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On décrit des essais sur l'emploi d'une colonne d'exclusion d'ions pour séparer et extraire de saccharose de mélasse de betteraves, des variables de procédé étant changées dans des intervalles d'importance commerciale. On a tracé des courbes, à partir des données expérimentales, qui montrent les teneurs en solides de saccharose et de non-saccharose en fractions successives aussi que dans le volume total de l'effluent dans une course typique. Telles courbes montrent les fractions qui peuvent donner de sucre cristallisable, et on a développé une série d'équations reliant des variables de procédé à l'extraction de saccharose pour une étude des aspects économiques dans une partie suivante.

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Contrôle de poussière dans une sucrerie betteravière. 2-ème partie: T. RODGERS, P. SWIFT et J. J. GILBERT. *Pages* 39–42

On décrit les formes différentes de dépoussiéreurs disponibles et donne des détails du procédé employé dans une sucrerie de la British Sugar Corporation, dans lequel des cyclones attrapent la poussière des pulpes sèches sortant du sécheur. On considère que la filtration est la forme la plus efficace de dépoussierage; elle est surtout utile où la poussière est de valeur et où un dépoussiérage mouillé n'est pas pratique.

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Bagasse Products Co. Ltd. *Pages* 43–44

On donne des informations sur la nouvelle compagnie établie par Tate & Lyle Ltd. et S. Hille & Co. Ltd. pour la fabrication de panneaux en fibre de bagasse sous le nom "Bagelle". On montre des exemples d'objets en "Bagelle", y compris des formes moulées pour le cabinet d'un appareil de télévision. On peut laminer des panneaux de "Bagelle" de, pour exemple, papier qui a été impregné de mélamine et appliqué sous pression, afin de donner un panneau de haute densité qu'on appelle "Bellamine". On cite des applications possibles de tels panneaux.

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Recherches sur canne à sucre en Hawaii. *Pages* 44–46

Cet article est une condensation du rapport annuel (1965) de la Hawaiian Sugar Planters' Association et traite de la transplantation de semis de canne, cultivé dans la pépinière, l'irrigation, la récolte mécanique, le désherbage, des insectes et animaux nuisibles et des maladies de canne, des variétés de canne, la nutrition et des engrais, et le contrôle de maturation de canne.

Technische Analyse von Ionenausschluss zur Saccharosegewinnung aus Rübenmelasse. I. Versuchsverfahren und Datenumwandlungsmethoden. W. G. SCHULTZ, J. B. STARK und E. LOWE. *Seiten* 35–38

Man beschreibt Versuche über die Anwendung einer Ionenausschluss-Kolonne zur Trennung und Gewinnung von Saccharose aus Rübenmelasse, bei welchen die Verfahrensveränderlichen in handelsbedeutsamen Bereichen verändert wurden. Die Verfasser stellen die Versuchsdaten graphisch dar, d.h. die Gehalten an Saccharosefeststoffen und Nichtsaccharosefeststoffen in aufeinanderfolgenden Fraktionen und im ausfliessenden Gesamtvolumen eines typischen Laufs. Solche Diagramme zeigen die Fraktionen, die kristallisierbare Saccharose geben können, und man hat eine Reihe Gleichungen entwickelt, die Beziehungen zwischen Verfahrensveränderlichen und Saccharosegewinnung zwecks Untersuchung von ökonomischen Gesichtspunkten in einem späteren Teil herstellen.

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Staubkontrolle in einer Rübenzuckerfabrik. Teil II. T. RODGERS, P. SWIFT and J. J. GILBERT. *Seiten* 39–42

Die Verfasser beschreiben die verschiedenen, verfügbaren Arten Staubfänger und berichten über das Verfahren in einer Zuckerfabrik der Firma British Sugar Corporation Ltd., wobei der Staub an den aus dem Trockner austretenden Trockenschnitzeln von Zyklonen erfasst wird. Als effektivste Methode der Entstaubung empfiehlt sich die Filtration, die besonders nutzbar ist, wo der Staub wertvoll ist und die Nassentstaubung nicht praktisch ist.

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Bagasse Products Co. Ltd. *Seiten* 43–44

Man gibt Informationen uber die neue Firma, die Tate & Lyle Ltd. und S. Hille & Co. Ltd. fur die Erzeugung von "Bagelle"-Pressplatte aus Bagasse gebildet haben. Unter einigen illustrierten Beispielen von Waren aus "Bagelle" sind Formstücke fur den Schrank eines Fernsehapparates. Es ist möglich "Bagelle" mit, z.B., Melamin imprägniertem Papier, unter Druck aufgelegt, zu lamellieren; das resultierendes Produkt heisst "Bellamine". Mögliche Anwendungen dieser Art Pressplatte werden erwähnt.

* * *

Die Zuckerrohr-Züchtung in Hawaii. *Seiten* 44–46

Dieser Aufsatz ist eine Abkürzung des jährlichen Berichts (1965) der Hawaiian Sugar Planters' Association, und betrachtet die Umpflanzung von in der Pflanzschule gezüchteten Sämlingen, Bewässerung, mechanisierte Rohrernte, Unkrautkontrolle, Schädlinge und Krankheiten, Rohrsorten, Nahrung und Dünger, and die Kontrolle von Rohrreifung.

Análisis técnico de la exclusión de iones como técnica para la recuperación de azúcar desde melaza remolachera. Primera parte: Procedimientos experimentales y técnicas para la conversion de dados: W. G. SCHULTZ, J. B. STARK y E. LOWE. *Pág.* 35–38

Se describen experimentos sobre el uso de una columna de resinas en un proceso utilizando la exclusión de iones para la separación y recuperación de azúcar desde melaza remolachera. En estos experimentos los factores qui afectan el proceso estan variado dentro extensiones de importancia comercial. Una gráfica que ilustra los contenidos de sacarosa y de no-azúcar en fracciones sucesivas y en el volumen total de efluente de una corrida típica se traza a base de los dados experimentales; tal gráfica demuestra las fracciones desde que es posible producir azúcar cristalizable. Los autores desarrollan una serie de ecuaciones en que los factores que afectan el proceso se relatan a la recuperación de azucar a fín de examinar aspectos económicos del proceso en una parte subsiguiente.

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Control de polvo en un azucarerera remolachera. Segunda parte: T. RODGERS, P. SWIFT y J. J. GILBERT. *Pág.* 39–42

Los varios tipos de colector de polvo se describen y se presentan detalles de método, empleando ciclones, que se utiliza en un azucarera británica para la colección de polvo de pulpa seca a la salida del tambor secadoro. Los autores consideran que filtración es el método lo más eficiente para separación de polvo, siendo especialmente útil cuando el polvo tiene valor y colección húmeda no es práctica.

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Bagasse Products Co. Ltd. *Pág.* 43–44

Se presenta información sobre la nueva compañia formado por Tate & Lyle Ltd. y S. Hille & Co. Ltd. para le fabricación de tablas de bagazo marca „Bagelle". Ilustraciones demuestran unos ejemplos de artículos fabricado en „Bagelle" e incluyen piezas prensadas para un bufete de televisión. Es posible laminar „Bagelle", por ejemplo, con papel impregnado con melamina, aplicado bajo presión para formar una tabla de alta densidad, marca „Bellamine". Aplicaciones posibles de esta tabla se mencionan.

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Investigaciones sobre caña de azucar en Hawaii. *Pág.* 44–46

Este artículo es un resúmen de la Memoria Anual (1965) de la Hawaiian Sugar Planters' Association, ye se trata del trasplante de caña semillera cultivado en plantel, de cosecha mecanizada, de control de malas hierbas, plagas y enfermidades, de variedades de caña, de nutrición y fertilizantes, y de control de maduración de caña.

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Notes & Comments

U.K. sugar surcharge increase.

Since the surcharge levied by the U.K. Sugar Board was last increased on the 1st September 1966, the world price of raw sugar has fallen further and the Minister of Agriculture, Fisheries & Food has accordingly made Orders under the Sugar Act, 1956, adjusting the rate of surcharge in conformity with this price movement. The existing surcharge of 4d per lb (37s 4d per cwt) was increased by the Orders to 4¼d per lb (39s 8d per cwt) from the 29th November 1966. This is the sixth change in the rate of surcharge in the past twelve months.

* * *

World sugar production estimates, 1966/67.

F. O. Licht K.G. recently published their first estimates of 1966/67 world sugar production[1] and these are reproduced elsewhere in this issue. Total production is expected to reach 66,478,890 metric tons, raw value, as against 63,478,988 tons produced in 1965/66. This represents an increase of somewhat more than 3 million tons or 4·73%. Beet sugar production is expected to rise from 27,099,735 tons to 28,228,890 tons, i.e. by 1,129,155 tons or 4·16%, while cane sugar production is expected to rise by 1,875,747 tons from 36,374,253 to 38,250,000 tons, i.e. 5·15%.

The greater part of the rise in beet sugar production is anticipated from East Europe where good crops are expected in spite of area reductions. In West Europe the considerable reduction expected in French sugar output largely compensates for increases due to good crops elsewhere.

The 2,000,000-ton increase of production expected in North and Central America stems almost wholly from the bigger crop expected in Cuba after the low figure in 1965/66 caused by bad weather. The low price of sugar has caused reductions of crops in Argentina and Brazil and the resulting estimate for South America is down by almost one million tons.

In African countries only slight production increases are expected, except for South Africa which, it is estimated, will produce 631,000 tons more than in the 1965/66 crop when it suffered badly from drought. Asian countries are expected to produce 440,000 tons less in 1966/67, most of this amount arising from the forecast for India, with smaller increases and decreases in other countries balancing. The figure for Oceania is 430,000 tons higher, all this increase being expected from Australia.

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Hawaii sugar production 1966.

Unofficial total production of sugar in Hawaii in 1966 was a record 1,234,128 short tons, raw value, according to the Hawaiian Sugar Planters' Association, as reported by *Willett & Gray*[2]. This exceeds the previous record of 1,217,667 tons set up in 1965 by more than 16,000 tons, and eight of the twenty-five plantations exceeded their previous records. The 1967 crop was scheduled to start in the first week of January and all the factories should be in operation by the 6th March.

* * *

U.S. sugar crops, 1966.

The U.S. Dept. of Agriculture reports a smaller output of sugar beets in 1966 but a record crop of mainland sugar cane[3]. In its final report for 1966, the Department stated that production of sugar beets was 20,259,000 tons, 3% or 659,000 below output in 1965 of 20,918,000 tons. Yield per acre was 17·4 tons as against 16·8 tons in 1965. The 1966 crop of cane for sugar was 24,978,000 tons, 10% more than the crop of 22,785,000 tons produced in 1965.

* * *

Sugar products as animal fodder.

It is customary for beet cossettes, after the sugar has been extracted from them in the factories, to be returned to the farm to be utilized in one form or another as cattle feed. Prices the beet pulp fetch vary from country to country and from season to season but it was recently calculated that in certain European countries around the equivalent of £20 per ton was being paid[4]. With sugar in the internal markets

[1] *International Sugar Rpt.*, 1966, **98**, (33), 1–4; (34), 1–3.
[2] 1966, **90**, 517.
[3] *Public Ledger*, 24th December 1966.
[4] C. Czarnikow Ltd., *Sugar Review*, 1966, (785), 195.

fetching some £60 per ton, and in some cases considerably more, this is a satisfactory procedure and there is clearly no pressure to change the existing production pattern. In many instances excess sugar is produced, however, and this has to be heavily subsidized so that it can be exported. With world sugar market prices now well below the return for the cossettes, the anomaly has arisen that the residual product has become the more valuable. It is not surprising, therefore, that thought should be given to the possibility of using the entire root as cattle feed without going through the procedure of extracting and purifying the sugar.

The use of roots purely as a feed product is no new phenomenon; in the Soviet Union details of beet sowings used to be subdivided showing the areas for sugar purposes and for feed requirements and in the 1963/64 season, when the beet crop was poor, roots grown for fodder were diverted to the sugar factories.

In the present situation, with heavy surpluses of sugar overhanging the market, any possibility of diversification of beet from the sugar factories will be beneficial to the statistical situation. Producing countries have recently been under pressure to limit their output. If diversification becomes at all widespread, beet producers will be able to claim that in diverting roots in this way they are already responding to this call, while they are also following a process of enlightened self-interest, and it will be interesting to see whether they will be able to encourage any similar process on the part of cane producers. Although it is, of course, impossible to utilize the entire cane residue in this way, there are many sugar cane by-products which have been successfully introduced into cattle fodder and recent experiments have shown that in the feeding routine for the fattening of farm animals, such as pigs, piglets and calves, a high proportion of sugar in the diet facilitates the changeover from natural diets to compounded foods. The low world market return for sugar must offer producers every incentive to explore such avenues of outlet and it is to be hoped that the lead taken by the beet producers will inspire similar steps from the cane areas. It will be recalled, incidentally, that, during the war, countries which were cut off from their normal sources of supply successfully utilized alcohol made from sugar as an additive to their petrol supplies, and it may be that this outlet is also worth further study.

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Caroni Ltd. 1965/66 report.

1966 was a very poor year indeed and a substantial loss was incurred. While no strikes took place, bad weather throughout the year adversely affected the size of the crop and costs of production rose accordingly. A drought during the first half of the year was followed by excessive rains culminating in the wettest June for over fifteen years. Teething troubles were also experienced in the new Ste. Madeleine mill and boiler house.

The cane:sugar ratio was also adversely affected by continuous and widespread cane fires. These, when they are on a large scale, make it impossible to reap the cane before it becomes stale and thus loses much of its sugar content. The ratio for 1966 was 10·72 compared with 9·82 in 1965. Sugar production was reduced to 186,670 tons, compared with 226,400 tons in 1965. At the end of crop 88,000 tons of Company canes and 4000 tons of farmers' canes were left standing-over until 1967. Fortunately these are all in the South where froghopper attacks are less severe.

* * *

Indian sugar statistics[1].

Final Indian statistics for the crop year November/October 1965/66 indicate that for the first time production passed 3·5 million metric tons. Consumption showed a welcome increase on the year of 350,000 tons, to bring total domestic usage to around 2·8 million tons, most of which was, presumably, in the form of whites, while after the low figures of the previous two years, exports rose again to 431,000 tons.

Stocks have risen by nearly 300,000 tons to 968,000 tons, but this cannot be considered an unwieldy level. The Sen Commission, which was set up to enquire into and report on the Indian sugar industry, recommended the establishment, if possible, of a buffer reserve of 1·2 million tons by the end of October 1966. Thereafter it was proposed that an obligatory store should come into existence which would not fall below 20% of the preceding season's level of production.

Presumably in case of need it would be possible for the stocks brought forward into the current season to be reduced to the minimum level of 700,000 tons, but recent statements by Indian leaders have indicated that they have little enthusiasm for world market sales while current price levels exist. With the new crop not expected to reach the 1965/66 level it seems unlikely that exports of Indian sugar will be made for the time being to other than the preferential markets within the Commonwealth and in the United States.

The actual figures of sugar movement during the past two seasons are reproduced below:

Metric tons	1965/66		1964/65	
	November/October			
Stocks 1st November		671,612(*a*)		156,212
Production		3,537,004		3,260,015
		4,208,616		3,416,227
Exports	431,000		279,000	
Consumption	2,809,609	3,240,609	2,457,202	2,736,202
Stocks 31st October		968,007		608,025

(*a*) Adjusted

[1] C. Czarnikow Ltd., *Sugar Review*, 1966, (793), 233–234.

