and permitted continuous reclaiming rates of 30 tons/hr.

* * *

Comparison of bagasse weighers and their effect on milling calculations. N. J. SAXBY. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 114–117.—The performances of three types of bagasse weighers installed in sugar factories owned by C. Brewer & Co. Ltd. are discussed and the weighers described. They were: a Kentron gamma-ray weigher, which has given excellent performance at Papaikou factory, a Merrick "Weightometer" load cell, which has operated satisfactorily at Pepeekeo factory, but with considerable trouble in the form of zero drift, and an Ohmart "Ray Weigh" gamma-ray weigher, which has operated well at Olokele factory, with some minor trouble with the totalizer. The accuracies of all three systems are evaluated by comparing results with values obtained by an inferential method.

* * *

Application of the French screw press in the sugar cane industry and results of first press at Grove Farm Co. Inc. B. STARRETT. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 137–145.—Performance data covering two weeks' continuous operation are given for a J-88 French screw press installed to dewater bagasse from the 4-mill tandem at Grove Farm. Bagasse pol and moisture content were reduced from 2·24 and 47·1% after the 4th mill to 1·22 and 43%, respectively, after the screw press, with an overall dilution averaging 29% on mill cane. The overall pol extraction in the mill, determined by analysing final mill bagasse, was 92·8%, compared with an average of 96·5% after the press.

* * *

High speed milling at Central Plata. F. F. VIDAL. *Sugar J.*, 1967, **30**, (3), 42.—By increasing the grooving in the first two mills of a six-mill Farrel tandem from 1¼ to 2½ inches and to 2 inches in the last four mills, and increasing the speed of the last three turbine-driven mills from 60 to 80 ft/min, while maintaining that of the first three at 60 ft/min, it has been possible to increase the daily crushing capacity at Central Plata from 3500 t.c.d. to 6000 t.c.d.

* * *

The diffuser and the cane. M. F. WALTER. *Sugar J.*, 1967, **30**, (3), 56–66.—Various aspects of cane diffusion are discussed and references made to the use of the Naudet process in Egypt. The need for caution in deciding the merits of cane diffusion is emphasized, particularly with regard to the possible increase in diffusion juice lime salts content, the use of press water and possible higher molasses production. Reasons for preferring bagasse diffusion to diffusion of disintegrated cane are given and the optimum liming temperature and amount of lime to add to diffusion juice are also discussed.

* * *

Standardization of losses and efficiencies in sugar manufacture. R. PEDROSA P. *Cuba Azúcar*, 1966, (July/August), 2–15.—Production of molasses depends on (i) the non-sugar solids content of the cane juice, which is affected by milling efficiency, (ii) the purity of the molasses produced, which depends on the boiling process adopted and the equipment used, and (iii) the general manufacturing process, including bacteriological control of mills, pipes, tanks, etc., the liming system, the heating and clarification systems and equipment, the evaporator and pan design and manufacture, crystallizer operation, type and operation of the centrifugals, the steam temperature and pressure, and the vacuum employed. Data from 1949 to 1953 were used to prepare standards for efficient operation, and these were found to be applicable in 1966, except that recovery became higher than calculated in 1960–66 by better control of crystallization. A system for calculating such standards is described; it uses a table constructed from calculations of theoretical loss for varying non-sugars in cane and molasses purities. Loss in bagasse depends on the amount and nature of fibre in cane, on pol in cane, imbibition usage, and on mill design and settings, and cane preparation equipment. The effects of these factors and establishment of standard losses are discussed. Losses in mud wash water and undetermined losses are not easy to standardize and an average over five seasons is taken as the standard.

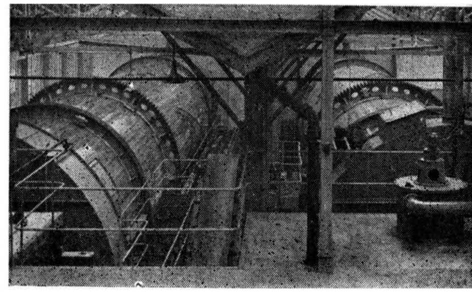
* * *

History of bulk sugar in Cuba. J. A. CHACÓN R. *Cuba Azúcar*, 1966, (July/August), 16–23.—The history of bulk sugar from Cuba began with shipments by the United Fruit Co. in 1932 to its own refinery at Boston and in its own vessels. Commercial bulk terminals were commenced later than in other countries because of the resistance of workers who were thereby made redundant. However, a terminal was started at Guayabal in 1955 and another at Matanzas followed. After the revolution in 1961 the two were completed and bulk facilities provided at nearby mills. In addition, a new terminal at Cienfuegos is nearing completion and it is planned to ship 5,300,000 metric tons from the three by 1970.

* * *

The displacement method of extracting sucrose from cane. J. H. PAYNE. *Ind.-Agric. Research & Management Newsletter*, 1967, **7**, (3), 2–3.—Aspects of diffusion are discussed, including cane preparation, juice filtration and clarification, and the effect of increased extraction on boiling house operations in view of the extra quantities of massecuite, particularly low-grade massecuite. Mention is made of the Silver pilot-plant diffusers tested in Hawaii.

Beet sugar manufacture



pH reduction in sugar factory juices in the evaporator station. F. NEUBRUNN. *Zucker*, 1967, **20**, 492–501. Reduction in pH as a result of water dissociation under the action of heat is examined and the concept of pH change discussed. The possibility of corrosion caused by a shift in the neutral point, i.e. an increase in the number of hydrogen and hydroxyl ions, is also considered. Studies at 20°C and 100–130°C on sucrose and molasses solutions and individual components of factory juices showed that addition of sodium nitrate to the solution before heating stabilized the pH, and reduced sucrose decomposition and juice coloration, by preventing liberation of hydrogen ions through deamination of the amino acids.

* * *

Rechenzentrum Zucker in Braunschweig. ANON. *Zucker*, 1967, **20**, 502–503.—The Rechenzentrum Zucker is a central accounts section, set up in 1966 by ten beet sugar factories in Lower Saxony, which uses a Honeywell H 120 installation with three magnetic tape units to process the accounts and statistics from each of the factories.

* * *

New purification schemes and results from tests on them. I. G. CHUGUNOV, E. V. YATSUK and N. N. TREGUBOVA. *Sakhar. Prom.*, 1967, **41**, (8), 17–23. Carbonatation schemes used in the USSR other than the standard system are described and evaluated. They include: (i) the UCMAS scheme, which incorporates Brieghel-Müller pre-liming, (ii) the Fives Lille-Cail method, in which some of the 1st carbonatation juice is adjusted to pH 9 in a second, "oversaturation", vessel before recycling to pre-liming, (ii) a modified BMA scheme, and (iv) one developed by YAKIMOV which includes preliminary treatment by pre-liming with 150–200% recycled defeco-saturated juice and simultaneous liming and gassing (defeco-saturation) followed by conventional pre- and main liming, 1st and 2nd carbonatation. Some of the 1st carbonatation juice is recycled to the juice line between the main liming tank and the 1st carbonatation vessel.

* * *

Raw juice purification by a scheme with predefecation and optimum colloid coagulation and intermediate defeco-saturation. A. F. YAKIMOV. *Sakhar. Prom.*, 1967, **41**, (8), 24–28.—Further details are given of the author's carbonatation scheme mentioned in the preceding abstract, and its efficiency is compared with that of the BMA scheme.