Engineering Analysis of Ion Exclusion for Sucrose Recovery from Beet Molasses

Part I. Experimental Procedures and Data Reduction Techniques

By W. G. SCHULTZ, J. B. STARK and E. LOWE

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ABOUT 5–10% of the sucrose in the diffusion juice entering a beet sugar factory using the Steffen process eventually leaves as waste simply because there is no economical way of recovering this small but potentially valuable amount of sugar from the molasses. The work discussed in this paper involved the use of an ion-exclusion column to accomplish the desired separation and recovery. The paper is in two parts. This first part deals with the experimental work that was involved and the data-reduction techniques that were employed to divide the data on effluent stream into product and waste fractions. Part II, which will be published later, is devoted to an analysis of the experimental results, including the development of empirical equations, optimization of process variables, a forecast of "production figures", and a cost projection for a commercial-size plant.

Ion exclusion

Ion exclusion is a chromatographic technique for separating materials of different ionic activity and molecular size and configuration by means of ion-exchange resins[1]. A typical resin bed consists of the polymer beads, the water in the beads, and the water in the space surrounding the beads, in approximately equal volume percentages. A column of resin is loaded with the components to be separated, and the separation effected by washing the components through the column with water. Compounds with a lower relative concentration in the resin beads are eluted more rapidly and therefore are separated from the components with a higher relative concentration in the resin bead. The technique is also applicable to the separation of non-ionic or slightly ionic compounds, providing that there is a large enough difference in the relative concentration of solutes inside and outside the resin beads.

The theory and application of ion exclusion were first discussed by WHEATON and BAUMAN in 1953[2, 3] and later by others[4,5,6,7,8]. The use of ion exclusion techniques for the purification of sugar beet solutions was examined by ASHER[9]; NORMAN, RORABAUGH & KELLER[10]; and STARK[1]. The present study is basically an engineering analysis of the ion exclusion process used to recover sucrose from beet molasses.

Materials and apparatus

On the basis of earlier work[1,4], "Dowex 50W"*, X-4, 50–100 mesh resin was selected for this study. The potassium form of resin was used because potassium is the principal cation in beet molasses. The feed material was taken from a 270-kg batch of 66 purity Steffen sugar beet molasses obtained from the Alvarado, California, plant of the Holly Sugar Company. Distilled water was used to dilute the molasses to the desired feed concentration. Distilled water was also used to elute and regenerate the resin column, and for back-washing the column at selected intervals during the test operation.

The 15-cm inside diameter experimental column is shown in Fig. 1, and diagrammatically in Fig. 2. The effective internal cross-sectional area is 175 sq.cm. The column has an overall height of 400 cm and is steam jacketed along most of this height for operation at elevated temperatures. The column sections are held together with slip-on tube couplings and neoprene gaskets (Smith-Blair No. 411-600). The inside surface of the mild-steel column is finished with a baked phenolic coating ("Bison 957") to prevent corrosion.

The resin bed is supported at the bottom of the column by a 160 × 160-mesh wire cloth (Newark twilled weave, 0·0028-in diameter monel wire) laid on top of a 16-gauge, 304 stainless steel perforated plate with $\frac{3}{16}$-in diameter holes on $\frac{1}{4}$-in staggered centres.

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[1] STARK: *Proc. Tech. Session on Cane Sugar Refining Research*, 1964; *J. Amer. Soc. Sugar Beet Tech.*, 1965, **13**, 492–502.
[2] *Ind. Eng. Chem.*, 1953, **45**, 228–233.
[3] *Ann. N.Y. Acad. Sci.*, 1953, **57**, 159–176.
[4] SIMPSON & WHEATON: *Chem. Eng. Progr.*, 1954, **50**, 45–49.
[5] *idem*: *Ind. Eng. Chem.*, 1954, **46**, 1958–1962.
[6] PRIELIPP & KELLER: *J. Amer. Oil Chem. Soc.*, 1956, **33**, 103–108.
[7] VASSILIOU & DRANOFF: *J. Amer. Inst. Chem. Eng.*, 1962, 248–252.
[8] JOHNSON & WHEELOCK: *Ind. Eng. Chem.*, 1964, **3**, 201–206.
[9] *Ind. Eng. Chem.*, 1956, **48**, 1465–1466.
[10] *J. Amer. Soc. Sugar Beet Tech.*, 1963, **12**, 363–370.

* Reference to a company or product name does not imply approval or recommendations of the product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

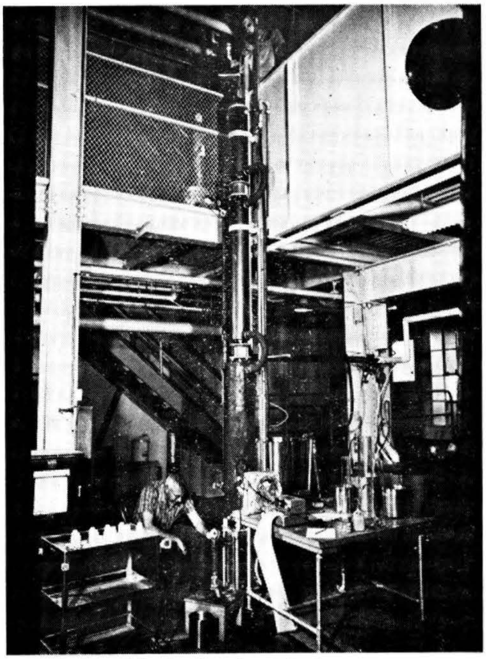

Fig. 1. Experimental column

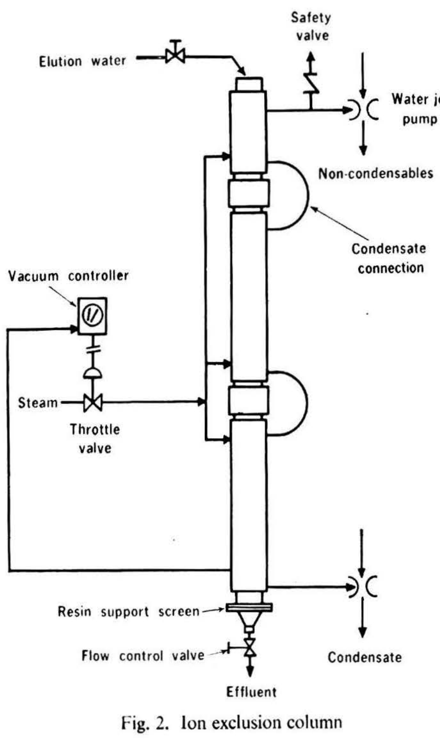

Fig. 2. Ion exclusion column

The steam jacket was operated at sub-atmospheric pressure. Condensate and incondensables were removed by water aspirators. Resin bed temperature was maintained by preheating all liquids entering the column, and by controlling the steam jacket temperature at the equivalent saturation pressure by means of a recording vacuum controller. Temperature variation within the resin bed was ±1·5°C from top to bottom, and ±0·5°C across any given cross section. Variations were determined by probing the bed with thermocouples.

Effluent flow from the bottom of the column was controlled by means of a $\frac{1}{8}$-in orifice needle valve at low flow rates, a $\frac{1}{4}$-in orifice globe valve at moderate flow rates, and a centrifugal pump (Eastern D-11) at high flow rates. Flow rate remained constant within ±1% so long as the established head of liquid in the column was held constant within ± 10 cm.

A distributor consisting of a feed cup, an adjustable length of tube, and a bottom diffuser, was used to introduce liquid feeds into the column without seriously disturbing the resin bed. The distributor was positioned with the bottom diffuser one centimetre above the resin surface.

Methods and procedure

At the beginning of a run involving a change in the effective column height or the operating temperature, the column was backwashed with distilled water to remove resin fines and other undissolved solids, to redistribute the resin beads that may have clustered together during a previous run, and to eliminate air pockets that might have been trapped in the resin bed. On the average, this was done about every fourth run. The backwashing operation involved the use of a 90-cm extension tube which was clamped to the top of the column for additional height. The extension is a necessity to provide for overflow and because the resin bed volume expands by 60% or more during the backwashing operation.

Following the backwash, the direction of water flow was reversed, the resin allowed to settle, and the bed height stabilized at the desired flow rate by holding the flow constant for half an hour or longer. Actual bed depth was determined under dynamic conditions, with water flow at the proper rate and the column stabilized at the desired temperature.

Molasses adjusted to the selected solids concentration and temperature was then introduced into the column as the water level was allowed to drop gradually down to the top of the resin bed. The amount of molasses introduced into the column during a given run varied from 8 to 20% of the total volume of the column. The flow of molasses through the column was maintained at the rate previously stabilized for the distilled water. The charge of molasses was then followed by the eluant (distilled water) at the same flow rate.

Beginning with the introduction of the molasses, the effluent from the column was collected in equal fractions, each 5% of the resin bed volume, to be analysed for sucrose and total solids. Typically, 20 to 45 fractions were collected per run.

Chemical analyses

Total solids were determined in duplicate by taking aliquots from a fraction to give a solid residue of 300–600 mg, placing the solution in tared glass weighing dishes, 50 mm in diameter, and heating 6 hours in a forced-draught oven at 60°C. The dishes containing the thick syrup were placed in a vacuum oven and the pressure reduced until the syrup foamed and filled the dish. After 30 hours' drying at 60°C the pressure was restored with air slowly bubbled through sulphuric acid. The dishes were placed in a desiccator and weighed when cool.

Aliquots of the fractions were taken for sugar analysis by the Munson-Walker official AOAC method[11]. The cuprous oxide was collected and weighed in a porcelain filtering crucible. Sucrose was calculated as 0·95 times the total reducing sugar after invertase inversion.

Data reduction

A total of 31 experimental runs were made with process variables covering ranges considered to be of commercial interest and significance (see Table I). Operating temperatures were varied from 20° to 94°C, feed solids from 104·3 to 550 g/litre, feed molasses volume (load volume) from 6·99 to 23·15% of total resin bed volume, bed height from 80 to 300 cm, and effluent flow rate from 10·2 to 159·2 litres per hour, or 0·97 to 14·97 ml per sq. cm. per minute.

Data from the single-batch-type runs were plotted to show the relationship between the sucrose and non-sucrose solids of the sample fraction and the cumulative volume of the effluent stream. Fig. 3 shows the plot for a typical run.

The plotted data were used to divide the effluent steam into product and waste segments, representing the conditions of operation for a continuous-batch-type unit. The separation was based on the following assumption: sucrose is crystallizable and therefore the effluent stream becomes a product stream if the purity of the effluent stream at any given moment is at least 65, and if the sucrose concentration of the stream is at least 25 g/l. Otherwise, the effluent is considered to be waste. Densities of all solutions were assumed to be equivalent to sucrose solutions of the same total solids.

In Fig. 3, solids first appeared in the effluent at line *m-m* and gradually disappeared at line *q-q*. This interval was considered the total cycle time (t). The product portion of the effluent stream lies between lines *n-n* and *p-p*. The areas under the various segments of the two curves, divided by the respective net cumulative volumes, represent the average sucrose or non-sucrose concentration for the particular segment of the effluent.

The various areas under the two curves (A_x) are defined as follows, with the subscript corresponding to the numbered areas in Fig. 3:

A_1 = Sucrose available for crystallization, kg.

A_2 = Non-sucrose solids inhibiting sucrose crystallization, kg.

A_3 and A_6 = Non-sucrose solids in waste segment, kg.

A_4 and A_5 = Sucrose in waste segment, kg.

The data reduction equations in Table II were then used to calculate the crystallizable sucrose rate (S) the waste solids rate (W), the water removal rate to 65% solids (by evaporation) from the solution to be crystallized (R), the water removal rate to 65% solids (by evaporation) from the waste solution (U), the total solids concentration of the solution to be crystallized (N), and the purity of the solution to be crystallized (P), for each of the experimental runs.

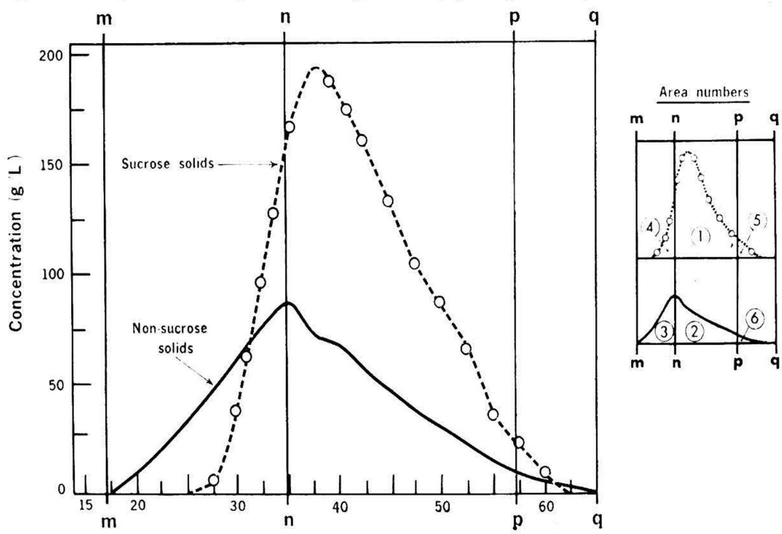

Fig. 3. Solids concentration in effluent stream—typical run

[11] Association of Official Agricultural Chemists Official Methods of Analysis, 8th Edn. (Washington, D.C., U.S.A.) 1935. Sections 6.2 (b), 6.74 (a), 6.77, 6.78 (b)(2), 29.35, 29.39, 29.40, and 42.11.

Table I

Experimentally determined and equation-derived data

	Independent process variables					*Dependent process variables*					
								Water to be evaporated		*Product solution*	
Run no.	*Temp. (°C)* x_1	*Feed concn. (g/litre)* x_2	*Load volume (%)* x_3	*Bed height (cm)* x_4	*Flow rate (l/hr)* x_5	*Cryst. sucrose (kg/hr)* S	*Waste solids (kg/hr)* W	*Product solution (kg/hr)* R	*Waste solution (kg/hr)* U	*Total solids concn. (g/litre)* N	*Purity (%)* P
1	20	107·2	14·92	268	98·6	0·381	1·950	18·05	77·68	43·17	81·20
2	21	213·2	7·46	268	114·2	0·400	2·263	21·49	89·52	47·95	77·80
3	60	214·5	6·99	295	10·2	0·156	0·149	2·08	7·74	82·83	93·70
4	60	441·8	21·27	290	92·7	1·395	7·894	41·73	40·12	133·23	72·43
5	81	108·1	14·92	295	152·1	1·556	2·836	41·96	104·90	53·79	87·60
6	81	424·9	22·17	298	47·0	0·858	4·089	17·85	23·39	166·63	73·17
7	94	108·3	7·43	300	48·0	0·329	0·407	8·76	39·51	42·41	94·41
8	94	436·5	15·05	296	31·2	0·696	2·287	11·05	16·69	156·58	76·55
9	94	433·8	14·80	164	34·2	0·608	2·385	10·09	20·60	170·33	74·96
10	62	212·4	14·83	159	106·2	0·843	3·465	25·98	74·99	83·47	77·27
11	20	214·1	14·90	149	11·9	0·131	0·376	2·79	8·49	100·94	79·33
12	20	433·6	7·46	149	51·8	0·191	1·512	13·03	36·68	78·59	70·94
13	94	216·6	14·80	164	13·1	0·196	0·486	2·64	9·65	124·44	82·90
14	25	322·1	11·19	149	29·0	0·238	0·901	7·29	20·31	94·41	75·78
15	21	104·3	22·90	81	12·5	0·083	0·267	2·92	9·14	61·61	79·90
16	21	320·6	15·50	80	33·0	0·135	1·424	8·65	22·51	104·18	69·90
17	21	422·1	7·62	81	114·4	0·165	2·737	22·17	88·29	70·74	68·38
18	60	321·5	22·90	83	35·2	0·322	2·088	8·58	23·75	156·77	71·88
19	60	108·7	11·50	83	157·2	0·088	1·925	9·00	145·11	37·14	73·72
20	60	520·5	15·50	81	55·0	0·467	3·314	23·00	27·45	115·93	70·30
21	80	548·4	7·72	85	11·2	0·150	0·459	2·28	8·20	145·33	78·21
22	80	214·0	23·10	85	102·6	0·680	4·467	28·16	68·06	102·05	72·30
23	80	110·8	11·57	85	33·0	0·144	0·323	5·70	26·67	43·47	84·32
24	93	107·9	23·00	86	10·8	0·086	0·233	2·29	8·11	75·55	80·91
25	93	317·8	7·61	87	105·3	0·480	2·474	24·82	76·55	67·53	74·21
26	92	535·8	11·43	87	154·4	0·807	8·154	63·11	81·28	97·42	69·07
27	92	534·8	22·85	87	151·7	1·047	12·504	73·94	62·35	132·71	68·16
28	93	480·7	23·15	289	121·7	1·364	9·598	44·68	64·08	161·98	70·36
29	22	436·7	22·00	273	10·5	0·098	0·708	5·81	3·73	103·69	69·99
30	63	546·2	10·61	291	32·2	0·432	1·719	11·91	17·74	121·28	74·00
31	81	329·9	11·27	293	101·1	1·160	3·604	33·72	61·47	94·22	76·36

The results of the calculation are shown on the right-hand side of Table I.