Juice purification scheme with mud removal after pre-liming. K. D. ZHURA and S. P. OLYANSKAYA. *Sakhar. Prom.*, 1967, **41**, (8), 29–32.—Tests on a scheme in which predefecation mud was sent via a mixer tank to a supplementary saturation vessel for gassing to pH 8 or to the vacuum filters did not give conclusive results, particularly in comparison with the standard Soviet carbonatation scheme. The amount of mud separated by settling (up to 98% of the total mud) was greater than that separated in centrifuges (95–96%). Difficulties were experienced in filtration of the mud, although sweetening-off was satisfactory, as were settling and filtration of the 1st carbonatation juice.

* * *

Some problems in the processing of beet of low technological quality. M. I. DAISHEV. *Sakhar. Prom.*, 1967, **41**, (8), 34.—While "hot" treatment of juice will give sugar of satisfactory quality at a raw juice purity of at least 85, "cold" treatment and lower temperatures in evaporation should be adopted when the raw juice purity is < 85, as when sub-standard beet are processed. Simultaneous liming and gassing of syrup containing remelted low-grade sugar will also help, although none of these methods will give sugar of required quality should the raw juice purity be < 78.

* * *

Work at Gnivan' group laboratory on juice purification. V. A. DANIL'TSEV. *Sakhar. Prom.*, 1967, **41**, (8), 35–37. The adverse effect on carbonatation of sub-standard beet, slow processing and prolonged juice retention in settling tanks was studied. A fall in carbonatation gas CO_2 content adversely affects juice quality and factory throughput. Evaluation of simultaneous liming and gassing is difficult because of errors in RDS determination and polarization, and ways of increasing the accuracy are discussed. While polyacrylamide has a number of advantages as a flocculating agent, including its poor solubility, a flocculant from sea kale has improved settling and filtration, while producing a sparkling, clear supernatant, when used at the rate of 1–2 kg/100 tons of beet.

* * *

Experience in the use of induction flowmeters. Z. S. VOLOSHIN. *Sakhar. Prom.*, 1967, **41**, (8), 38–42.—The application of induction flowmeters in juice purification for measurement of milk-of-lime and juice flow is discussed on the basis of experience at a Soviet sugar factory.

Automatic boiling in Danish sugar factories. R. F. Madsen. *Zucker*, 1967, **20,** 515–525.—Details are given of tests conducted at DDS sugar factories, where almost all pans have been provided with automatic controls. The system used incorporates a time-controlled programme for graining and dilution while the rest of the boiling is controlled on the basis of conductivity (and hence supersaturation), which is reduced in five stages as the massecuite reaches successively the level of electrodes installed in the pan. If the conductivity is too low, the syrup feed valve is opened. A proportional control is used for vacuum (and hence temperature), with one target used up to nucleation and during tightening of the massecuite, and a second value for nucleation and dilution. No steam feed control is used with DDS pans, which are provided with stirrers. Automatic control starts once the syrup footing has been introduced and the required quantity of seed fed into the hopper. Among the advantages of the system are an improvement in sugar quality and a cut in labour requirements. Alternative methods are discussed. In a discussion of the article, reference is made to tests on BPE control, which has the disadvantage of requiring constant vacuum. The effects of certain variables and of fluctuations in a number of factories on boiling are also discussed.

* * *

Treatment of evaporator thick juice with Pittsburgh activated carbon. T. E. Paxson, L. P. Orleans, W. A. Harris and R. L. Naylor. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14,** 271–277.—Moving bed tests with "CAL" granular carbon at Carlton, California, beet sugar factory are discussed. Colour removal from the thick juice was 30·5% of an initial specific colour

$$\left[= \frac{\text{adsorbance at } 425\mu \text{ after filtration}}{\text{cell length (cm)} \times \text{concentration (g/c.c.)}} \right] \text{ of } 493{\cdot}3,$$

and the apparent purity was raised from 85·78 to 86·30. Reduction in the saponin content permitted a floc-free white sugar to be obtained, while molasses purity fell from 61·2 to 60·4. White sugar colour was reduced, but turbidity was somewhat greater than without carbon treatment. Increase in total sugar extraction and reduction of labour and fuel costs attributed to a reduction in the re-boiling required mean that the carbon treatment is a paying proposition.

* * *

A rapid method of sorting sugar beets for storage. S. T. Dexter and M. G. Frakes. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14,** 350–356.—The method is based on the linear relationship between specific gravity and sucrose content of beet roots, for which a correlation coefficient of 0·898 was found. The difference between the weight of a root in air and in water is related to the specific gravity (to give a so-called "submerged" weight), showing that slight differences between the specific gravities of roots are reflected in large differences in weight. Hence, for rapid determination of the general quality of truck loads of beets, it is considered sufficient to weigh the same in water using a modified scale and assuming a 40-lb sample. Beets showing a submerged weight less than 1·7 lb should be processed immediately, while those having a value greater than 2·2 should be stored for late processing. Beets having values between 1·7 and 2·2 lb should be stored for a moderate period.

* * *

Use of "Zetfax" units for transmission of analytical results in sugar factories. J. Wacker. *Zucker*, 1967, **20,** 525–527.—The use of "Zetfax" facsimile units for transmission of analytical data, weighments, etc. by internal telephone systems in sugar factories is discussed[1].

* * *

Potential applications of mathematical methods in the sugar industry. F. Teschner. *Die Lebensmittelind.*, 1967, **14,** 297–299, 340–342.—Formulae are presented for estimation of a number of variables in beet sugar manufacture, including cossette sugar content, raw juice draught, sugar losses in stored beet, coal requirements in terms of raw juice draught and beet to be processed, and white sugar, molasses and pulp yields with varying storage losses and diffusion performance. A worked example is presented.

* * *

Utilization of (beet) piling and unloading equipment at Tuczno sugar factory. W. Jozwiak. *Gaz. Cukr.* 1967, **75,** 185–188.—The economics and efficiencies of various pieces of beet unloading and piling equipment, of Polish, Czech and Soviet origin, at this Polish sugar factory are discussed.

* * *

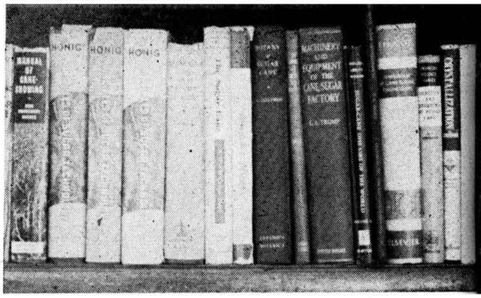
Beet storage using mechanical ventilation. A. Karatnicki and J. Malec. *Gaz. Cukr.*, 1967, **75,** 193–195. Results of experiments over a 14-year period are discussed, demonstrating the advantages of forced ventilation over natural ventilation as regards sugar and weight losses in beet. The economics of forced ventilation are considered.

* * *

Inhibition of microbial activity by different quantities of formalin during diffusion. I. Toth-Zsiga. *Ind. Alim. Agric.*, 1967, **84,** 1019–1026.—Experiments showed that addition of 50–60 litres of formalin every 12 hr gave best results with average infection and every 8 hr with heavy infection. In the case of battery diffusers, the juice temperature should be raised to 70°C in cells 6–7 of a 12-cell diffuser, the formalin being added in separate doses in these cells. Tabulated data are presented showing the extent of sucrose decomposition in a battery and a J-diffuser without disinfection and with disinfection adding 50 and 60 litres of formalin every 12 hr, respectively, in the battery diffuser and 250 and 300 litres of hypochlorite every 12 hr, respectively, in the J-diffuser.

[1] *See also* Haeseler: *I.S.J.*, 1967, **69,** 308.

New books



Proceedings of the 12th Congress of the International Society of Sugar Cane Technologists, Puerto Rico, 1965. Ed. J. BAGUE. lxxx + 1916 pp.; $7 \times 10\frac{1}{4}$ in. (Elsevier Publishing Co., P.O. Box 211, Amsterdam-C, Holland.) 1967. Price: £10 0s 0d.

This huge volume contains the texts of the papers read at the ISSCT 12th Congress held from 28th March to 10th April 1965. Published by the Executive Committee of the ISSCT it includes a list of ISSCT committees and members, a report compiled by the Sub-Committee on Coordination of Sugar Cane Research, and the general introductory addresses to meetings and symposia as well as minutes of discussions on the papers. The volume concludes with an author index. As stated by the publishers, the volume provides a remarkably comprehensive survey of modern developments in cane agriculture and cane sugar technology, but it is questionable whether the unwieldy size of the Proceedings (it weighs $8\frac{3}{4}$ lb) will not reduce its value as work of reference.

* * *

The Australian Sugar Year Book. Vol. 27, 1968. 368 pp. + xxxi; $7\frac{1}{4} \times 9\frac{3}{4}$ in. (The Strand Press Pty. Ltd., 236 Elizabeth St., Brisbane, Queensland, Australia.) 1968. Price: $A 6.00; 56s 0d.

Laid out in very much the same form as past editions, the latest Year Book contains much of interest to those seeking information on the Australian sugar industry. The first 31-page section gives details of the various sugar organizations, names of officers and staff, and sugar factory addresses. The next section of 160 pages includes reports of the 1967 annual meetings of the New South Wales Cane Growers' Association and the Queensland Cane Growers' Association, besides reports from field days at various sugar experiment stations and the 1967 conference of the Australian Sugar Producers' Association. Also included are a number of papers from the 1967 conference of the Queensland Society of Sugar Cane Technologists as well as several articles on various subjects. A summary of a report on mechanical harvesting in Queensland during 1966 is well illustrated. After a 32-page section of statistics on cane and sugar production, mostly up to and including 1966, comes a section giving information on Australian sugar mills and districts, also including details of the main tourist attractions.

Sugar price movements in world and US domestic markets. (C. Czarnikow Ltd., Plantation House, Mincing Lane, London E.C.3.) 1968.

This 22×30-inch graph, published annually by one of the world's leading sugar brokers to show the trends in raw sugar prices during the 8-year period up to and including the December preceding publication, is recommended to all those interested in the subject, since it gives such a clear picture of price movements while noting those factors having significant effect on the prices at any given period. The graph includes the world sugar price (London Daily Price and New York Nos. 4 and 8 Contract Spot Prices), the US Domestic Market Price (New York Nos. 6 and 7 Contract Spot Prices) and the Commonwealth Negotiated Price. The vertical axis gives the price in cents/lb and £/ton. An inset panel gives a graph showing average world sugar values during the period 1930–1967.

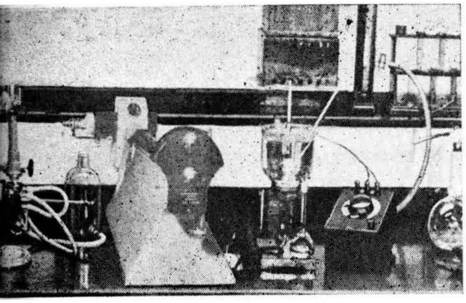
* * *

Raw cane sugar manufacture and the chemical engineer. C. W. DAVIS. 28 pp.; $5\frac{1}{4} \times 8\frac{1}{4}$ in. (University of Queensland Press, St. Lucia, Queensland, Australia.) 1968. Price: $A 0·60; 5s 8d.

This small book is the text of a lecture presented by C. W. DAVIS, Chief Chemist of the Colonial Sugar Refining Co. Ltd., as a memorial to Col. D. E. EVANS, a pioneer chemical engineer in the Queensland sugar industry and a former member of the Board of the Faculty of Engineering of the University of Queensland.

It takes the form of a brief introduction to the world and Australian sugar industries and a description of the sugar manufacturing process. The chemical engineering aspects of early sugar men, e.g. HOWARD's vacuum pan, RILLIEUX's multiple-effect evaporation, are mentioned as having preceded the creation of chemical engineering as a formal discipline.

Mr. DAVIS analyses the function of the chemical engineer and points to specific aspects where his talents can be applied in the sugar industry, giving suggestions for lines of work which might lead to improvement and rationalization of sugar manufacture.



Laboratory methods & Chemical reports

Progress report on sugar quality study. C. C. Tu. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 169–170. The colour content of juice from limed cane was found to be 20–25% higher than that from unlimed cane, and was 50% higher in juice from limed cane containing 3% air-dried leaves than from limed cane without leaves. An increase in temperature from 160° to 190°F over a 1-hr period increased the colour content by 30%. The colour content varied with cane variety. A 30–50% reduction in juice colour content was obtained by mixing limed cane with 0·3% active carbon, while 3–4% active carbon gave practically colourless juice. Insoluble matter in the sugar crystal was found to be the main factor affecting filtrability of the sugar solution. However, while light-scattering techniques showed that sub-standard filtrability was caused by the presence of large particles in the solution, correlation between the light-scattering data and filtrability was poor, indicating that the latter is not a dependable factor for evaluating refining properties. A compound having a u.v. absorption maximum at 281 nm was isolated from a crystal colour fraction and identified as hydroxymethylfurfural, which although colourless is a major product of thermal degradation of reducing sugars.

* * *

Developments in the continuous determination of polarization and refractometer solids in the sugar factory. G. E. Sloane and K. M. Onna. *Rpts.* 1966 *Meeting Hawaiian Sugar Tech.*, 171–177.—Details are given of the continuous diffuser press juice analysis system at Pioneer. The scheme includes a filter consisting of a cylinder with membranes at each end, a Bendix 143A automatic polarimeter, a Waters Associates differential refractometer, and a computing and recording unit, in which the RDS, pol, purity and extraction are computed and recorded in sequence, the complete cycle taking 30 sec. Performance of the analysis system during 1966 is discussed.

* * *

Dissolution of sucrose in the presence of non-sugars. G. Mantovani, F. Fagioli and C. Accorsi. *Zucker*, 1968, **21**, 70–74.—Single sucrose crystals weighing 25 g were dissolved without stirring at 25°C at 0·90 supersaturation in the presence of various organic and inorganic non-sugars and the rates of dissolution calculated using Kukharenko's formula[1]. The results were compared with crystallization rates obtained at 1·10 supersaturation under otherwise identical conditions. The data are tabulated. Difficulties in determining the true surface of partially dissolved single crystals are discussed. Photomicrographs are presented showing etched patterns on different surfaces and on the same surfaces in the presence of various non-sugars.

* * *

Refractometric Brix determination. Anon. *Ann. Rpt. Research Dept., Sugar Manuf. Assoc. (of Jamaica) Ltd.*, 1966, 153.—The effect of mercuric chloride, used as a factory juice preservative, on hydrometer and refractometer Brix measurements was examined, 0·25, 0·50 and 1·00 ml of mercuric chloride in alcohol per litre of juice being added to 1st expressed juice, mixed juice, residual juice and clarified juice (0·5 ml/litre is the standard rate). The greatest mean increase was with 1st expressed juice, the hydrometer Brix of which was raised by 0·08° and the refractometer Brix by 0·07°. The greatest difference between hydrometer and refractometer Brix was 0·14° (the hydrometer value being higher) in the case of clarified juice.

* * *

Polarization and moisture determinations on export sugar. Anon. *Ann. Rpt. Research Dept., Sugar Manuf. Assoc. (of Jamaica) Ltd.*, 1966, 154.—Comparison of pol and moisture contents of export sugar as measured at four individual sugar factories and at the Ocho Rios bulk terminal revealed marked differences in some cases. The data are tabulated, showing standard deviations ranging from 0·170 to 0·383 in pol and from 0·111% to 0·202% in moisture content. In all cases except one the pol and moisture contents at Ocho Rios were lower and higher, respectively.