Multiple regression techniques were employed to develop empirical equations expressing the relationships between the above dependent variables and the independent variables shown on the left-hand side of Table I. This and other aspects of data analyses will be discussed in a later paper. It will be shown that the recovery of sucrose from beet molasses by ion exclusion is not only economical, but highly profitable.

Table II

Data reduction equations

(Lettered subscripts correspond to cut-off lines shown in Fig. 3.)

$$S = \frac{A_1 - kA_2}{t}$$

$$W = \frac{(1 + k)\,A_2 + T_{mn} + T_{pq}}{t}$$

$$R = \frac{(V_{np}D_{np}) - k'T_{np}}{t}$$

$$U = \frac{(V_{mn}D_{mn}) + (V_{pq}D_{pq}) - k'\,(T_{mn} + T_{pq})}{t}$$

$$N = \frac{T_{np}}{V_{np}}$$

$$P = \frac{A_1}{T_{np}}$$

SYMBOLS FOR TABLE II

A_1 = Sucrose available for crystallization, kg.

A_2 = Non-sucrose solids inhibiting sucrose crystallization, kg.

A_3 and A_6 = Non-sucrose solids in waste segment, kg.

A_4 and A_5 = Sucrose in waste segment, kg.

D = Average density of solution, kg/litre.

N = Total solids concentration of solution to be crystallized, g/litre.

P = Purity of solution to be crystallized, %.

R = Water to be evaporated from sucrose solution, kg/hr.

S = Crystallizable sucrose, kg/hr.

T = Total solids, kg.

U = Water to be evaporated from waste solution, kg/hr.

V = Volume, litres.

W = Waste solids, kg/hr.

k = Ratio of sucrose to non-sucrose solids at 65 purity = 1·8571.

k' = Ratio of the weight of a 65°Brix solution to the weight of sucrose in the same solution = 1·5385.

t = Total cycle time, hr.

Acknowledgement

The authors wish to acknowledge the assistance of Mr. NOEL H. HURD in the conduct of the experimental work, and the valuable help of Mr. ALAN E. GOODBAN and Dr. ROLAND M. MCCREADY in the review of this report.

Dust Control in a Beet Sugar Factory

By T. RODGERS (British Sugar Corporation Ltd.),
P. SWIFT and J. J. GILBERT (Dust Control Equipment Ltd.)

Paper presented to the 18th Technical Conference of the British Sugar Corporation, 1966

PART II

Dust Collection Equipment

There is, within quite narrow limits, only one correct design of hoods and ducts for any specific dust collection installation. Similarly, the air quantity is fixed, and the total pressure drop across the system is influenced largely by the hood and duct design—although it is dependent to a degree on the choice of collector. It follows, therefore, that the capital cost of hoods, ducts and fan is practically a fixed amount, and dependent entirely on the particular installation. It is by the correct choice of collector that we can achieve the desired collection efficiency at the lowest total cost.

There are very many designs of dust collectors on the market. However, they are all based on a quite small number of separation principles, and it is under this latter heading that they can best be classified.

Gravitational collectors

The cheapest form is simply an expansion chamber which reduces the "dirty" air velocity and allows the particles to settle by gravitational force. Factors affecting the collection efficiency are the reduction in conveying velocity achieved, the vertical distance through which the particles must fall, the particle size, and relative densities of the gas and particles. For sugar and pulp dust, with the collection efficiencies desired, the last consideration rules out this type of collector in sugar factories—and indeed in most other industries! The principle has been used however for separating larger particles such as grit and sand from milk-of-lime and sugar juices, but the installations are bulky and efficiency low.

Inertial collectors

With this type, the system depends on a sudden change of direction of the dust-laden air, when, owing to the much greater inertia of the dust particles, they are separated from the gas stream and collected by various means. Again, the separation that can be obtained depends very much on the size and density of the dust particles. This principle is used in sugar factories for entrainment prevention, and it has also been used in separating relatively large pulp particles from drying gases. The "Aerodyne" separator is an example of such a unit. This is an enclosed cone, the surface of which has numerous slots cut in such a way that the gas has to change direction violently to pass through. The dust particles cannot do so, and are collected (or concentrated) in the cone interior, the concentrated dust/air mixture then passing to a more efficient collector, which may now be of considerably smaller dimensions. This type has not proved particularly successful on sugar dusts. For a steady efficiency, the dust-laden gas quantity and the slot size, must remain constant, suffering neither build-up nor wear from abrasion. In practice we have not found this is achieved, and when a final collector is incorporated, the demands on the latter can vary too greatly.

The inertial type therefore is a relatively cheap form of dry collector, which can remove particles of much smaller dimensions than a reasonably sized gravitational unit, but as a collector of fine dusts of low density it is not of sufficiently high efficiency for normal sugar factory requirements.

Cyclones

In the strict sense, all centrifugal separators, of which the cyclone is perhaps the most widely used industrial collector, fall within the principle of inertial collector. Because of the many designs available, cyclones are considered as a special case.

The cyclone, in its basic form, is a simple and comparatively cheap type of collector. It can be designed for much higher efficiency than the units already described, and yet it has no moving parts, nor has it any fabric which can choke, and for the quantity of air treated it is remarkably compact. The principle is well known, and suffice to say that the particles are subjected to an outward centrifugal force and an inward viscous drag, the resultant between the two determining whether they move to the wall and so into the collecting hopper beneath, or are included into the "clean" gas core which is discharged centrally through the top. Theoretically, at least, the efficiency can approach 100% for any particular centrifugal force but in practice the theoretical sharp "cut" dependent on particle size is not realised, and a graded efficiency results. If we refer to Fig. 3 a theoretical separation would be OMNP, and the actual grade efficiency is best determined experimentally, and takes the form of curve OP, where area "A" represents particles that should have been discharged with the clean gas, but which have been swept to the side by larger particles and so trapped with the collected dust, and area "B" represents particles which should have been trapped, but have escaped because of entrainment from the discharging material at the bottom of the cyclone into the inner vortex of cleaned gas.

Whereas a cyclone is a simple, clean and compact collector, in no sense can it be compared with an absolute filter, and it is rarely possible to recirculate air into a working space. Consequently, there are appreciable heat losses if the extraction area is heated for working comfort. Cyclones are frequently used in conjunction with other types of collectors of higher efficiency, so reducing the load on the latter.

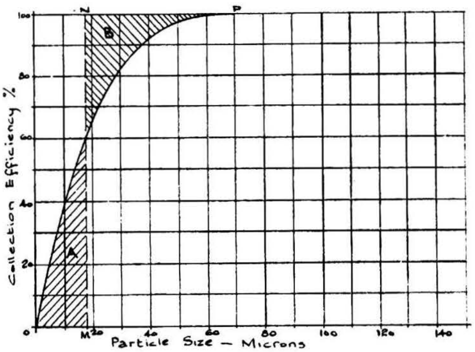

Fig. 3. Typical grade efficiency curve for cyclone collector

One of its most disagreeable facets is that its efficiency decreases with increasing diameter, and diameter must increase for increasing throughput. To achieve separation of small particles from large gas volumes, recourse is often made to nesting a number of small diameter units.

This is only partially effective, however, because it usually results in a loss of efficiency due to the difficulty in maintaining uniform gas and dust distribution in the system, and there is also a definite risk of loss of both performance and output, by choking of some of the small cyclones. It is doubtful whether the slight increase possible in theoretical efficiency is worth the risk. The effect of cyclone diameter on collection efficiency is illustrated by Fig. 4, which shows efficiency curves for sugar dust collected in different sized medium efficiency cyclones.

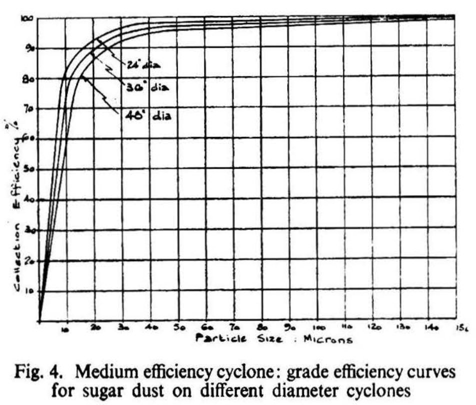

Fig. 4. Medium efficiency cyclone: grade efficiency curves for sugar dust on different diameter cyclones

Variations in design of cyclone can be introduced to achieve higher separation efficiency at lower throughputs, or higher capacity with a loss in efficiency. The main difference is in the "wrap-around" inlet of the high capacity units. Of course, many compromises are possible in these design features, but Table IV gives some indication of relative capacities of two such units compared with the amount of dust escaping with the cleaned gas.

Table IV
Effect of cyclone diameter on efficiency and air quantity

	Type B—High efficiency		*Type C—High capacity*	
Cyclone dia. (inches)	*Air flow (c.f.m.)*	*Cut size % in-efficiency*	*Air flow (c.f.m.)*	*Cut size % in-efficiency*
18	820	4·2	1,540	10·9
21	1,120	4·4	2,100	11·5
24	1,460	4·7	2,740	12·0
27	1,850	4·9	3,470	12·5
30	2,280	5·1	4,280	12·9
33	2,670	5·3	5,200	13·3
36	3,280	5·5	6,180	13·8
39	3,850	5·7	7,250	14·2
42	4,470	5·8	8,400	14·7
45	5,060	6·0	9,650	15·2
48	5,830	6·2	11,000	15·4
Pressure loss	4 in w.g.		2½ in w.g.	

In general, when gas rates are high—involving a cyclone of over 4 ft–5 ft dia.—and fine sugar or pulp dusts have to be collected, the collection efficiency is not good. It is possible to make recourse to a number of smaller units, but this becomes more expensive. If the basic cyclone design is chosen for an installation, then careful consideration must be given to grade efficiency curves of different sized units so that a prior estimate can be made of the amount of discharge.

A problem common to all sugar factories producing dried pulp is the separation of comparatively large quantities of drying gases from the product. This has traditionally been done by large diameter, high gas volume, cyclones, with a corresponding low efficiency. To aggravate conditions, dryer capacities have been increased in the years, and this overloading destroys the original design basis. With increasing resistance to air pollution and loss of product, it became necessary in B.S.C. factories to improve collection efficiency. This has been done very conveniently by the adoption of higher efficiency collectors using the van Tongeren system. The design consists of a preliminary chamber which concentrates the dust, and the latter is then "peeled off" into much smaller diameter—and therefore higher efficiency—secondary cyclones. By this means an appreciable increase in collection efficiency has been achieved while maintaining the simple operation of the cyclone, and without too great an increase in pressure loss. For present standards of effluent discharge, this has provided a satisfactory solution, although discharge of very fine particles still exists.

It may be of interest to mention some details of a more refined method for pulp dryer discharge which has been installed for three years at one B.S.C. factory. In addition to fitting higher efficiency cyclones mentioned above, it was decided to reduce the nuisance of vapour and fines to the adjacent dwellings by arranging the discharge at a high level, thus dispersing it over a wide area. This was done by building a tall brick chimney 220 ft high following the cyclones. The chimney should be designed to have a gas/vapour exit velocity of 50 ft/sec at a temperature of 110°C. The internal surface was lined with 4½ in acid-resisting brick set in acid-resisting cement. The height of such chimneys is laid down by U.K. Government recommendations of the "Clean Air Act" which gives a complicated formula. However, as a rough guide, the height can be taken as 2½ times the apex height of adjacent buildings.

This arrangement has certainly produced the desired results, and after three campaigns' use is in good condition. Care is necessary at the beginning of each campaign when the residue deposits in the lining can be discharged as smuts, but this only happens once, and provided the dampers of the collectors are adjusted for optimum efficiency no further difficulties are experienced. We consider that a steel chimney would also be satisfactory, and in this case it would be clad, e.g. with aluminium sheeting. The latter acts as an insulation, thereby reducing condensation on the inner surface of the steel, thus prolonging its life. This has been done successfully on other pulp dryer chimneys.

An important consideration with cyclones is that their efficiency can be significantly improved by irrigating the walls, and in the beet sugar factory this is particularly attractive during campaign operations when generally sufficient water is available and the collected materials can be disposed of immediately. To illustrate the effect of irrigation on efficiency, Fig. 5 indicates grade efficiency curves for a 33 inch dia. medium efficiency cyclone operated dry, and with varying quantities of irrigation water.

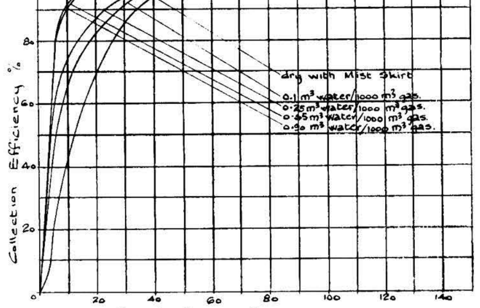

Fig. 5. Medium efficiency irrigated cyclone: grade efficiency curves for 33 in dia.

Again the performance does not reach that of a filtration unit, but the efficiency is considerably improved at no increase in pressure drop and very little capital cost, and as a means of reducing nuisance dust without necessarily recovering all the product, it is a cheap and simple expedient. The wetting effect improves the efficiency in two ways. Firstly, it eliminates, or minimizes interference between air and dust flow patters which occur in a dry unit, and which contributes significantly to the cyclone inefficiency; the particles are now trapped and retained on the irrigated surface. Secondly, allied with a mist skirt, it minimizes the effect of precession currents at the top of the cyclone, and reduces the amount of dust which would otherwise by-pass and escape up the chimney.