* * *

Study of the sucrose-borax complex. J. Fernández B. and J. Marinello. *Cuba Azúcar*, 1966, (May/June), 2–8.—See *I.S.J.*, 1967, **69**, 107–111.

* * *

The influence of two typical polysaccharides on certain properties of sucrose in aqueous solution and in the crystalline state. G. Mantovani, F. Fagioli and I. Karczewska-Oglaza. *Ind. Sacc. Ital.*, 1967, **60**, 133–138.—The effects are reported of carboxymethylcellulose and dextran on sucrose solubility at 25°C and of dextran on pH, viscosity and optical activity. The observed effects of the polysaccharides on sucrose crystal habit are also noted. Crystallization and dissolution rates have been measured; the former is considered to be affected by temporary adsorption of the polysaccharides on the crystal surface, while the dissolution rates are related to the viscosity.

[1] *Planter & Sugar Manuf.*, 1928, 443–445, 463–464.

Influence of electrolytes on the refractive index of sucrose solutions. A. EMMERICH and K. JÖRN. *Zucker*, 1967, **20**, 405–410.—The effect of various electrolytes on the refractive indices of sucrose solutions was studied at 20°C and a sucrose concentration of 60–67%. The tabulated data demonstrate the wide differences between the electrolytes as regards the effect on the refractive index, some causing a considerably greater increase in the index than the same weight of sucrose, while others gave a much lower index. If the sucrose solutions are regarded as solvents, variation in the refractive index caused by addition of alkali halides may be satisfactorily represented by quadratic equations. The results are considered of significance for refractometric determination of dry matter.

* * *

Thin-layer chromatography of carbohydrates. YU. S. OVODOV, E. V. EVTUSHENKO, V. E. MASKOVSKY, R. G. OVODOVA and T. F. SOLOV'EVA. *J. Chromatogr.*, 1967, **26**, 111–115.—Thin-layer chromatography using silica gel impregnated with various salts and thirteen solvent mixtures was tested for separation of mixtures containing seven monosaccharides or five oligosaccharides (including sucrose). Generally, no or only partial separation was effected. Only when mono- or dibasic sodium phosphate was used as additive was satisfactory separation obtained of sugars in the concentration range from above 30 µg to 500 µg. The optimum concentration of NaH_2PO_4 in the impregnating solution was 0·2–0·3M for monosaccharides and 0·05–0·1M for oligosaccharides.

* * *

New developing solvent for paper chromatography of various phenolic compounds, sugars and amino acids. T. FULEKI and F. J. FRANCIS. *J. Chromatogr.*, 1967, **26**, 404–411.—In paper chromatographic tests, the upper phase of a 100:19:10:25 1-butanol:benzene: formic acid: water mixture permitted excellent separation of sugars. R_G values are given for sucrose, raffinose, maltose, lactose, glucose, fructose, galactose, mannose, xylose, arabinose, rhamnose, glucuronic acid and galacturonic acid.

* * *

Molasses exhaustion. R. CAROLAN. *Irish Sugar Co. Ltd. Research & Devel. Dept. Rpt.*, 1967, (195), 21 pp. Despite a steady increase in Irish molasses purity over the eight campaigns up to and including 1966/67, the sugar lost in molasses has fallen gradually from 2·05 to 1·87% on beet over the same period, a decrease also occurring in the molasses non-sugars:ash ratio (from 3·8 to 2·7) and in the ratio between sugar molecules and (K + Na + Ca) atoms (from 1·28 to 1·12). The apparent discrepancy is explained by the different melassigenic properties of various non-sugars, with the consequent varying effect on sugar inversion and conversion into non-sugar. By applying a factor of 0·95 to the number of g.-atoms of (K + Na + Ca) found by ashing or flame photometry, it is possible to determine the number of g.-molecules of sugar in well-exhausted molasses, and hence permit a target molasses loss to be established.

* * *

Two-dimensional thin-layer chromatography of sugars. K. FIGGE. *Experientia*, 1966, **22**, 767–771; through *S.I.A.*, 1967, **29**, Abs. 513.—Mixtures of up to 14 mono- and oligosaccharides, including sucrose, glucose, fructose and raffinose, were separated and identified by two-dimensional thin-layer chromatography on borate-impregnated silica gel G/kieselguhr G. Solvents were 5:4:1 *iso*butanol:glacial acetic acid: water and 8·5:1·5 *n*-propanol:water or 8·6:0·5:0·9 *n*-propanol:dimethyl sulphoxide:water. By drying the chromatogram under controlled conditions after the first separation, graduated activation of the sorbent layer was obtained, permitting a good separation with the second solvent.

* * *

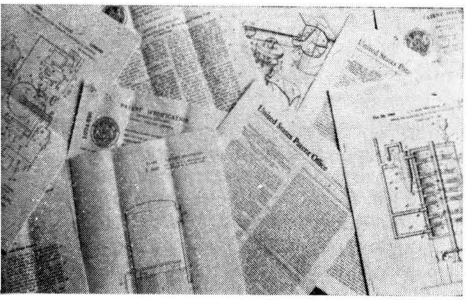
Instrument for measurement of liquid density. D. CAMERON. *Ind. Electronics*, 1967, **5**, 104–107; *S.I.A.*, 1967, **29**, Abs. 517.—The Sangamo specific gravity meter, which has been used with sucrose solutions and molasses, uses as a measure of density the voltage which must be applied to an electromagnet to keep a plummet suspended in the liquid being tested. The accuracy is $\pm 3 \times 10^{-4}$ g/ml.

* * *

Theory of crystallization of sucrose from suspended solutions. A. V. ZUBCHENKO and YU. N. LEVIN. *Khlebopekar. Konditer. Prom.*, 1967, (5), 20–22; through *S.I.A.*, 1967, **29**, Abs. 523.—A theoretical analysis of the process of sucrose crystal nucleation is given. The phase transformation is non-stationary, since the rate of formation of crystal nuclei is a function of time, rising rapidly to a maximum and then falling to zero in nearly the same time interval owing to the consequent fall in supersaturation. The period during which nucleation takes place is nearly constant (~ 40 min) at 1·29–1·82 supersaturation; however, the latent period decreases with increasing supersaturation, and the maximum nucleation rate (new centres/min) reaches a higher value with a consequent increase in the total number of nuclei at higher supersaturations. The observed data are in agreement with the classical "fluctuation" theory of nucleation.

* * *

Qualitative chromatographic determination of sugars in the processes of synthesis and microbiological fermentation. I. M. RODRÍGUEZ. *Cuba Azúcar*, 1966, (July/August), 24–29.—Various paper chromatographic techniques were used to examine molasses alcoholic fermentation musts and dextran synthesis media. Best results were observed when using a 1:5·3:3 *n*-butanol:pyridine:water mixture as developing solvent, using a multiple descending method (letting the solvent drip for 48 hr), and using a mixture of silver nitrate in acetone and sodium hydroxide to detect the sugars (sucrose, glucose, fructose, arabinose and mannitol), the spots being fixed with Kodak F-5 fixer.



Patents

UNITED STATES

Tabletting sugar (for preparation of medical or confectionery lozenges, etc.). F. E. Reimers and M. D. Miller, *assrs.* American Sugar Co., of New York, N.Y., U.S.A. **3,305,447.** 12th June 1963; 21st February 1967.—Sufficient (1–20%) of a concentrated invert sugar or corn syrup containing over 87% (about 95%) solids and at about 135°C is mixed with granulated sugar under turbulent shear and impact conditions so as to produce a substantially dry (less than 1% water), homogeneous mixture in a form which may be ground immediately to powdered sugar fineness such that 95% will pass through a 200-mesh Tyler screen. The product is compacted (by passing through a set of pressure rolls), comminuted to a desired particle size and pressed in a mould to the desired shape.

* * *

Beet topper. N. E. Wells, of Boise, Idaho, U.S.A. **3,306,017.** 26th April 1964; 28th February 1967.

* * *

Cane harvester. J. M. Mizzi, of Ingham, Queensland, Australia, *assr.* International Harvester Co. **3,307,338.** 31st December 1963; 7th March 1967.

* * *

Beet topper. J. N. Vacca and D. A. Bratsch, of Modesto, Calif., U.S.A., *assrs.* General Foods Corporation. **3,307,599.** 18th March 1964; 7th March 1967.

* * *

Continuous centrifugal. G. Trojan, of Bochum-Harpen, Germany, *assr.* Hein, Lehmann & Co. A.G. **3,307,703.** 10th February 1966; 7th March 1967. See U.K. Patent 1,062,880[1].

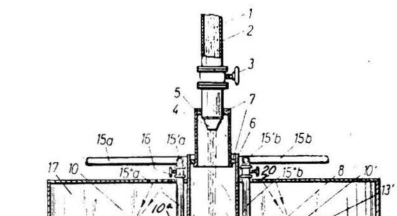
* * *

Treating sugar cane to improve sucrose yield. H. M. Guyot, of Capesterre, Guadeloupe, French West Indies, *assr.* Esso Research & Engineering Co. **3,307,932.** 12th May 1964; 7th March 1967.—The cane is treated 15–30 days before harvest with a composition containing mainly mineral oil [of b.p. range 300–580°F (375–580°F) at 10 mm Hg pressure, viscosity 50–175 (70–110) SUS at 100°F, s.g. 0·84–0·88, and < 26% (< 15%) aromatic content by weight] in a quantity (11–30 litres/ha) less than the phytotoxic limit whereby growth is halted. The composition contains an additive comprising about 0·5–10% w/w of a hydrocarbon polymer having a mol. wt. of at least 10,000 (butyl rubber, poly*iso*butylene) and 0·5–2% w/w of copper naphthenate.

* * *

Continuous centrifugal. W. Hirsch, of Monheim, Rhineland, Germany, *assr.* Hein, Lehmann & Co. A.G. **3,311,240.** 10th April 1964; 28th March 1967.

Feed to the centrifugal is delivered through nozzle 4 which is located within tube 5 the lower edge of which is located within tube 6, suitable seals 7 being provided to make the arrangement air-tight. Mounted on a flange 10a at the bottom of the tube 6 is an annular plate 10 which lies within the conical perforated basket 12 of the centrifugal so that only a small annular gap exists between this basket and the periphery 10′ of the plate. This gap is sufficient to allow free passage of crystals separated from the massecuite feed which rise up the screen and pass over the edge 13′ of the drum 13 and so into chamber 17. Molasses passes through the perforations of screen 12 and is collected in the inner chamber 14.



[1] *I.S.J.*, 1967, **69**, 381.

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).

Wash water is sprayed onto the crystals on the screen from nozzles 11 which are supplied through one or more pipes 15'a and 15'b passing through flange 10a. This spray results in a mist forming within the chamber 18 inside the basket but, since passage of liquid through the screen reduces the pressure within chamber 18 and the feed tube assembly is air-tight, air passes inwardly through the gap between the plate 10 and screen 12 and none of this mist leaves the chamber 18 to dampen the separated crystals which pass outwards and into chamber 17.

* * *

Deionizing sugar solutions. A. MIYAHARA, T. OOMAGARI and H. TSUCHIYA, *assrs.* ROHM & HAAS CO., of Philadelphia, Pa., U.S.A. **3,313,655.** 27th December 1963; 11th April 1967.—A dilute sucrose solution, e.g. beet juice at 15°C or cane juice at 12°C, is directed first through a bed of strongly acidic (macroreticular) cation exchange resin in which the cross-linking agent is present to the extent of 10·5–50% of the resin copolymer, and subsequently through a strongly acidic cation exchange resin in which the cross-linking agent is present to the extent of 1–10%, both resins having sulphonate or sulphate polar groups and being in the H^+ form. The first resin is regenerated with H_2SO_4 or HCl, while the second is regenerated by treating with NH_4OH, NaOH or NaCl, followed by HCl or H_2SO_4.

* * *

Defecation of sugar solutions. E. J. SWARTHOUT, of Edwardsburg, Mich., U.S.A., *assr.* MILES LABORATORIES INC. **3,314,818.** 27th March 1964; 18th April 1967.—Solutions of sugar (e.g. crude slab sugar) (of 25°Bx and pH approx. 4·6) are treated with ferric citrate or copper sulphate to give 50–1000 p.p.m. of Fe or Cu in the solution, and mixed at pH 2·5–5 until a floc is formed with the undesirable impurities. The floc is then separated from the purified solution.

* * *

Beet thinner. R. L. PROPST, of Ann Arbor, Mich., U.S.A., *assr.* HERMAN MILLER INC. **3,315,753.** 14th July 1965; 25th April 1967.

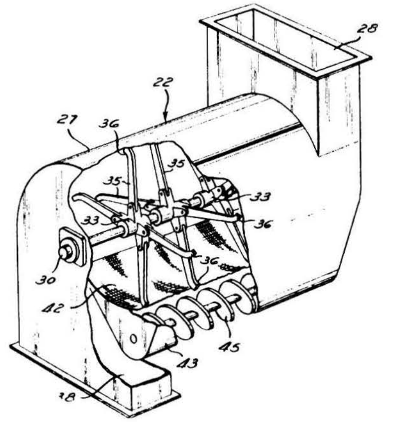
* * *

Centrifugal discharge device. A. MERCIER and R. JOSIEN, *assrs.* SOC. FIVES LILLE-CAIL, of Paris, France. **3,315,811.** 18th February 1965; 25th April 1967. See U.K. Patent 1,058,784[1].

* * *

Process for separating pith from bagasse. E. J. VILLAVICENCIO, M. SIERRA R. and S. ESCOBAR, of Mexico City, Mexico, *assrs.* CIA. INDUSTRIAL DE AYOTLA S.A. **3,317,964.** 16th November 1962; 9th May 1967.

Bagasse enters the feed chute 28 of the separator 22 through a metering device and falls into the chamber 27 where it is subjected to the action of the swing hammers 35. These hammers are pivotally attached to hubs 33 which are mounted at intervals along the shaft 30 which passes the length of the chamber. The hammers are arranged in a helix so that they gradually move the bagasse from inlet 28 towards the outlet 38. The ends 36 are rounded to prevent cutting or chopping of the fibres which are rubbed together by the action of the hammers, so separating the pith which falls through screen 42 into the trough 43 below the chamber. This separated pith is carried away towards the feed end by a screw conveyor 45 and may be used for fuel, feed or fertilizer, while the fibres which pass out through the discharge 38 may be used for paper-making. A fan



may be connected with the trough to draw air from the chamber 27 through screen 42, this air stream helping to prevent pith particles adhering to the fibres.

* * *

Extraction of sugar from sugar cane. H. F. SILVER, C. R. STEELE and F. B. PRICE, of Denver, Colo., U.S.A., *assrs.* AMERICAN FACTORS ASSOCIATES LTD. **3,323,948.** 21st April 1966; 6th June 1967.—In the ring-type diffuser described in U.S. Patent 3,248,263[2], lime is added to the subdivided cane before it is deposited as a diffusion bed and, in addition, lime, preferably in the form of lime-water, is added to the (screened) bagasse press water which is heated and partially clarified in a sedimentation tank, and then returned to the system. The under-flow from the sedimentation tank may either be filtered or added to the wet bagasse before it is sent to the press.