In practice, water can be sprayed into the inlet air stream or onto the walls. The object is to cover the latter with a water film. Relatively coarse water spray nozzles may be used, so minimizing the possibility of jet choking which would have an immediate adverse effect on performance. This also permits the use of water which is not filtered to a high degree. We have adopted this method as a simple but effective and relatively cheap means of disposing of low-value pulp dust collected from conveying systems, weighing and bagging machines during campaign. Normal clarified effluent water is used for supplying the cyclone, and the collected dust is disposed as a slurry into the effluent system—thereby avoiding any labour usage on the unpleasant duty of emptying filter bags. The effluent is quite within our tolerance. Two conditions of operation apply: the water supply must not fail and should be sufficiently clean to avoid blockage of the jets used, and the slurry discharge should be visible, and preferably by an open drain, to avoid build-up within the cone through obstructed discharge, and allow easy detection if water quantity alters. Neglect of these points, allowing a cyclone to run dry or semi-dry, can result in serious wall abrasion or substantial material carry-over, while restricted discharge can result in reduced entrainment rates.

Filtration

The great advantage of this method of separation is that, properly applied, it can achieve virtually 100% collection. Where the dust is of value, or where the efficiency for any reason has got to be very high, then filtration offers the best solution to the problem when wet collection is not practical. The particles themselves are not materially affected by the collection process, and the filter air can usually be returned to the working area without danger to health and safety, provided normal precautions are engineered into the installation.

Separation by filtration can be divided into two categories: first, treatment of the dust laden gas on a closely woven fabric (this system generally provides some simple means of regenerating the filtering medium), and second, treatment of the dirty gas through a paper filter (this very often follows a previous separation) or through a maze which may, or may not, have surface treatment to improve the adherence of the particles. In general, the second systems are not easily regenerated, and are mainly used when dust concentrations are low, such as in normal atmospheric dusts from ambient air. These types are used in factories to protect plant, e.g. alternators, or to reduce contamination of drying air in sugar granulators and anti-condensation air in liquid sugar storage tanks. Their filtration efficiency is very good, but it is necessary to make careful and frequent checks on air flow rates, and to replace the medium at some pre-determined stage.

Fabric filtration offers the widest scope for high efficiency sugar dust collection during an off-season. It is, however, never cheap and here differentiation must be made between intermittent and continuously rated systems. The lowest cost filter available is one capable of efficient but intermittent operation. It is intermittent because, working on a particular dust control system, the fan has a certain capacity to overcome resistance to air flow. If this resistance increases, the quantity of air will decrease (Fig. 6).

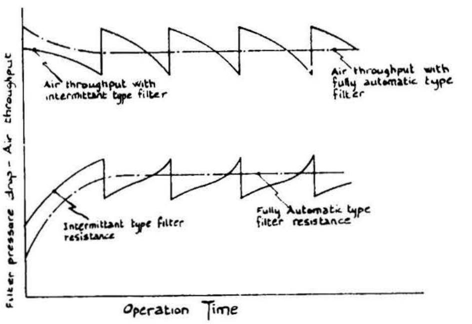

Fig. 6. Flow rate and resistance with intermittent and fully automatic fabric filters

Thus, as the dust collects on the fabric the adverse effect of increasing resistance will reduce the air entrainment rate (in the zone of dust generation) to a point where it is insufficient to prevent some escape of contaminated air. Before this point is reached, the dust cake should be discharged from the filter medium, and this is done by isolating the filter—usually by stopping the fan—and agitating the filtration medium. During this cleaning period, no dust control is exercised. Consequently this type of filter must be applied to processes which naturally present regular breaks in operating procedure, and the complete system must be designed to suit the process. There are applications, however, where it is an extremely economical and compact way of applying dust control facilities to a number of defined sources. These unit filters can be obtained with a fan, filter elements, hopper and bin, together with a cleaning device all contained within one unit chassis, and they have a further advantage that they are relatively mobile and can be reused, within their design capabilities, should any changes to plant layout occur.

An important consideration with this unit is that the operating air velocity through the fabric should preferably not exceed about 5 ft/min, otherwise blinding of the fabric by the fines fraction, together with compaction of the dust, leads to excessive filter resistance and even eventual breakdown of the filter bed. In general, therefore, to achieve high efficiency, the filter has to have relatively large filtration areas and avoid frequent cleaning, which in turn limits the maximum dust concentrations. In its simplest form labour is required for routine operation—although at some extra expense this can be avoided. Operated within its designed limits it can achieve efficiencies of close to 100%. Such units are used in B.S.C. factories where no trouble arises from intermittent working such as in packeting plants, sugar bagging stations, etc.

Many of the above limitations can be overcome with a more sophisticated design of fabric filter working on a "reverse jet" cleaning system. Here a limited section of the filtering area is automatically isolated from the filtration cycle for a short period at predetermined intervals and the collected dust is discharged from this section by air flow in the reverse direction, i.e. from the clean side of the filter. The cycle of cleaning is either controlled on a time or pressure drop basis, and the reverse air can be previously filtered air or, preferably, high pressure air. Thus, too large a build-up of deposited material can be avoided. The use of felted materials as filtering medium increases the permissible filtration velocity which in general cases can be as high as 10–15 ft/min, but with sugar dust we generally limit it to 10 ft/min. Virtually absolute efficiencies can be obtained and very much higher dust concentrations can be handled.

By fitting seals, such as a rotary valve, on the discharge, these units can be fully automated, and high pressure air (90 p.s.i.g.) and limited bag agitation, ensure an efficient cleaning operation. Furthermore, these filters can be used continuously throughout the year. They are the standard installation in British factories on sugar conveying systems that must operate continuously in the campaign and intermittently or continuously in the off-season, including protection for air drying units in sugar silo conditioning systems.

The correct selection of the filter medium is important with fabric filtration installations. In general, if a filter is cleaned by the reverse jet principle it is possible to use a felted material, as opposed to woven cloth necessary with mechanical agitation. Felt is a remarkable substance in this context and permits a significant increase in filtration velocity over that normally associated with woven cloth. Other benefits follow, such as a reduced filtration area and a more compact unit. When handling hygroscopic sugar dust we have found the best results are achieved by using a "Terylene" felted material, with which we get the filtration characteristics of the synthetic fibre due to the inertness of the medium and its non-absorption of moisture from the dust cake. An added refinement is to use oil-free, dried, compressed air for the reverse jet. This helps to keep down the filter resistance for a longer period, as any dissolving of sugar dust due to moisture, or impregnation with oil, leads to reduced permeability of the cloth. We should say however, that absolutely oil-free, dry air is not essential, and we have fabric filters working from normal compressors without aftercoolers.

(To be continued)

Bagasse Products Co. Ltd.

IT was announced some time ago[1] that Tate & Lyle Ltd. were joining with S. Hille & Co. Ltd., a U.K. furniture-making company, in the formation of a new company, Bagasse Products Co. Ltd. Bagasse is imported from the Tate & Lyle Group sugar factories in the West Indies where, after pressing into low density bales and storing for 4–8 months in the open air, the moisture content is reduced from 50 to 15% on average. After this maturing, the bales are compressed again into high-density bales and shipped to Plaistow Wharf where a pilot plant (Figs. 1 and 2) was installed in September 1964[2] for conversion to "Bagelle".

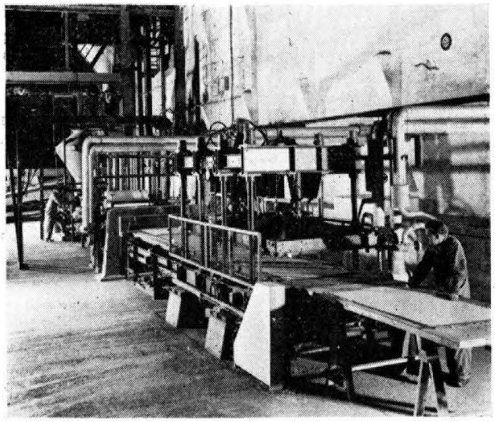

Fig. 1

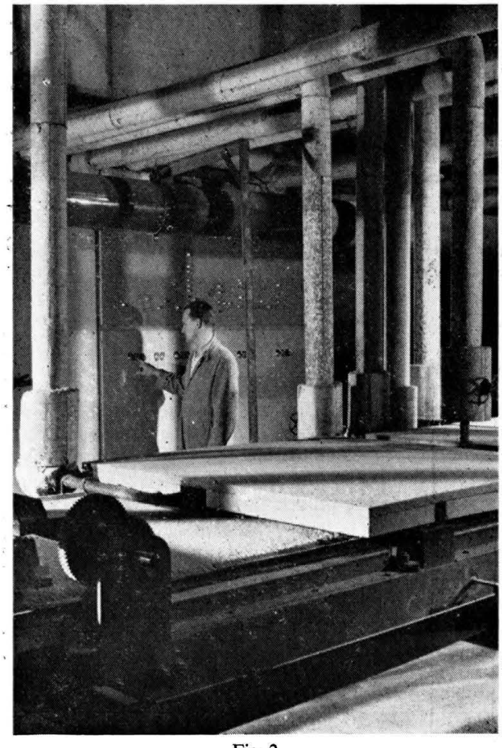

Fig. 2

This product, supplied in board and loose form, is prepared from the bagasse fibre and contains 15% of thermosetting phenol-formaldehyde resin and other additives. The "Bagelle" board is a semi-cured partly compressed board designed to allow users of laminating presses to manufacture strong, waterproof exterior-grade board in thicknesses of 5 mm ($\frac{3}{16}$ in) or more to their own requirements, as well as moulding three-dimensional objects using techniques developed by Bagasse Products Co. Ltd.

The "Bagelle" boards are produced in sizes up to 11 ft × 3 ft 1 in, and can be processed to give varying density, strength and thickness. They can be cut to shape, moulded and faced with wood veneers, melamine papers or fabric and, since the material displays no "telegraphing" or show-through of core material, it needs no sanding before facing. Screw threads and metal fittings may be incorporated during pressing, as indicated in Fig. 3 which shows part of the front panel of a television set, made from "Bagelle".

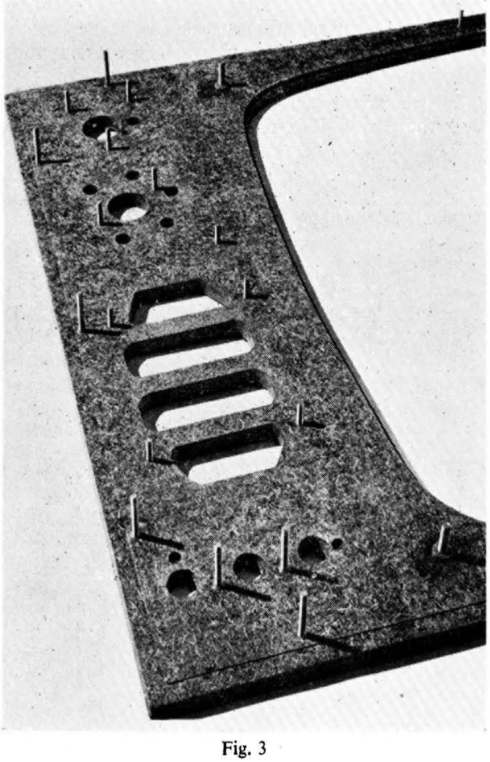

Fig. 3

[1] *I.S.J.*, 1964, **66**, 370.
[2] *I.S.J.*, 1965, **67**, 339.

The finished panel, with veneer applied, is seen in Fig. 4, which also includes a number of other veneered and coated mouldings produced from "Bagelle". Certain of the smaller products are made from the "Bagelle" powder which can be moulded and finished in one operation, the curing time required being 5 minutes as against 20 minutes for wood chipboard.

A further economy for users is provided by the fact that clean un-processed offcuts of "Bagelle" can be returned to the manufacturers for re-use.

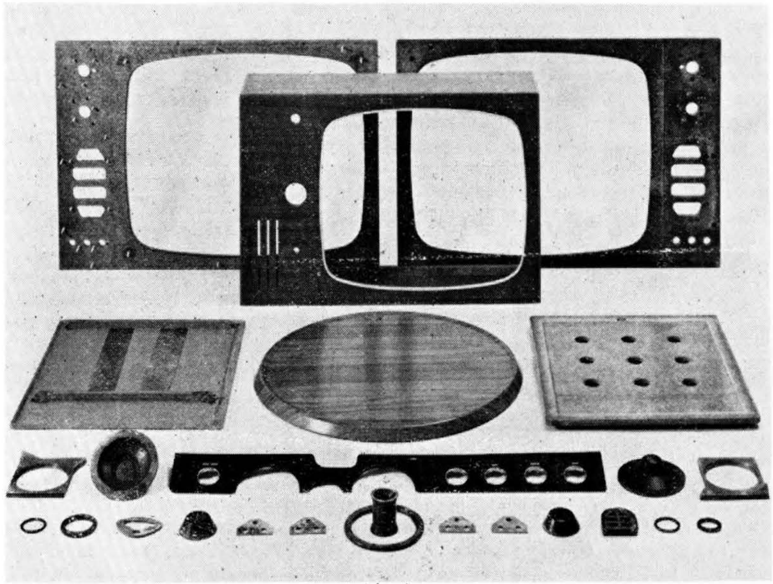

Fig. 4

"Bagelle" boards, laminated to melamine-impregnated plain, printed or decorative paper under high pressure, become "Bellamine", a high-density board, resistant to weathering, impact, corrosion, boiling water, petrol, and heat. It can be used for the exterior cladding of buildings, washing machine tops, road signs, kitchen furniture, etc.

Particle board consumption in the U.K. doubled over the period 1962–65 and Bagasse Products Co. Ltd. have every confidence that their products will increase the market still further by opening up new applications and creating new possibilities. Negotiations are under way for distribution of the materials overseas and consideration is being given to expansion of production capacity at Plaistow Wharf.

Sugar Cane Research in Hawaii

Annual Report, 1965, Hawaiian Sugar Planters' Association

THIS report, which covers the period 1st October 1964–30th September 1965, gives an account of the many lines of research that are being carried out and of their very wide range. The report, which extends to 71 pages, is divided into ten main sections: basic plant physiology and biochemistry; climatic studies; cultivation practices; mechanical harvesting and related research; nutrition and fertilization research; plant protection research; sugar technology research; varieties programme; water studies and irrigation programme; and weed control programme and chemistry.

The Director in his introductory remarks expresses his belief that encouraging progress has been made in three broad areas. "First, in seeking ways of recovering more of the sugar we now produce (see the reports on diffusion, cut-load harvester and dry cleaner, and rat control). Second, in seeking ways of improving efficiency or lowering costs of present practices (see the reports on weed control, irrigation systems and efficiency of water use, automation and central control systems in factories, optimum use of fertilizers, computer programming for climatic data and for optimization of irrigation system designs). Third, in seeking ways of increasing the per-acre yield of sugar (see reports on ripening and tassel control, transplanting, yield decline, slag and growth-regulating substances).

In July, the Station was awarded a 3-year contract by the U.S. Department of Agriculture. Under this contract the Physiology and Biochemistry Department will conduct basic physiological and biochemical investigations of "yield decline" in sugar cane.

Planting

An account is given of experiments in planting nursery-grown plants, nine weeks old and grown from one-eye seed pieces instead of the usual plantation practice of planting three-eye setts direct in the field. Combined with this has been a study of the effects of various chemicals on germination. Results indicate that it should be possible to stimulate or inhibit root and/or shoot development under the nursery conditions implicit in the transplanting concept. It is considered that the sugar industry is being forced in the direction of intensive farming and that transplanting is one indicated step in that direction. So far results have been encouraging provided there is no shock to the transplants caused by soil moisture deficiency immediately after planting. Preliminary work is under way to automate and mechanize nursery and transplanting operations. One of the first steps will be to determine the best container. A polyethylene bag is considered probable even though it will have to be removed prior to planting.

Irrigation

An irrigation engineering seminar was held to provide up-to-date information on design procedures and on materials available to those in the Hawaiian sugar industry concerned with designing sprinkler systems. Attendance at the 4-day session was approximately 75. The proceedings of the seminar have been included in an irrigation engineering manual.