* * *

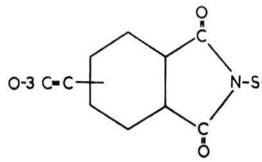
Animal feeds. J. W. LYONS, of Webster Groves, Mo., U.S.A., *assr.* MONSANTO COMPANY. **3,325,289.** 16th April 1963; 13th June, 1967.—A fluid useful as an animal feed component comprises a mixture of (i) a major proportion of a sugar-containing residue from sugar manufacture (beet molasses, cane molasses), (ii) a minor amount, sufficient normally to cause gellation, of ortho- or pyrophosphoric acid or an ammonium or alkali metal salt of one of these acids [1–10% (2–7%) of a mixture of ortho- and pyrophosphoric acid, 1–15% of ammonium orthophosphate], and (iii) sufficient (0·1–1%) of a water-

[1] *I.S.J.*, 1967, **69**, 349.
[2] *ibid.*, 284.

soluble alkali metal polyphosphate, having a chain length greater than 2 (Graham's salt, sodium tripolyphosphate, sodium hexametaphosphate) to keep the mixture fluid.

* * *

Increasing saccharide content in sugar beets. R. M. THORUP and A. H. HUNTER, *assrs.* CHEVRON RESEARCH Co. **3,318,678.** 6th April 1964; 9th May 1967. During the growing season (at least 3 months after planting but at least 2 weeks before harvest), a physiologically effective amount (1 lb/acre) of a compound is applied to the beets. The compound is of the formula



where m is 1 or 2, $l = 2(m - 1)$, X is a halogen of atomic number 17 to 35, Z is either hydrogen or a halogen of atomic number 17 to 35 (N-trichloromethylthio-Δ^4-tetrahydrophthalimide, N-1,1,2,2-tetrachloroethyl-Δ^4-tetrahydrophthalimide). At least one cation of the group Mg, Mn, Fe, Zn and Cu is also added.

* * *

Recovery of glutamic acid from a beet molasses fermentation bath. D. A. CONKLIN and J. GILLIN, *assrs.* MERCK & Co. INC., of Rahway, N.J., U.S.A. **3,325,539.** 19th November 1962; 13th June 1967. The broth is passed upflow (at 40–60°C) through a bed of strongly acidic (sulphonated polystyrene) cation exchange resin on the H^+ cycle at a rate sufficient to expand the bed by 5–60% (5–40%). The glutamic acid is adsorbed on the resin and is eluted, after discontinuing the broth flow, with a downflow of 0·5–2·0N NaOH at $>$40°C (40–60°C). The eluate fraction containing $>$10 g/litre of glutamic acid, at a pH $\not>$8, is adjusted to pH 3·2 to precipitate the glutamic acid.

* * *

Cane harvester. M. W. FOGELS, J. K. GAUNT and J. J. ZAGORSKI, *assrs.* MASSEY-FERGUSON (AUSTRALIA) LTD., of Sunshine, Victoria, Australia. **3,325,982.** 5th October 1964; 20th June 1967.

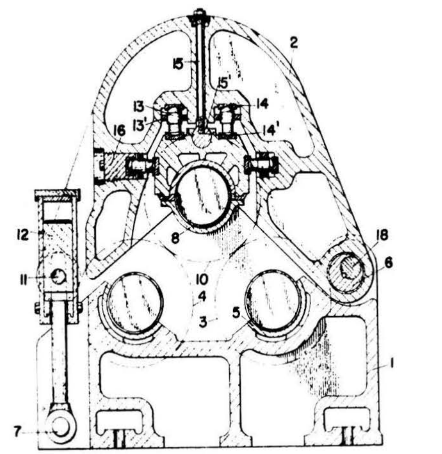
* * *

Citric acid fermentation. W. GOLD and R. J. KIEBER, *assrs.* STEPAN FERMENTATION CHEMICALS INC., of Keyport, N.J., U.S.A. **3,326,774.** 6th June 1966; 20th June 1967.—To a cool fermentation medium which includes a fermentable carbon source derived from cane (e.g. diluted blackstrap molasses) is added a ferro- or ferricyanide salt and the medium sterilized, kept at pH 6–9 (7–8), and a citric acid-producing organism introduced (as spores dispersed in a starch gel). The organism is maintained as spores in a germination medium containing nutrient and a minor proportion of starch (to give less than 1% w/v in the fermentation medium) and maintained at a temperature for germination of the spores. Test fermentations of the medium are carried out at various spore counts to pre-determine the count giving optimum fermentation results (500–15,000 spores/ml).

* * *

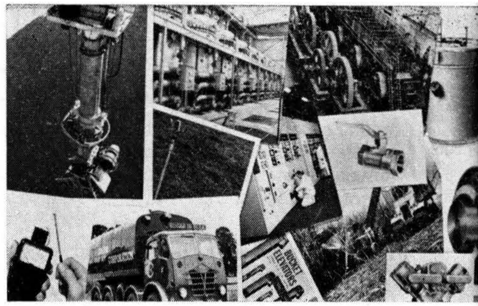
Cane mill. G. DE COOMAN, of Hellemmes, Nord, France, *assr.* SOC. FIVES LILLE-CAIL. **3,329,084.** 8th September 1965; 4th July 1967.

The three-roll mill is provided with a stationary housing 1 in the form of two frames and a bracket 2 attached to each frame by an opening in each through which pass hollow bearing pins 6 keyed to eccentric shafts 18. The shafts have arms attached which can be turned and locked to give precise adjustment of the pivoting axis. The other side of the bracket 2 is attached by pivot pins 11 to the



cylinder of a hydraulic jack 12 the piston of which is secured to the stationary frame 1 by pivot pin 7. The bagasse and feed rolls 3, 4 are journalled in sleeve bearings 5 while stub shafts of the top roll 10 are journalled in split bearing blocks 8 in the middle of each bracket 2. In order to allow for tilting of the top roll through uneven cane blanket thickness, the bearings 8 are given a universal-joint character; the block is held against the bracket by means of tie-rods 15 at each end which carry spherical members 15′ which prevent downward movement of the blocks under gravity. The block is held apart from the bracket by four abutment pins 13, themselves held in blind recesses by rubber rings 13′ and provided with spherical ends which match spherically dished surfaces of members 14, 14′ in the bracket and block, respectively. Alternatively, the block surface may be spherical and cooperate with a spherically concave surface in the bracket, a suitable bearing being interposed. The relationship between the gaps between the top and feed rolls and the top and bagasse rolls are maintained relatively constant as the bracket pivots and can be adjusted by variation of the axis of pivoting through rotation of the eccentric shaft 18.

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.

"Ti-Automat" titration unit. C. A. Hendley & Co., Victoria Rd., Buckhurst Hill, Essex, England.

The "Ti-Automat" free-standing or bench-mounted unit comprises a back panel on which are mounted 4 or 6 burettes, each fitted with a float valve which permits vacuum from the pump provided with the unit to be applied to the burette. Standard solution is drawn in from each of four 2-litre polyethylene reservoirs and when the burette is full the float valve closes and remains closed, overfill being returned to the reservoir by an automatic zero device. The unit has built-in illumination flooding the back panel and the working space with high-intensity colour-matched light, which facilitates reading of the meniscus and recognition of coloured end-points. The illumination also permits the unit to be installed in the darkest and least used corner of a laboratory.

* * *

"Opacity Recorder". Paterson Candy International Ltd., 21 The Mall, Ealing, London W.5, England.

The Paterson Candy "Opacity Recorder" has been developed as a means of directly determining when a filter having a fixed bed of granular material as filtering medium needs cleaning. It operates by measuring accurately the turbidity or colour of the liquid being filtered, and basically consists of a viewing chamber through which a sample of the liquid is allowed to flow continuously. A beam of light is directed through the fluid between windows onto a measuring photocell, its intensity being adjusted by iris diaphragm. Another beam of light is directed onto a second, reference, photocell, and the electric output of the two cells is then compared by a ratiometer which reads the degree of opacity directly. Two rotating glass discs act as the windows at each end of the viewing chamber; since they are continuously cleaned, formation of deposit on them is prevented. A range of models can be provided, measuring from 0·1 p.p.m. to 20,000 p.p.m. turbidity, by altering the cell depth. Apart from the application mentioned, the "Opacity Recorder" is applicable to water treatment and other uses in various industries, including the sugar industry.

PUBLICATIONS RECEIVED

ALKALINITY CONTROL BY "STARVATION". The Permutit Co. Ltd., Pemberton House, 632–652 London Rd., Isleworth, Middx., England.

A new technical publication explains the fundamentals of alkalinity control by "Starvation", which involves passing the water to be softened through "Zeo-Karb 216" granular carboxylic resin which exchanges H^+ ions for Ca^{++} and Mg^{++} cations associated with alkaline hardness. Metallic cations associated with non-alkaline hardness are not exchanged, but may be removed if required by subsequently passing the water through a simple base exchange softener situated after the degassing tower used to remove the carbonic acid formed after the initial "Zeo-Karb" treatment. Various applications of the system are illustrated.

* * *

WEIGHT CONTROL SYSTEMS. L. A. Mitchell Ltd., Harvester House, Peter St., Manchester, England.

An 8-page brochure, C.P. 10, is available describing Mitchell weight control systems for bulk material handling. It contains information on the range and design of the equipment, which is applicable to sugar and sugar beet as well as numerous other materials.

* * *

STAINLESS STEEL ROAD TANKERS. Stainless Steel Development Association, 7 Old Park Lane, London W.1, England.

The advantages of stainless steel road tankers are described in a 20-page booklet illustrating their uses for various types of material, including syrup, 2400 gal of which is carried in a tanker having three compartments of equal capacity for Albion Sugar Co. Ltd., manufacturers of brewing and glucose syrup.

* * *

Stainless steel tubes for Venezuela.—TI Stainless Tubes Ltd. is making 135,000 ft of stainless steel tube for juice heaters and evaporators in a sugar factory being supplied by The Mirrlees Watson Co. Ltd. to Central Portuguesa S.A. of Venezuela. The daily crushing capacity of the factory will be 3000 metric tons with provision for extension to 6000 metric tons.

* *

Norit acquires UK active carbon manufacturer.—Norit N.V. of Holland has acquired the complete share capital of Clydesdale Chemical Co. Ltd., of Glasgow. Both firms are well known as manufacturers of active carbon. The name of the UK company is to be changed to Norit-Clydesdale Co.

* * *

Sugar factory modernization in Bolivia.—BMA has received an order from Cía. Industrial Azucarera San Aurelio S.A., of Santa Cruz, Bolivia, for modernization and extension of San Aurelio cane sugar factory. The contract provides for juice purification plant, evaporators, vacuum pans, centrifugals and sugar drying equipment. The order is worth about DM.6 million.

Cuban Sugar Statistics[1]

	1967	1966
	metric tons, raw value	
Initial Stocks	362,502	471,960
Production	6,236,000	4,866,710
	6,598,502	5,338,670
Exports	5,682,872	4,434,639
Consumption	629,498	541,529
Final Stocks	286,132	362,502
Exports		
Albania	4,235	10,490
Algeria	42,713	618
Bahrein	5,176	—
Belgium/Luxembourg	511	6,704
Bulgaria	194,671	158,051
Canada	66,175	69,378
China	556,079	619,731
Czechoslovakia	214,884	262,098
Egypt	114,278	97,038
Finland	21,158	10,789
Germany, East	249,623	207,192
Hungary	16,730	—
Iran	71,327	10,336
Iraq	42,095	—
Italy	58,890	45,399
Japan	542,127	359,961
Jordan	14	69
Korea, North	83,346	21,335
Kuwait	16,115	—
Lebanon	753	329
Libya	23,417	—
Mali	118,989	—
Mongolia	5,273	—
Morocco	152,768	181,327
Netherlands	71,318	18,862
Norway	22,216	22,294
Poland	22,327	52,843
Spain	158,581	145,343
Sudan	205	—
Sweden	22,223	44,741
Switzerland	51,487	48,437
Syria	63,789	53,309
USSR	2,473,305	1,814,930
UK	70,290	61,646
Vietnam, North	45,510	13,077
Yugoslavia	64,678	97,912
Zambia	10,727	—
Other Countries	4,869	400
	5,682,872	4,434,639

Thames refinery fire.—Fire broke out in the cube-making department on the fourth floor of Tate & Lyle Ltd.'s five-storey Thames refinery in London in the early hours of the 3rd July. About 2000 tons of packed refined sugar was lost in the blaze and there was also minor damage to buildings. The cube-making plant will be out of operation for three months, and total value of the damage has been estimated at between £250,000 and £500,000.

* * *

UK sugar surcharge.—In view of the level of the world price of raw sugar on the London in the previous weeks, the Minister of Agriculture made orders under the Sugar Act, 1956, whereby the surcharge was reduced from 3¾d per lb (35s 0d per cwt) to 3½d per lb (32s 8d per cwt) from the 28th June 1968. On the 17th July, however, the surcharge was restored to its previous level, following a fall in world prices.

* * *

New Iran sugar factory[2].—A new beet sugar factory has just been constructed at Yazui in the province of Fars, having a capacity of 1000 tons of beets per day.

Brevities

The late L. A. Tromp.—As we go to press, we have learned of the sudden death on 8th July of L. A. Tromp, A.M.I.Mech.E. the distinguished sugar technologist and consulting engineer, and long-time contributor to this Journal. He spent a lifetime in the industry, at one time being the President of the Engineering Section of the Cuban Sugar Technologists' Association. Readers will need no reminder of his many valuable studies on a wide range of cane sugar engineering topics, while his magnum opus was, of course, his "Machinery and Equipment of the Cane Sugar Factory". This book, published in 1936, became one of the industry's standard works, and was still in demand after a quarter of a century. Although he had been retired for a number of years, Tromp maintained an avid interest in everthing to do with cane sugar manufacture and his circle of friends and correspondents throughout the world will be saddened at his passing.

* * *

New international sugar research group.—Sugar companies on four continents are sponsoring a new association to conduct research activities on a global scale. The International Sugar Research Foundation Inc., functioning from the 1st July, has elected Dr. Philip Ross, of Potomac, Maryland, U.S.A., as its first president. Dr. Ross is a specialist in demography and human ecology. The world-wide membership of the International Sugar Research Foundation will include cane sugar refiners, beet sugar processors and raw sugar producers from Australia, Belgium, Canada, Ireland, Mexico, South Africa, the United Kingdom and the United States. The new organization succeeds the 25-year-old Sugar Research Foundation which initiated the first long-term programmes of scientific utilization studies for the sugar industry. Its studies have embraced dental health, consumer preference of food sweetness levels, improvements in food technology, non-food uses of sugar and artificial sweeteners. The International Foundation will extend these activities and will take steps to coordinate independent research programmes in the various countries. The Foundation expects to initiate new research programmes in nutrition and public health. In Great Britain the Sugar Research Foundation is supported by Tate and Lyle Ltd., Manbré and Garton Ltd. and the British Sugar Corporation Ltd. Headquarters of the International Sugar Research Foundation will be at 52 Wall Street, New York, N.Y., U.S.A.