Work was continued on the testing of component parts of sprinkler systems. Eleven types of sequencing valves, six control valves and six sprinklers were tested for flow characteristics and reliability. Test results are used by plantation engineers in designing field layouts and by manufacturers in evaluating their products for the conditions under which they will be used in the Hawaiian sugar industry. Over a thousand pattern-distribution tests were run on six different sprinklers under a wide range of operating and field conditions. The results were analysed and made available to the industry. Field experiments at four plantations to determine the effect on yield of sprinkler spacing, uniformity of water application and method of interval control were initiated. These required 50 acres at each plantation. Results will not be available until harvest in 1967.

Mechanical harvesting

Tests were continued with the H.S.P.A. experimental cut-load harvester (chopper harvester) which was kept in field use all through the 1965 grinding season. It supplied cut cane to the experimental dry cleaner at the mill. Development work with the harvester centred round mechanical and functional improvements on the crossflow cutter, the elevating conveyor and the cutterhead suspension.

The experimental dry cleaner was designed to clean or remove trash from the short cut cane supplied by the experimental cut-load harvester. The basic reason for this dry cleaning, as opposed to wet washing, was to salvage the 3–6% pol now being lost in the wash water of the conventional cane cleaner. Comparison of the two methods showed that the harvester and dry cleaning was superior by 5–9% or approximately 0·6 ton sugar/acre. The principal trash extraction component on the dry cleaner is the pegtooth drum and blower combination.

Weed Control

The screening programme for chemical weedkillers for sugar cane was actively pursued. The herbicides tested during 1965 fell into three categories: (i) those continued from previous years, (ii) new herbicides receiving widespread plantation testing and (iii) those included only in one or two tests. Full-scale tests are compared with the three present standard herbicides—"Diuron", "Atrazine" and "Ametryne". Two compounds, "Du Pont 767" and "Du Pont 732" emerged from field tests as promising soil-residual herbicides, especially for the control of seedling grasses and nutsedges. As a foliar post-emergence treatment "Du Pont 676" did not measure up to "Diuron", but "Du Pont 732" gave excellent control of emerged weeds. Both of these uracils injured cane with more frequency than did "Diuron" in the same tests at the same rate, generally 4 lb/acre; "Du Pont 732" caused more cane injury than did "Du Pont 767", both as a pre- and post-emergence application.

Work was continued on soil moisture relationship to weed control, on varietal susceptibility to "Diuron" and on the evaluation of "Picrolam". Details are given of a lightweight boom made of reinforced nylon tubing for use with hand spray knapsacks, which has been developed at the Station.

Pests and diseases

Much attention is being given to the question of rat control and reduction of rat damage, with the appointment of additional staff for the work. The establishment of a cooperative research programme has been recommended. "Endrin" powder (2%) was highly successful when used as a contact poison in rat burrows wherever found, usually along field roads and on embankments and is to be recommended as standard practice. Promising results from the use of thallium-treated macadamia nuts (grown in Hawaii) are reported, also work with one of the old standbys, zinc phosphide, and with sodium fluoroacetate. Work on baits is also being actively pursued.

Colonies of the ground-nesting termite, *Coptotermes vastator*, new to Hawaii, are reported. This is one of the most destructive termites in the Philippines and is regarded as a potential danger to the sugar industry in Hawaii. Another potential sugar cane pest, the large grasshopper *Schistocerca vaga*, continues to be found in spite of efforts to eradicate it. The billbug, *Sphenophorus venatus vestita*, which infests lawns and attacks transplanted seedling cane, is also a threat. A parasite brought from Missouri in 1963 to check it proved a disappointment. The lady beetle, *Hyperaspis trilineata*, brought from Barbados in 1963 to prey on the mealy-bug, has also failed to become established.

Interest in *Pythium* stems from the fact that this fungus is a cause of root rot of sugar cane seedlings and also because it is now suspected as a possible factor in yield decline. Of six fungicides tested during the year for controlling root rot of cane seedlings only one, "Terrachlor Super X EC" appeared promising and is to be evaluated further. Other sugar cane diseases referred to in the report include pineapple disease, brown spot, brown stripe, eye spot, leaf scald, red rot and ratoon stunting disease.

Cane varieties

The leading commercial variety in Hawaii, for the third consecutive year, was H 50-7209. It gained 15,000 acres during the year bringing the year bringing the total acreage devoted to it to over 80,000 acres. The variety H 49-3533 showed an increase and moved into fifth place. Five other commercial varieties showed sizeable decrease. A new record was set up when 4,600 tassels or flowering heads for pollination were cut in a single day. Details are given on about a dozen of the newer commercial varieties now being increased and disseminated. Of these H 57-5174 appears to be a possible replacement for the now leading variety H 50-7209.

Nutrition and fertilizers

Soils regarded as zinc deficient for pineapples did not cause deficiency symptoms when the leading commercial variety of cane, H 50-7209, was planted in them in pot experiments, suggesting that sugar cane (or some varieties at least) are less demanding in regard to zinc than pineapples. Results of experiments on slag applications to sugar cane on low-silicon soils are discussed. In two field trials highly beneficial results followed the use of electric furnace slag, reflected in growth of cane and yield. No evidence was obtained that the neutralization of soil acidity associated with the use of slag was a factor in the improved cane growth.

Control of ripening

Increased interest has been shown in Hawaii in the possibility of controlling ripening in sugar cane by chemical means, and greater emphasis is being given to the subject by the Experiment Station. Apart from earlier work a screening test for preliminary evaluation has shown another group of about a dozen chemicals to be active. These are listed. Two have shown activity which is at least equal to that of "Trysben" (2,3,6-trichlorobenzoic acid). These are the herbicide "Tordon" and a substituted octadecylammonium chloride. Preliminary trials with "Trysben" in small plot work, under various conditions, have been promising and warrant large scale trials in the near future.

Other studies with a physiological background which are reported on include nitrogen fertilization through overhead systems, water requirements of sugar cane, tassel control, varietal response to temperature, uptake and transport of amino acids, and importance of nitrogen and sunlight on tillering.

F.N.H.

Memorial to C. W. Murray

THE Directors of Fletcher and Stewart have decided to commemorate their late President, Mr. C. W. MURRAY, by making an award for the best essay submitted on a subject connected with beet or cane sugar technology.

The award will be made yearly for a period of not less than five years and will consist of a prize of £250. Further prizes of £100 and £50 will be given to runners-up—the latter prize being restricted to those of 25 years of age or under. In choosing essays particular regard will be paid to originality of thought.

An editorial panel has been set up to recommend a list of subjects from which competitors will make their choice and also to consider the essays submitted at yearly intervals and recommend the three best. The following have kindly agreed to serve:—

W. B. BOAST
Technical Director of The British Sugar Corporation.

R. R. FOLLETT-SMITH
Vice-Chairman, British Section of the International Society of Sugar Cane Technologists and lately Chairman of Bookers Sugar Estates.

C. R. D. SHANNON
Consulting Engineer, Jamaica.

The award will be made for essays submitted before 31st March 1968 and thereafter at yearly intervals and the subjects of essays to be submitted in 1968 and 1969 will be published simultaneously in March 1967. With the exception of the 1968 competition, for which a period of one year is available, subjects will normally be announced two years before the last date of submission in order to provide sufficient time for fundamental research. The subjects will be chosen primarily to encourage operating staff to contribute.

The Directors of Fletcher and Stewart will present a shield on which will be engraved annually the name of the award winner, and each winner will receive a small replica of the shield.

The list of subjects and the address to which applicants should write for full details of the award scheme will be published shortly.

Sugar cane agriculture

Selection pressure: its significance in the development of sugar cane varieties. G. ARCENEAUX. *Sugar J.* (La.), 1966, **28,** (11), 15–20.—The term "selection pressure" is used for the intensive selection employed in breeding work with sugar cane. Some interesting facts on cane varieties throughout the world are presented, notably their highly limited adaptability range. Of a total of 107 important varieties, 82 have not been extensively cultivated outside the region for which they were bred and selected.

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Hurricane Betsy wreaks havoc on cane yields in 1965. L. G. DAVIDSON and J. E. IRVINE. *Sugar J.* (La.), 1966, **28,** (11), 38–41.—Details are given of damage to cane caused by this hurricane (10th September 1965), considered to be the most destructive storm to strike south-eastern Louisiana this century. Losses in cane yield were estimated to be 12 to 28%, loss being due partly to cane left in the field and partly to low stalk weights resulting from severely reduced growth rates following the storm.

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Recent changes in cane handling methods in Louisiana. J. FAIRBANKS. *Sugar J.* (La.), 1966, **28,** (11), 43–52. Some of the systems, innovations and recent experiments in cane handling under Louisiana conditions are reviewed, briefly analysed and discussed.

* * *

Nitrogen pays on sugar cane. G. D. SULLIVAN. *Sugar J.* (La.), 1966, **28,** (11), 58–61.—Results of fertilizer trials in different locations in Louisiana are presented and discussed. Application of at least 60 lb nitrogen per acre was profitable in every case. In some experiments profits were still increasing with much higher rates.

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Louisiana cane crops damaged by Hurricanes "Hilda" and "Betsy". L. L. LAUDEN. *Sugar J.* (La.), 1966, **28,** (11), 67–69.—The serious effects of these two hurricanes (in 1964 and 1965) on cane yields in Louisiana are discussed.

* * *

Sugar cane mosaic virus purified. T. P. PIRONE and L. ANZALONE. *Sugar J.* (La.), 1966, **28,** (11), 63.—A new technique for handling this virus in the laboratory, normally a difficult operation, is described. *Sorghum* was used as host plant as it contained the greatest amount of virus. It is hoped it may soon be possible to differentiate strains on a chemical and physical basis and thus gain a better understanding of their relationships. Such information may aid efforts to produce new, mosaic-resistant sugar cane varieties.

* * *

Eradicate those weeds. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **13,** (5 & 6), 2, 10.—In weeding programmes in V.M.C. cane fields (Philippines) an attempt is being made to give up off-barring and on-barring by tractor, which may damage the stools, and to attempt retaining only pre-emergence 2,4-D spraying plus early hand weeding. An attempt is also being made to adopt the use of C.A.D.E. (concentrated activated diesel emulsion) with or without small additions of commercial herbicides, in order to replace hand-weeding, especially during labour shortage.

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Fertilizer formulas recommended for the 1966–67 crop. ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **13,** (5 & 6), 5.—Three formulas are given, involving the use of rock phosphate, urea and muriate of potash, to be used with different soils. Soil analysis is recommended. In the acid, highly phosphate-fixing soils, rock phosphate, notably Florida rock phosphate, is considered the best source of phosphorus; it is not acidic and does not contain high amounts of iron and aluminium oxides.

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***Tilapia* controls weeds in canals and improves drainage.** ANON. *Victorias Milling Co. Expt. Sta. Bull.*, 1966, **13,** (5 & 6), 11.—Reference is made to work in Hawaii in controlling aquatic weeds in drainage canals and ditches in sugar cane areas by means of fish (*Tilapia mossambica*). The fish proved so effective as a means of biological control that canals were kept open and free of aquatic weeds, resulting in the reduction of the water table by approximately 3 feet.

* * *

Foreign matter in mechanically harvested cane. II. A. F. BETANCOURT. *CubaAzucar*, 1966, (March-April), 28–52.—The problem of foreign matter or trash in mechanically harvested sugar cane in Cuba is discussed at some length and the results published of a questionnaire sent out to cane mills. The writer also refers to the problem in other countries, viz. Florida, Louisiana, Hawaii, Mexico and Australia. He gives his personal observations in the first two mentioned.

The influence of nitrogen and potash fertilizers on the yield, c.c.s., stalk population and nutrient uptake of sugar cane. R. B. MOLLER. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 69–76.—Two experiments to investigate possible *variety* × *nitrogen*, *variety* × *potash* and *variety* × *nitrogen* × *potash* interactions are described. The quantities of nitrogen and potash and the names of the cane varieties used are given. Very high levels of nitrogen, much higher thant hose normally used commercially in Queensland, caused depression of c.c.s., some varieties being affected more than others. Nitrogen applications caused sharp rises in the nitrogen content of the millable cane, all the varieties being similarly affected. The potash level did not influence c.c.s.

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Notes on orange freckling of sugar cane. R. FERRARIS. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 77–80.—The soils and areas where this sugar cane malady, first observed in 1958, is to be found in Queensland are described. Reasons are given why it is thought it may be associated with magnesium deficiency in some way. As more areas become affected each year, some severely, and the soils continue to be cropped, it is thought that the problem may increase in severity. It is felt investigations should be continued with a view to providing practical control measures if possible.

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Border effects in fertilizer trials utilizing small plots. G. C. BIESKE and L. S. CHAPMAN. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 81–86.—The likelihood of border effects proving significant with small cane plots, favoured for reasons of economy, is discussed and results are given of observations of four variety × nitrogen trials through a crop cycle of one plant and two ratoon crops. It was found that 0·01-acre plots were statistically as accurate as 0·025-acre plots. Border effects were found to occur, the maximum effect recorded reducing the true yield response by 43%. The suggestion is made that for four-row 0·01-acre plots, without guard areas, the number of replications be increased.

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Spray equipment for windy conditions. R. W. FRAZIER. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 93–96.—The development of overhead irrigation with sugar cane is traced and the different kinds of sprinkler that have been used are described. The importance of the angle of tilt of the nozzle in windy conditions is explained. The development of the latest type of nozzle, for which helicopters and cinematograph equipment were used, is described.

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The Woongoolba and area drainage scheme. C. L. TOOHEY. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 87–92.—This refers to one of the oldest sugar cane producing areas of Australia (the area bounded by the Logan and Pimpama rivers) and a drainage problem that is peculiar to it, with an average soil elevation of only some five feet above sea level. The area is subject to ready inundation and drainage is complicated by the necessity for keeping the salt sea water out. The economics of a major drainage proposal, which will involve maintenance costs, are discussed.

* * *

The principle of mixing chemicals to broaden or enhance herbicide activity. E. ROCHECOUSTE. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 139–142.—The theoretical considerations involved in the mixing of herbicides are discussed with special reference to weed control in sugar cane. Mixing of herbicides with special reference to weed control in sugar cane. Mixing of herbicides can broaden or enhance insecticide activity and cause a wider range of weed species to be controlled. A watchful eye must be kept on the possibility of injury to the cane plant. Indiscriminate mixing of herbicides by growers is strongly condemned.

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The development of "Pesco 18-15" for weed control in Australian sugar cane. D. N. DARBY. *Proc. 33rd Conf. Queensland Soc. Sugar Cane Tech.*, 1966, 143–149.—The history of this herbicide (a mixture of MCPA and TBA), first developed in Europe as a post-emergence herbicide for broad-leaf weed control in cereal crops, is discussed. An account is given of experiments designed to assess its reliability and safety with cane under Australian conditions. Trials were made under a variety of soil and climatic or environmental conditions. Provided it was applied pre-emergence it proved very successful with a wide range of weeds, the names of which are given. It did not present any real problems in regard to damage to cane.

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Cut cane deterioration and the *Leuconostoc* organism. ANON. *Cane Growers' Quarterly Bull.*, 1966, **29**, 111. Bactericidal agents, successful in the laboratory, cannot be applied or are ineffective in the field. There is now a hardening of opinion that the problem, where chopper harvesters are concerned, will not prove amenable to direct treatment of the cane either before or after cutting into pieces. The problem could respond to a sociological and industrial approach. In other words the solution doubtless lies in a rearrangement of harvesting and crushing times.

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Using wild species to produce better canes. J. C. SKINNER. *Cane Growers' Quarterly Bull.*, 1966, **29**, 112–116.—An account is given of the rôle of wild species of *Saccharum*, notably *S. spontaneum* and *S. robustum* and their numerous varieties in the breeding of better canes. Among the noble canes (*S. officinarum*), once so extensively grown commercially, *Badila* is still grown in Queensland to the extent of 2%. It is pointed out that crossing with wild canes is a long-term project and may take 20 years to produce commercial varieties.

Sugar beet agriculture

A new method of chemical control of aphids in field crops. W. Meier. *Mitt. Schweiz. Landw.*, 1966, **14,** (2), 17–26; through *Field Crop Abs.*, 1966, **19,** 206. Granular or seed-treatment formulations of systemic insecticides were tested with sugar beet and peas. With sugar beets, treatment before or after emergence with "Solvirex" (5% "Thiodemeton") granules at 30 kg/hectare reduced the incidence of aphids and virus yellows, and also of beet flies, but reduced plant growth slightly and, owing to relatively low incidence of these pests, failed to increase yields significantly. However, it is recommended for areas where there is a regular heavy incidence of virus yellows.

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Effects of defoliation on the yield of sugar beet seed balls. S. Hayashi and K. Akita. *Sci. Rep. Hyogo Univ. Agric.* (*Agric.*), 1964, **6,** (2), 159–161; through *Field Crop Abs.*, 1966, **19,** 206.—Radical leaves, culm leaves, or all leaves were removed on 15th May or 15th June. Treatments, particularly on 15th May, reduced total and individual weight of seed clusters. Removing radical leaves on 15th May gave a lower yield of seed than removing culm leaves but when carried out on 15th June this situation was reversed.

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Study on the influence of gibberellic acid on certain physiological processes in sugar beet (*Beta vulgaris*), **soybean** (*Glycine hispida*) **and potato** (*Solanum tuberosum*). H. Chirilei, G. Curticapeanu and I. Zaharia. *Lucrari Stiint., Seria A.* VII. (Bucuresti). *Ed. Agro-Silv.*, 1964, 301–315.—Investigations have revealed, *inter al.*, that gibberellic acid applied to sugar beet seed stimulated germination and plant growth, increased the dry solids and chlorophyll accumulation, and intensified plant respiration and photosynthesis. Yield of the treated beets increased by 20·8–44·3% during 1962 and drought resistance was considerable. Root quality and sugar content were only slightly reduced. Best results were given by soaking the seeds for 18–24 hr in a solution of 0·1–0·3% concentration.

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The structure of vessels, tracheids, and cell wall pits of sugar beet. O. Wiklund. *Zeitsch. Zuckerind.*, 1966, **91,** 197–206.—Literature on the anatomy of the sugar beet root or tuber is discussed. The writer states that he has paid special attention to the structure of the pits in the cell walls, not previously closely studied. Two distinct types of pitting are described.

Farm management with hired labour on sugar beet farms. U. Bilstein. *Zucker*, 1966, **19,** 310–316. Difficulties facing the sugar beet farmer with increasing labour costs and decreasing prices for crops are discussed. The importance of efficient farm management is stressed. Increasing the beet acreage can be a palliative.

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Trials of commercial varieties of sugar beet. L. A. Willey. *British Sugar Beet Rev.*, 1966, **34,** 165–170. Tables are given showing the results of trials in each of the 18 U.K. factory areas during the years 1963–1965, the varieties grown being those recommended by the National Institute of Agricultural Botany, Cambridge. The tables show number of roots, yield of roots, calculated yield of sugar, average percentage of sugar in roots, purity of juice and percentage of bolters at harvest. There was a tendency for fewer roots harvested in the polyploid varieties. Highest yields of sugar were given by the varieties Zwaanpoly and Sharpe's Klein E. Zwaanpoly also gave the highest yield of roots. Following their introduction two years ago, Anglo-Maribo Poly and Anglo-Maribo N gave high yields.

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Magnesium deficiency. P. B. Tinker. *British Sugar Beet Rev.*, 1966, **34,** 171–174.—Symptoms of magnesium deficiency in sugar beet are described and its greater prevalence now than formerly pointed out. Dung normally contains about 7 lb Mg per ton of dry matter but many beet fields now receive little or no dung. Magnesium deficiency arises in light sandy soils, not heavy or clay soils. In the U.K. it is most prevalent in East Anglia, especially in the King's Lynn, Bury St. Edmunds, Cantley and Ipswich sugar factory areas. The beneficial results in trials of applying magnesium, in the form of kieserite at 5 cwt per acre, are described. This gave a mean yield response of nearly 4 cwt of sugar per acre or about £8 cash value.

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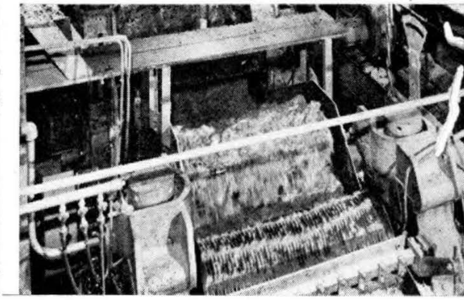
Livestock and sugar beet in Shropshire. E. K. Rodenhurst. *British Sugar Beet Rev.*, 1966, **34,** 175–176. Details are given of the methods adopted by a successful farmer in Shropshire with seven farms and a total acreage of 2,200 in producing sugar beet and utilizing the pulp and tops for the production of beef and mutton. After supplies of fresh pulp are exhausted the animals receive dried beet pulp in the ration plus, of course, other feeds.

Cane sugar manufacture



Two-and-a-half muscovado strike system. J. G. MEYER. *Bol. Azuc. Mex.*, 1966, (200), 24–28.—See *I.S.J.*, 1966, **68**, 55.

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Uses for excess and non quota sugar. J. B. ALEXANDER. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 69–73.—The position is envisaged of South Africa's having more land under cane than needed for making sugar for internal requirements and foreseeable exports. Possible outlets for such cane are discussed; these include the manufacture of high-test or invert molasses and dehydrated cane juice, the first a useful medium for fermentation reactions and the second a valuable ingredient in starter rations for young animals.

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Sugar in industry. A. M. HOWES. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 74–77.—Statistical information gathered by the Market Research Committee of the South African Sugar Association is examined and discussed. Comparisons are made between South African industrial sugar consumption and that in other developed countries, increasing consumption is tabulated by five-year averages, and industrial usage in South Africa is discussed in terms of product concerned and area. Separate sections discuss the production of liquid sugars, invert sugar and caramel.

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Boiler mountings and control equipment for process steam. W. G. VAN ASWEGEN. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 78–84.—Problems in the design of valves, especially as a result of uprating of flanges, are discussed, and a description given of the design and advantages of the parallel slide valve, both full-bore and venturi patterns. Mention is made of recent kinds of water-gauge, of the continuous blowdown system, of desuperheating of steam by water injection and factors involved in the choice of reducing valves for pressure control. Finally, the applicability of the empirical formulae of B.S. 759 in relation to boiler safety valves is mentioned.

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Mutual Milling Control Project, Progress Report No. 4. E. J. BUCHANAN, K. DOUWES DEKKER and A. VAN HENGEL. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 85–95.—Average milling data for the 1964/65 season are tabulated and discussed in detail. Several factories show notable improvement in performance, possible causes being suggested. The average data suggest trends in milling variables similar to those noted in previous reports. Although the data in some respects do not have the required degree of accuracy to warrant computer analysis, standardization of equipment may facilitate the establishment of relationships between variables. Data quoted in the report suggest that pressure feeders are not economical under their present conditions of operation in Natal, and long tandems appear to be necessary for good extraction.

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Intermediate carriers. C. E. DENT. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 96–104.—Failure of intermediate carriers in a milling tandem is responsible for a high proportion of downtime, and this has increased with higher crushing rates. The trends in intermediate carrier design since 1950 are reviewed and the difficulties with each type discussed. These include the apron conveyor, the Ramsay drag-type conveyor, and rubber belt intermediate carriers, the last being replaced by a return to the drag-type carriers, but with different chain and attachments. Selection of all-stainless steel chain in the case of apron-type carriers and of stainless steel fitted chains in the case of drag-type carriers is considered to be the solution to the high maintenance required with this part of the tandem.

* * *

The influence of Brix-free water when assessing milling performance. T. H. FOURMOND. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 105–107.—Brix-free water is the amount of water physically attached to the fibre and lies between 16 and 30% on fibre. The variability of this figure means that two tandems discharging bagasse with the same fibre content will have different milling efficiencies if the Brix-free water is different for the two bagasses. The differences are calculated for an example and extended to a complete tandem. Examination of Brix-free water figures measured daily over two weeks and related to the lost absolute juice % fibre show the marked influence of the former on milling performance.

* * *

The incentive to accident prevention. A. BURGERS. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 108–111.—The direct and indirect costs of accidents are analysed and the benefits from accident prevention are discussed. A programme for prevention is outlined, involving setting up of a safety organization, identification of known and possible hazards and selection and application of remedies.

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Split roller bearings. K. J. SAUNDERS. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 112–113. The split roller bearing is described in detail and its advantages are discussed. Although it costs slightly more and makes slightly more noise than a solid bearing, this is more than made up at the first breakdown because of the ease of dismantling, opportunity of inspection for wear and of retention of parts which might otherwise be discarded. A list of typical applications for the bearings is provided.

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Dalton—South Africa's first milling-diffusion sugar factory. W. R. BUCK. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 114–121.—See *I.S.J.*, 1965, **67**, 239–242, 268–270.

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Barometric condensers. D. S. STRAUSS. *S. African Sugar J.*, 1966, **50**, 467–471.—The various types of barometric condenser are listed with brief descriptions, detailed attention being paid to the counter-current direct contact condensers in which injection water passes down through a series of trays and baffles against the rising stream of vapour. Examples are given of calculation of dimensions of the barrel, air extraction branch, tailwater pipe, barometric column and sealpit to meet a required duty.

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What is measurement and control? A. A. TROY. *Sugar J.* (La.), 1966, **28**, (12), 17–19.—Basic principles of measurement and control are enunciated, with definitions of a process variable, primary elements, set point, accuracy, reproducibility, lag, etc.

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South African sugar warehouse loads at 500 tons per hour. ANON. *Sugar J.* (La.), 1966, **28**, (12), 24–25. A brief account is given of the Maydon Wharf sugar warehouse in Durban with particular reference to the applications therein of Du Pont "Neoprene" products.

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Clarification of cane sugar juice by new flocculants. H. ITO and T. SHIRASAKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 40–46.—Experiments were carried out at the Nakatane factory of Shinko Togyo Co. Ltd. on the evaluation of a number of new flocculants in cane juice clarification, comparing them with "Separan AP-30". "Primafloc C-3, C-5, C-6 and C-7" and "Kurifloc F-1" produced no benefit in mud volume, settling rate or turbidity, but "Primafloc XA-10" and "Kurifloc SB-60A" formed rapid-settling flocs at optimum concentrations of 3 and 5 p.p.m., respectively, compared with 3 p.p.m. for "Separan AP-30". "Primafloc XA-10" gave the clearest supernatant of the three materials and "Kurifloc SB-60A" the fastest settling, while "Separan AP-30" gave the smallest mud volume.

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Centrifugation of *B*-molasses. J. C. P. CHEN and F. PROSKOWETZ. *Sugar J.* (La.), 1966, **28**, (12), 28–32.—An account is given of experience at Hacienda Casa Grande on the treatment of *B*-molasses in centrifuges for separation of insoluble solids—principally potassium and calcium sulphates—which would otherwise be partly included as impurities in the *C*-sugar crystal. The treated B-molasses is of higher purity and gives better quality *C*-sugar seed for the higher grade sugars and also provides a 3·3% increase in sugar recovery from the *C*-boilings.

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Investigations on the removal of starch from cane juice. E. C. VIGNES and J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1965, 123–127.—Juice was extracted from cane treated in a Jeffrey cutter-grinder and its pol content determined as well as its starch and reducing sugars contents before and after keeping in a water bath at 73°C for up to 30 min. The starch content decreased with increase in storage time (by 61% after 30 min), while the sucrose content also decreased with increase in storage time (by 0·31% after 30 min); but it was found that storage for up to 15 min would more than halve the starch content without significantly affecting the sucrose content. Factory-scale tests involved the use of three storage tanks; mixed juice heated to 75°C was retained for 6½ min in the first tank and limed in the second tank, but in subsequent tests it was retained for 12 min in the first two tanks and limed in the third tank. Results showed that 6½ minutes' rentention caused a 27–28% reduction in the starch content with a 0·16% drop in the sucrose content, while 12 minutes' storage reduced the starch content by 42·7–54·1% with a 0·17% drop in the sucrose content.

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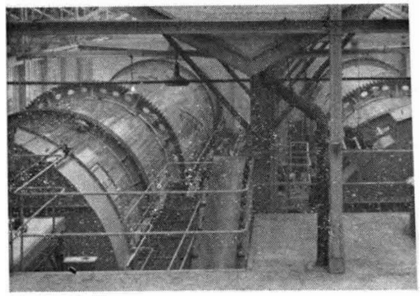
Curing low-grade massecuite in an Allis-Chalmers 2750 continuous centrifugal. E. PIAT and M. RANDABEL. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1965, 127–131.—Tests conducted on an Allis-Chalmers 2750 horizontal conical centrifugal showed that its massecuite re-heater was inadequate and that it gave a molasses purity 1·7 units higher than did a Broadbent 1800 r.p.m. batch machine. However, it is considered possible to reduce the molasses purity by using an alternative screen having 0·06 mm slits and 8% open area instead of the screen used in the tests, which had 0·15 mm slits and 28% open area. The average throughput of the continuous machine was 39 cu.ft./hr compared with 35 cu.ft./hr in the batch machine, while the sugar purity in the Allis-Chalmers centrifugal was 86·2 compared with only 79·6 in the batch machine. Subject to the choice of suitable screen and massecuite reheater, the continuous machine is preferred.

Beet sugar manufacture



Ion exclusion purification of molasses. J. B. STARK. *Proc. Tech. Session Cane Sugar Refining Research,* 1964, 45-53.-See *I.S.J.,* 1966, 68, 182.

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Performance of a beet slicer drive with inductor friction clutch. S. ZHURBA, A. SAVENKOV and A. YAN'SHIN. *Sakhar. Prom.,* 1966,40, (5), 34-36.—In the Soviet Union an inductor friction clutch drive for a beet slicer has been found to be better and cheaper than a drive fed direct from a generator.

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Application of starch flocculants (in beet juice clarification). J. MIJAKOWSKI. *Gaz. Cukr.,* 1966,74,95-98.- Laboratory tests were conducted on NLT and P-26 starch flocculants. Both were added at 1% and 2% solutions in quantities of 1–4 ml to·375 ml of juice. NLT was also factory tested. In general, both flocculants increased the settling rate of defecation and 1st carbonatation juice, reduced the volume of mud % obtained after 25 min, increased the amount of sediment and gave clearer juices than were obtained without treatment. The P-26 flocculant was more "active" than the NLT.