* *

Bumper cane harvest in China[3].—There has been a bumper sugar cane harvest in the Kwangtung province of the People's Republic of China, despite a drought last year, Radio Canton has reported. The radio claimed that output was up 17% on 1966/67.

* * *

New cane sugar factory in Syria[4].—A new cane sugar factory has been put into operation recently in the Ghal region. It cost 35 million Syrian pounds (£3,400,000) and has a crushing capacity of 2000 tons per day.

* * *

East German beet research[5].—An agreement signed between the Beet Research Institute at Kleinwanzleben in East Germany and representatives of the East German sugar industry aims at close collaboration in order to increase the sucrose content in beet from the present 14% to 17–18% in as short a time as possible. A 1% increase in the sucrose content would be worth an extra 50 million Marks to the East German economy.

[1] *I.S.C. Stat. Bull.*, 1968, **27**, (3), 32–33.
[2] *Zeitsch. Zuckerind.*, 1968, **93**, 197.
[3] *Financial Times*, 14th May 1968.
[4] *Zeitsch. Zuckerind.*, 1968, **93**, 197.
[5] *Die Lebensmittelindustrie*, 1968, **15**, 202.

Brevities

Italian sugar compensation fund[1].—The establishment of a sugar compensation fund is planned in Italy. This fund will be used principally in order to maintain domestic prices for sugar unchanged after 1st July when the Common Market in Sugar commenced. The sugar producers of the country will have to pay a sum into this fund at the entry of the sugar into the consumers' market, this sum corresponding to the difference between the domestic and EEC prices. Furthermore, the producers and also the beet growers will have to provide one or two lire for each kilogram of sugar beets sold during 1967 and 1968. On the other hand the fund will pay to the sugar beet growers an additional 687·50 lire per ton of beets with a basic sugar content of 16%, and to the sugar producers 912·50 lire per 100 kg of white sugar produced within the Italian EEC quota. In addition, the fund will pay subsidies for sugar exports from Italy.

* * *

Yugoslavia sugar production, 1967/68[2].—Sugar production in the 1967/68 campaign is reported as 448,390 metric tons, white value, compared with 529,553 tons in 1966/67 and 333,566 tons in 1965/66.

* * *

Cane mechanization in Guadeloupe[3].—By the end of 1968 it is estimated that 12,000 hectares or 50% of the total area planted to cane will be mechanized, and that the proportion will have increased to 75% of the total within three years.

* * *

Danish loan to Uganda[4].—An agreement has been signed between Denmark and Uganda under which Denmark will make a loan of 19 million Uganda shillings (£1,100,000) which will be used to buy Danish machinery and equipment including cane sugar diffusion equipment.

* * *

Bagasse carton project in Ecuador[5].—The Ministry of Industry and Commerce recently indicated that preliminary negotiations are being held with a United States firm on the installation of a plant to manufacture cartons using bagasse as raw material. Kraft corrugated paper boxes are needed for the packing and shipping of bananas for export.

* * *

Brazil sugar production 1968/69[6].—The financial arrangements for the 1968/69 sugar season, which have been approved by the Conselho Monetário Nacional, provide for a rise in price of 18·5%, and an increase in permitted production of 2 million bags to 71 million bags (120,000 metric tons to 4,260,000 tons).

* * *

Sierra Leone sugar imports[7].—Imports of sugar into Sierra Leone during 1967 totalled 22,925 long tons, tel quel, very slightly more than the 22,606 tons imported the previous year. The principal supplier was the UK with 8107 tons (9360 tons in 1966), while 5163 tons came from the USSR (3931 tons in 1966), 4632 tons from Czechoslovakia (4930 tons in 1966), 2527 tons from France (2535 tons), 1168 tons from Poland (1237 tons), and 1328 tons from other countries (613 tons).

* * *

Colombia sugar production, 1967[8].—Production of sugar in 1967 in Colombia, at 575,000 tons, exceeded the 1966 output by more than 50,000 tons. Exports in 1967 reached a record 200,000 tons against 113,000 tons in 1966.

* * *

Czechoslovakia sugar exports[9].—According to official announcements, sugar exports in 1967 amounted to 391,650 metric tons, compared with 325,385 tons exported in 1966.

US Sugar Supply Quota, 1968

	Original quota	*Net changes on 20th and 27th June*	*Revised quotas*
	(short tons, raw value)		
Domestic Beet	3,120,333	−4,666	3,115,667
Mainland Cane	1,134,667	34,666	1,169,333
Hawaii	1,191,704	—	1,191,704
Puerto Rico	740,000	−215,000	525,000
Philippines	1,126,020	—	1,126,020
Argentina	62,862	8,660	71,522
Australia	191,062	2,520	193,582
Bolivia	6,082	838	6,920
Brazil	511,008	70,391	581,399
British Honduras	13,391	1,666	15,057
British West Indies	183,810	22,870	206,680
Colombia	54,073	7,449	61,522
Costa Rica	60,157	8,286	68,443
Dominican Republic	586,008	78,846	664,854
Ecuador	74,353	10,241	84,594
Fiji	41,928	553	42,481
French West Indies	57,823	7,195	65,018
Guatemala	50,696	6,984	57,680
Haiti	28,389	3,911	32,300
Honduras	6,082	838	6,920
India	76,425	1,008	77,433
Ireland	5,351	—	5,351
Malagasy	9,023	119	9,142
Mauritius	17,514	231	17,745
Mexico	522,497	71,973	594,470
Nicaragua	60,157	8,286	68,443
Panama	37,853	5,216	43,069
Peru	407,590	56,146	463,736
Salvador	37,177	5,122	42,299
South Africa	56,257	742	56,999
Swaziland	6,900	91	6,991
Taiwan	79,609	1,050	80,659
Thailand	17,514	231	17,745
Venezuela	25,685	3,537	29,222
	10,600,000	200,000	10,800,000

India sugar exports[10]—Exports of sugar by India in 1967 totalled 216,568 metric tons, tel quel, and included 78,365 tons to the UK, 71,930 to Canada and 66,273 tons to the US. In 1966, exports totalled 441,185 tons and included 99,214 tons to Malaysia and Singapore, 98,628 tons to the UK, 65,440 to the US, 51,074 to Canada, 40,557 to Iran, 20,898 to France, 19,370 to South Vietnam, 10,308 to Zambia, 10,091 to Lebanon, and 25,605 to other countries.

* * *

Spanish beet sugar campaign, 1967/68[11]—Spain produced 514,458 metric tons of beet sugar in the 1967/68 campaign, or 3720 tons less than the comparative figure for 1966/67. These figures, issued by the Syndical Statistics Service, comprise production between the 1st July 1967 and the 28th February of this year; a few more tons of beet sugar may still appear in statistics for the month of March, as happened last year when 14 tons were produced. Otherwise the bulk of production from March to June inclusive will consist of cane sugar which last year reached 36,463 tons.

[1] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (18), 4.
[2] C. Czarnikow Ltd., *Sugar Review*, 1968, (864), 88.
[3] *Sugar y Azúcar*, 1968, **63**, (5), 68.
[4] *Barclays Overseas Review*, May 1968, p. 41.
[5] *Sugar y Azúcar*, 1968, **63**, (5), 68.
[6] *Bank of London & S. America Review*, 1968, **2**, 279.
[7] C. Czarnikow Ltd., *Sugar Review*, 1968, (868), 106.
[8] *Bank of London & S. America Review*, 1968, **2**, 289.
[9] F. O. Licht, *International Sugar Rpt.*, 1968, **100**, (15), 4.
[10] *Lamborn*, 1968, **46**, 97.
[11] *Public Ledger*, 15th June 1968.