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Investigation of mass transfer in continuous diffusers. V. M. LYSYANSKII, A. P. VERKHOLA and N. N. PUSHANKO. *Sakhar. Prom.,* 1966. 40, (6), 7-10.- Experimental data were processed by computer, for which the programme formula is given, and the results are given in graph form showing the value of the mass transfer coefficient β throughout four different types of diffuser. In a KDA-58 tower diffuser β was maximum in the middle section where the cossettes were distributed fairly evenly across the tower section. Lower values at the bottom were a result of packing and at the top were caused by loss of elasticity coupled with agglutination and irregular mixing of the cossettes and juice and the retarding effect of the discharge mechanism for the exhausted cossettes. Increase of β with reduction in juice draught in the upper section was attributed to increase in the mutual cossette-juice flow which caused compression of the juice-cossette mixture. In a DDS diffuser maxima occurred in the gaps between the scroll sections, these maxima falling steadily towards the end of the diffuser. With increase in the specific load, β also increased throughout the diffuser. but the pattern remained unchanged. In an Olier diffuser. peaks occurred in the bends. after which the values in the vertical sections were minimal. In a 17-21 m long rotary diffuser, β remained constant up to the end of the diffuser, where it fell sharply.

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Reasons for deterioration of screens and baffles in rotary diffusers. M. A. KOKHAN. *Sakhar. Prom.,* 1966.40, (6), 11-13.- Juice was sampled hourly over five days at 14 points along a rotary diffuser. The pH was determined and values are tabulated. A graph showing the change in pH throughout the diffuser is also presented. The average results indicated a gradual fall in pH from 6·58 at the first sampling point to a minimum of 5·13 in the centre of the diffuser, after which it rose gradually to 6·46 at the discharge end. The feed water had a pH of 7·75. Press juice pH was found to approximate to that of the raw juice. The fall in pH. with resultant corrosion of the screens, is attributed to microbial action taking place at inadequately high temperatures (64-66°C). Formalin was added at the end of the diffuser. A higher temperature is advocated (70–72°C), as is the installation of a number of thermometers instead of only one.

* * *

Method for establishing temperature conditions in low-grade massecuite crystallization and curing. M. I. DAISHEV. *Sakhar. Prom.,* 1966, 40, (6). 23-25.—It is shown that the difference between molasses standard Brix as determined from the true viscosity and as determined by SILIN'S method[1] can be assumed. for practical purposes, to be constant for all temperatures. Hence, it is suggested that a correction factor be determined at a given temperature (preferably 40°C) and this applied to determination of the standard Brix at any curing temperature. The slope of the molasses saturation curve on a graph of purity *vs.* Brix will, it is suggested. indicate the optimum curing temperature to obtain minimum standard molasses purity, subject to the crystallization requirements. However. it is admitted that when the quality of beet is low. the optimum curing temperature should be determined by mathematical calculations. since the slope of the straight line will be too shallow for practical purposes. While the need to cure at high temperatures rarely occurs in beet sugar manufacture, it is pointed out that it can arise in cane raw sugar refining. The author has collaborated in the construction of a nomogram to facilitate the calculations[2].

1 *I.S.J.,* 1963, 65, 342.
2 *Trudy Krasnodar. Nauch.-Issled. Inst. Pishch. Prom.,* 1965, 2, 20–23.

The performance of sulphitation tanks improved. V. A. PETRENKO. *Sakhar. Prom.*, 1966, **40**, (6), 31–33. Faults in the design of spray-type sulphitation tanks are discussed and details given of modifications to tanks of this type at Pavlovskaya sugar factory. The improvements mainly concern the air ejector.

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Raw material quality—a decisive factor in (sugar) production profitability. G. N. VERKHOLAZ and S. M. FISHLER. *Sakhar. Prom.*, 1966, **40**, (6), 48–50.—Where the amount of beet supplied to factories in a particular region exceeds the factory slicing capacities, it is unpractical to recommend a campaign length that is too short. However, starting the campaign too early results in processing of unripe beet and/or, if too large a proportion of the crop is lifted early, excessive storage of the beet, while extending the campaign into January and February leads to processing difficulties associated with poor beet quality. These views are exemplified by results from Moldavia. Arrangements with growers are called for, whereby deviation from a set daily supply would carry monetary penalties. The supply figure would be set for the period up to 15th September, after which the figures would be fixed for each 5-day period.

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New charging device for a shaft lime kiln. J. MRÁZEK, J. KOKEŠ and J. MRÁZEK. *Listy Cukr.*, 1966, **82**, 111–117.—A description is given of a patented automatic charging device for limestone and coke feeding to a lime kiln. Results obtained with the unit at one Czechoslovak sugar factory are discussed and the economic effects calculated.

* * *

Changes in the technical value of sugar beet with various types of storage. K. HANGYÁL. *Zucker*, 1966, **19**, 279–285, 303–310.—Details are given of tests in which beet were stored by five different methods: (i) 10 days' storage in a flume during early autumn, i.e. during dry, warm weather, (ii) 46 days' storage during late autumn in an unventilated pile covered with plastic sheeting, (iii) 96 days' storage in a forced-ventilated pile, (iv) 51 days' storage of withered beet in an unventilated pile during late autumn, and (v) 7 days' winter storage of frozen beet. The effect of the storage conditions on various factors was studied, these factors including sugar content, resistance to slicing, elasticity modulus, diffusion constant, conductimetric ash, invert content, amino-N content, total anions in press juice, filtration rate and thin juice purity, conductimetric ash, lime salts content and total anion content. The results were evaluated in terms of total sugar lost in processing, including molasses losses, white sugar yield and the *Va* factor. The *Va* factor is the total sugar loss % white sugar and is given by $100V/A$, where V = total sugar loss % on beet and A = yield % on beet. Hence, the beet quality is excellent at a *Va* factor below 20, good at 20–23, average at 23–26, poor at 26–30 and unusable above 30. The daily increase in the value of the *Va* factor ranged from 0·019% with method (iii) to 0·79% with method (v), while the increases for methods (i), (ii) and (iv) were 0·57%, 0·024% and 0·090% respectively. From the tests it is concluded that it is possible to minimize beet deterioration provided the beet are fresh, healthy and undamaged when first stored and are protected against withering and frost during storage.

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Extent of removal of calcium and magnesium salts as a function of 1st carbonatation juice alkalinity. M. S. ZHIGALOV and P. M. SILIN. *Sakhar. Prom.*, 1966, **40**, (7), 14–18.—Results of laboratory tests in which 1st carbonatation juice samples were re-carbonatated showed that in almost all cases a reduction in 1st carbonatation juice alkalinity (which ranged from 0·040% to 0·103% CaO) was accompanied by an increase, albeit slight, in the quantity of Ca salts in 2nd carbonatation juice. Further tests, in which 30 g of $MgSO_4$ and 5 g of $CaCl_2$ were added to factory 1st carbonatation juice samples to raise the very low content of these salts in normal factory juices, showed that a drop in 1st carbonatation juice alkalinity from ~0·12% to ~0·06% CaO was accompanied by a 500–600% increase in the Mg content of the 2nd carbonatation juice (found by deducting the Ca content from the total Ca + Mg salts). On the basis of the results it is recommended to maintain a 1st carbonatation juice alkalinity above 0·10%, thereby reducing the risk of scale formation resulting from Ca and Mg salts.

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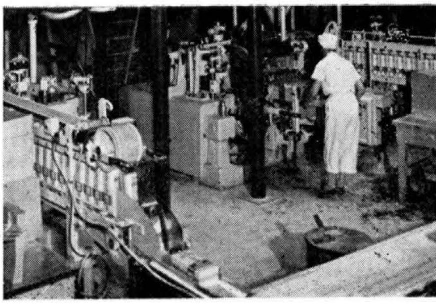
Crystallization and circulation of massecuite in a continuous multi-compartment vacuum pan. N. V. KHEIZE, YU. D. KOT and A. K. SUSHCHENKO. *Sakhar. Prom.*, 1966, **40**, (7), 18–22.—Tests were carried out on boiling of a 67°Bx 98·2 purity syrup in a horizontal vacuum pan. The first two compartments were designed for syrup concentration, the third for nucleation, and the remaining 17 compartments for crystal growth. Data from the 10 days' tests show that the grain was not always sufficiently uniform, irregular setting of the grain in the head compartments being ascribed to inadequate transfer of massecuite between sections. Uniformity was increased by adding large drinks every 1½–2 hr in the head compartments, whereby the crystals in the 3rd and 5th compartments were dissolved and massecuite transfer improved. Every 10–15 min after each drink the crystals in the 4th compartment were re-grained by adding powdered sugar. The quantity and size of conglomerates were of the same character as in batch vacuum pans. Within the first few days the sight glasses became coated with sugar. Magma from the massecuite was suitable for pressed refined sugar. However, it was not possible to increase the crystal content of the massecuite above 35–40%, and in some cases this limit was 30–35%. This is attributed to insufficient lift of the vapour bubbles necessary to move the more viscous massecuite.

Sugar refining



The chemical method of refining sugar using solvent. Y. Kamei, S. Kobayashi and E. Sugita. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 1–9.—The method of Othmer and Luley[1] for refining of sugar was studied and modified. This involves extracting the sugar with solvent—methanol was used in the studies described—to give a purified product which was dried and screened while the solvent containing the impurities was evaporated and the vapours condensed to give pure solvent for return to the process, and a solution of the extracted impurities which was converted into liquid sugar. In the studies reported the extraction was carried out at 60°–65°C and the sugar processed at the rate of 6 kg/hr. In pilot tests, using a methanol:sugar ratio of 1:1, the washed sugar was obtained in 94–95% yield and with a pol of 99·6–99·8. In other tests a 1:1 ratio of methanol to sugar produced a yield of 88·5% falling to 85·5% with a 2:1 ratio, 82·3% with 3:1 and 79·2% with 4:1; these were made with a cruder sugar, however, the purity rises obtained being, respectively, 9·1, 9·5, 9·8 and 10·2 units. The pilot plant used was modified by addition of a pre-evaporator and pre-distillation column, while a design is presented for a large-scale unit.

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Several characteristics of "Adster" granular active carbon. Part II. Spherical granular carbon. T. Miki and T. Ando. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 33–39.—Spherical granular "Adster" carbon of 32–35 mesh, 14–18 mesh and 8–10 mesh was compared with Pittsburgh CAL carbon of 14–18 mesh. Colour removal efficiency of the "Adster" carbon was higher with smaller particle size and lower flow rates. The "Adster" carbon of the same mesh size as the CAL carbon was slightly superior at the same flow rate. A regeneration technique has been devised in which contact between carbon and alkali was extended; at the 4th cycle colour removing ability fell slightly but from the 5th to the 15th remained constant at about 65%. Considerable amounts of sulphate and chloride ions were eluted from the carbon during regeneration but experiments showed that the pH drop of the effluent was not due simply to these ions. Tests showed that the spherical granular "Adster" carbon was harder than cylindrical granular "Adster" carbon and CAL carbon; it would not be influenced by the normal concentration of HCl used in factory regeneration but would decrease with an increase in the concentration of alkali.

Sorption of colouring matter by granular active carbon. L. G. Vorona, A. K. Kartashov and G. P. Pustokhod. *Sakhar. Prom.*, 1966, **40**, (8), 24–28.—AG-5 granular active carbon was used in laboratory tests on decolorization of sugar solutions, prepared from 1st massecuite and molasses, of known colour and R.D.S. An average purity rise of 0·66% was obtained. Further tests in which solutions of fixed optical density but different purities were decolorized showed that the initial purity of a solution plays little part in colouring matter adsorption. Adsorbability tests with solutions of known colouring compounds gave the following results, in order of decreasing adsorbability: alkaline degradation products > melanoidins > caramels. The distribution is attributed to molecular size and ionic charge differences. However, tests in which adsorbability was determined on a weight basis gave: caramels > melanoidins > alkaline degradation products. It is concluded that the products from alkaline degradation of hexoses contain a considerable proportion by weight of colourless compounds which were not easily adsorbed by the carbon, while the large quantity of colourless compounds in the caramel sample was easily adsorbed by the carbon. Most of the melanoidins are coloured and so were easily adsorbed.

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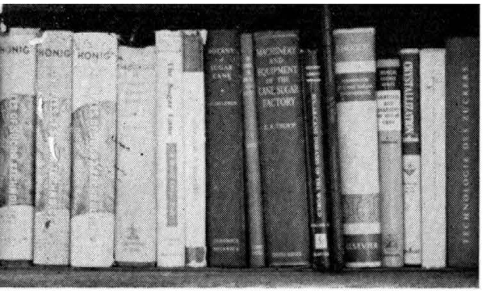
Device for metering and feeding powdered sugar into a vacuum pan. N. L. Krentsel'. *Sakhar. Prom.*, 1966, **40**, (8), 36–38.—The device, which has been patented, comprises a hopper fixed to the side of the pan. Powdered sugar is fed through the top of the hopper and falls through an aperture in a disc into a chamber, the volume of which corresponds to a given weight and is adjustable by a screw device, calibrated in g, which raises or lowers the floor of the chamber. An electric impulse actuates the drive to the rotary shaft to which the disc is attached. The disc rotates through 180°, during a period of time which is adjustable, to bring the aperture above the metering chamber. Air pressure through the aperture plus the suction created on the pan side forces the sugar through nozzles into a funnel and thence into the pan. The disc then rotates to an intermediate position, during which further sugar is pushed by paddles into the metering chamber, and subsequently returns to its original position. The device is claimed to be suitable for remote control, and has been tested at Odessa refinery.

[1] *Sugar*, 1949, **44**, (7), 26; *Sugar J.* (La.), 1949, **11**, (8), 3.



New books

Techniques for Efficient Research. L. E. Lloyd. 215 pp.; $5\frac{1}{2} \times 8\frac{1}{2}$ in. (Chemical Publishing Co. Inc., 212 Fifth Avenue, New York, N.Y., 10010 U.S.A.) 1966. Price: $8.50.

It becomes evident, when reading many papers concerned with chemical and engineering research, that a great deal is carried out in an unsystematic way and with less attention to the economics concerned than in the case of sugar manufacture. This new book should be a stimulus to both the researcher and the research manager for securing the best return for expenditure on research by offering a plan for correlating technical knowledge with business outlook. It proposes a method of tackling a problem, seeking answers to the questions of how facts should be assembled and assessed and how the researcher should go about his work. Other factors considered include selection of problems and personnel, communications and equipment, and an index is provided.

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Inversion of Sucrose: Causes and Effects. 8 pp.; $8\frac{1}{2} \times 11$ in. (B. W. Dyer & Co., 120 Wall Street, New York 5, N.Y., U.S.A.) 1966.

This pamphlet has been published by B. W. Dyer & Co., the sugar economists and brokers, with the aim of helping food processors, who use dry or liquid sugar, to understand the physical changes that may occur when sugar is dissolved and to evaluate the magnitude of these changes and possibly assess what effect, if any, they may have on their finished products. After an explanation of the effects of temperature on sucrose, tables are presented showing (i) the increase in Brix caused by inversion, (ii) the increase in the weight of solids and total weight (lb/gal) caused by the inversion of liquid sucrose, and (iii) the increase in Brix and decrease in volume as a result of total inversion of liquid sugar. The first two tables cover the Brix range 1–80° and 10–100% inversion in 10% (absolute) intervals; invert is assumed to have the same density as sucrose. Table III also covers 1–80°Bx.

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International Conference on the Chemistry and Technology of Sugar. Ed. S. Zagrodzki, J. Dobrzycki and H. Zaorska. 431 pp.; $6\frac{3}{4} \times 9\frac{1}{2}$ pp. (Panstwowe Wydawnictwo Rolnicze i Lesne, Warszawa, Poland.) 1966. Price: 50 zloty.

This is the proceedings of an international conference held in Lodz, Poland, on 4th–7th September 1962 under the auspices of the Committee of Food Chemistry and Technology of the Polish Academy of Sciences, the Dept. of Sugar and Food Technology of the Lodz Institute of Technology and the General Executive of the Polish Sugar Industry Federation. The main themes of the Conference were juice purification (26 papers), juice extraction (13 papers) and sugar crystallization (12 papers). The papers are reproduced in the language in which they were presented, 21 being in German, 15 in English, 10 in French and 5 in Russian. A completely separate book gives summaries of the papers in French, German and English (abstracts also appeared in the 1963 volume of the *I.S.J.*), the two books providing the complete record of a very important conference.

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Claus Spreckels: the Sugar King in Hawaii. J. Adler. 339 pp.; $6 \times 9\frac{1}{4}$ in. (University of Hawaii Press, 2327 Dole St., Honolulu, Hawaii, 96822 U.S.A.) Price $8.00; £2 18s 0d.

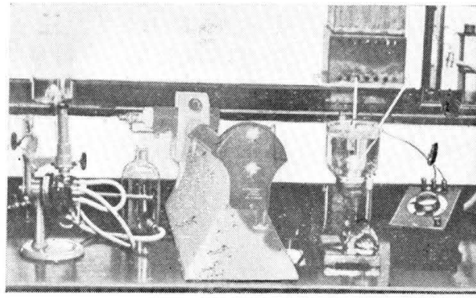
The author attempts to set forth the full extent of the influence on the economic progress of Hawaii of Claus Spreckels, who built a sugar empire in California and in the Hawaiian Kingdom and died over half a century ago.

"In Hawaii his (Spreckel's) reputation for rascality lives on. In many ways, as the . . . pages . . . show, the reputation was well earned. But his contributions to the development of the island kingdom remain largely unsung. This book tries to throw some light on these.

"The story deals with Spreckel's rise and fall in Hawaii. It tells of the clash of a mainland entrepreneur with an island community. It records his initial warm reception, his gradually tightening grip on the Hawaiian Kingdom, his spreading monopoly of the sugar industry, his conflicts with the conservative businessmen, his sudden fall from political power, and the consequent decline of his economic power."

The subject matter is set out in a manner that is easy to follow, even though much of the material concerns politics and finance. A number of photographs are collected into "A Spreckels Album", showing various persons, ships, factories, etc. connected with Spreckels. Notes are given at the back of the books and these are followed by an index. The type is very clear and the book is probably one that many sugar men would like to have in their library.

Laboratory methods & Chemical reports



Study of the structure of sugar solutions using molecular sieves. K. Číž and V. Čejková. *Listy Cukr.*, 1966, **82,** 107–111.—A study of the structure of model sugar solutions (pure sucrose and molasses in water), re-melt liquors, thick juice, syrups and molasses solution passed through a "Sephadex G 25" gel column showed that at 20–25°C the apparent sizes of the sucrose molecule and of the conductimetric ash aggregates were unaffected by purity in the range 65–100, but remained constant at 0·85 mμ and 0·78 mμ (sucrose molecule and ash aggregate, respectively). In the case of solutions of deionized sucrose, to which 20 mg KCl/100 ml had been added, and refined sugar solutions the sucrose molecule and ash aggregate were of practically constant size up to 15°Bx in the temperature range 20–50°C. The size then increased sharply, but remained constant after 60°C. The sucrose molecule in the deionized sucrose-KCl mixture was much larger than in the refined sugar solution at 20–70°C, but only slightly larger at 80°C, while the ash aggregate was much larger in the refined sugar solution (in which the ash content was less than 0·1 mg/100 ml) at between 0·90 and 1 mμ compared with that in the sucrose-KCl solution (0·78–0·83 mμ).

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Rapid method of determining the sugar content in beet cossettes and pulp. B. I. Kats and D. E. Sheinerman. *Sakhar. Prom.*, 1966, **40,** (7), 33–35.—The method involves the use of a "Starmix" apparatus (of West German manufacture) which mixes a 26-g beet sample with 178·2 ml of lead acetate solution for 3 min at 12,000 r.p.m. after which the mixture is filtered and the pol of the filtrate measured using a 400-mm polarimeter tube. The total time for weighing, digestion, filtration and polarization is 8–9 min. For beet pulp, a 60-g sample and a 200-mm tube are used. While the results for beet sugar content were in good agreement with those given by the conventional method, in the case of pulp the cold digestion method gave somewhat higher (and more accurate) values than the conventional method. The cold digestion method is therefore recommended for routine analysis.

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Mechanization of sampling and analysis of beet for true dirt content. A. E. Popov, I. I. Nagornova and A. E. Pochekaev. *Sakhar. Prom.*, 1966, **40,** (7), 60–62. Details are given of tests conducted on a unit incorporating a "Rüpro" beet sampler (manufactured by Elfa-Apparate-Vertriebs G.m.b.H.) and a plant for determining the true dirt content in beet. While the sampler damaged 11·3% of the root per sample (by weight), only 0·013% of the damaged roots were returned to the pile, an insufficient amount to cause any deterioration in storage. The part of the load from which samples were taken affected the dirt content of the beet, those taken from the centre being less representative than those from the cabin and tailboard ends of the truck. Suggested modifications to the unit include a larger washer to permit a 150% increase in throughput. Sampling from every fifth load required two operators, 70 days' operation saving 814 man-days compared with the previous system. The unit is recommended for factories receiving 50,000–100,000 tons of beet per campaign.

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Salt concentrations in a sucrose gradient. K. M. Onna· *Proc. Tech. Session Cane Sugar Refining Research*, 1964, 53–58.—See *I.S.J.*, 1964, **66,** 331.

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Rôle of physical chemistry in sugar technology. K. S. G. Doss. *Sharkara*, 1965, **7,** 17-29.—Some aspects of physical chemistry in sugar manufacture with which the author was associated while at the National Sugar Institute, Kanpur, are discussed. They cover milling control on the basis of osmotic pressure, clarification with bauxite, skimming, estimation of surface-active agents in cane juice, reducing sugars determination by paper chromatography, pH control, sedimentation, carbonatation mud re-utilization, dropwise condensation in evaporators and juice heaters, evaporator scaling, syrup sulphitation, sucrose crystallization, graining methods, active carbon application, boiling and crystallization control, resistance heating of massecuites, sugar storage, and various test methods. The article concludes with a brief discussion of the use of sulphitation mud as boiler fuel and the use of fuel cells based on cellulose.

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Observations of the effects of gums. R. P. Jennings. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 46–49.—Gums were precipitated with acidified alcohol from cane syrup and purified by washing and reprecipitation. Solutions were made of the purified gums and of reagent-grade starch and the effect of varying concentrations on the polarization, filtrability and viscosity of sugar solutions was measured. The gums (average specific rotation 149·03°) increased the pol of sucrose solutions and when clarified with lead acetate in the presence of borax the resultant polarization suggested that the gums not precipitated or neutralized exhibited negative polarization of up to 10°S per g of gum. Addition of 0·35 g of gums per 100 g of solids may reduce filtrability of a liquor by 61%, while 0·32 g of the starch per 100 g of solids reduced filtrability by 93%. The presence of 0·35 g gums per 100 g of solids increased the viscosity of prefiltered 60°Bx carbonatation supply liquor by 16·3% at 40°C, 11·6% at 60°C and 9·9% at 80°C. The increase in viscosity caused by the addition of 0·164 g gums per 100 g solids to 70°Bx solutions increased viscosity by 6·8% at 40°C, 5·5% at 60°C and 5·0% at 80°C. Starch added to 60°Bx solutions at the rate of 0·3251 g per 100 g solids increased their viscosity by 10·6% at 40°C, 9·1% at 60°C and 8·1% at 80°C.

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Variation of filtrability with Brix. R. D. ARCHIBALD. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 50–55.—Refinery liquors are commonly of higher Brix than the 60° used at the standard concentration for filtrability determination. Since dilution to 60°Bx may alter the characteristics of the liquor, the expression of filtrability as the comparison of the flow rate of the liquor at its natural Brix with sucrose solution at (i) 60°Bx and (ii) the same Brix as the liquor was examined. Variant (ii) is recommended since the results obtained show lower variation than when expressing filtrability in terms of variant (i).

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Filtrability tests on A-, B- and raw sugars at Sezela, 1964/65. E. DEDEKIND. *Proc. 39th Congr. S. African Sugar Tech. Assoc.*, 1965, 56–60.—Filtrability measurements of the three grades of sugar at Sezela, measured on monthly snatch samples, are tabulated and variations related to processing characteristics and cane deterioration. Monthly filtrability measurements by the factory and by the S.M.R.I. are compared and the analyses for wax, gums, starch, silica and P_2O_5 made by the S.M.R.I. on 3-monthly composite samples are commented upon.

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Influence of the non-sugar complex on the melassigenic power of its individual components. T. P. KHVALKOVSKII. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1965, (5), 42–46; through *S.I.A.*, 1966, **28,** Abs. 243. Experimental results obtained by adding various salts to beet molasses, in which the amount of added salt was 5 or 10% on molasses of 81–83°Bx, are compared with new results in which the influence of 11 salts on the solubility of sucrose in otherwise pure solution was determined at salt concentrations of 1–10 g/18 g of water. The latter results are shown in a graph of the sucrose solubility coefficient α' against the non-sucrose:water ratio A. In the presence of the non-sucrose complex of molasses, the value of α' estimated for individual salts is a linear function of A (numerical values are not given): for K and Na acetates or other salts, $\alpha' > 1$ and increases with A; for Ca salts and all nitrates studies, $\alpha' < 1$ and decreases as A increases. The α' values measured in the presence of molasses non-sucrose approximate to those in the sucrose-salt system at purities similar to those of thick juice, but differ at lower purities. Lines of constant Brix are marked on the graph to indicate the α' values corresponding to the molasses standard Brix. Similar relations are shown to hold between the melassigenic coefficient M' and $1/A$, where M' = sucrose:non-sucrose ratio.

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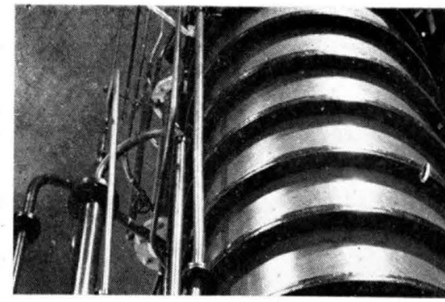
Determination of the true sucrose content of sugar beets and refinery products by isotope dilution. M. J. SIBLEY, F. G. EIS and R. A. MCGINNIS. *Anal. Chem.*, 1965, **37,** 1701–1703; through *S.I.A.*, 1966, **28,** Abs. 269.—A simpler method than that of HÖRNING & HIRSCHMÜLLER[1] is described, which requires only 24 hr and gives an accuracy of ±0·1–0·2% of the amount of sucrose in the sample. Pure sucrose is recovered from the mixture of ^{14}C-labelled sucrose and the sample by precipitation as barium saccharate, removal of the barium as barium carbonate, treatment of the remaining sucrose solution with activated carbon and ion exchange resins, and repeated crystallization from ethyl alcohol. For counting of radioactivity the sucrose samples are pressed into tablets of standard shape, and β-radiation is measured with a gas flow detector. Mixtures of labelled sucrose and amounts of non-radioactive sucrose roughly equal to those in the samples were treated in a similar way to eliminate errors due to background radiation and absorption. It is shown that other sugars do not interfere with the result. Applications to other sucrose-containing materials are very briefly discussed. The standard deviation of the results is 0·1–0·2% on sucrose in the sample.

* * *

Simplified determination of sucrose losses in filter cake. S. ZAGRODZKI and H. ZAORSKA. *Zeitsch. Zuckerind.*, 1966, **91,** 317–319.—After determination of the sugar content of a specially prepared mud suspension, the calcium ion content is determined by adding 20 ml of 1N HCl to a 10-ml suspension and heating to boiling point to drive off CO_2. The solution is then neutralized with 1N NaOH, made up to 500 ml, and 10 ml pipetted into another flask to which are added 5 ml of a buffer solution (67 g of NH_4Cl + 620 ml of 25% ammonia solution made up to 1 litre) and some drops of Eriochrome Black in alcohol. A solution of N/28 EDTA (disodium salt) is then added until the colour changes to bluish-green, 1 ml of EDTA corresponding to 1 mg of CaO. The sugar loss is read off a table showing the polarimeter reading (200-ml tube) for a 10-ml mud suspension to which up to 20 ml of EDTA has been added. The method can also be used to determine the amount of lime added to juice when carbonatation juice is recycled to defecation.

[1] *I.S.J.*, 1960, **62,** 107.

By-products



MSG manufacture, a profitable industry for molasses utilization. K. W. PENG. *Taiwan Sugar*, 1966, **13**, (2), 26–30.—The properties of monosodium glutamate as a food preservative and flavouring agent are described as well as its manufacture by hydrolysis of wheat gluten. More attention is given to the fermentation process used in Taiwan, whereby the glutamate is produced during the culture of *Micrococcus glutamicus* on clarified molasses. Brief mention is made of the synthesis of glutamic acid from acrylonitrile. Increasing usage of the glutamate is discussed and the prospects of its manufacture assessed as splendid.

* * *

Design of a unit for producing briquetted molasses-dry pulp mixture enriched with urea. A. I. SHAPIRO. *Sakhar. Prom.*, 1966, **40**, (6), 14–16.—Beet pulp pressed to 17% moisture content is mixed with 17% molasses (on weight of dry pulp) and dried to 88% dry solids. This mixture is mixed with a hot solution of 7% crystal urea and 8% molasses and then pressed into briquettes 20 mm in dia. and 35 mm long. After cooling these are weighed automatically and stored.

* * *

Production of food yeast from sugar cane molasses. N. M. SHEIKH, G. K. JOARDER and S. A. AHMED. *Sci. Res.* (Pakistan), 1965, **2**, 48–54; through *S.I.A.*, 1966, **28**, Abs. 258.—Experiments to find optimum procedures for the production of *Torulopsis utilis* NCYC 359 are reported. The molasses used contained 50% sugars, 7·9% ash and 0·28% N, and the fermentations were all carried out at 32°C and pH 4·5. A 2·5% molasses solution gave higher yields of dry yeast than did 5 or 10% solutions, the optimum quantity of inoculum (containing 0·055 g dry yeast) was 1 ml/100 ml solution, and the optimum rate of aeration was 300 ml/100 ml solution/min. The optimum quantity of mustard oil, added as an anti-foaming agent, was 0·35 ml/100 ml solution. The combination (out of 14 tried) of added inorganic salt concentrations which gave the highest yield of dry yeast (60·6% on molasses sugar) was 0·6% $(NH_4)_2SO_4$, 0·18% $(NH_4)_2HPO_4$ and 0·003% Na_2HPO_4. The dry yeast contained 54·17% protein and 7% ash (containing Si, Cu, K, Al, Ca, Mg, Fe and P_2O_5).

* * *

Studies on sugar cane bagasse. IV. Structural features of hemicullulose A_1 from sugar cane bagasse fibre. S. R. PATHAK and V. R. SRINIVASAN. *Indian J. Chem.*, 1964, **2**, 365–367; through *S.I.A.*, 1966, **28**, Abs. 255. The A_1 fraction, obtained in 12·5% yield from the ethanol-benzene extracted bagasse fibre[1], and which forms nearly 90% of the total hemicelluloses of the fibre, was methylated with NaOH and dimethyl sulphate and then with Purdie's reagent (Ag_2O and methyl iodide). Hydrolysis of the product with acidic methanol gave (after separation on a cellulose column) 2,3,5-tri-*O*-methyl-L-arabinose, 2,3,4-tri-*O*-methyl-D-xylose, 2,3-di-*O*-methyl-D-xylose, 2-*O*-methyl-D-xylose, D-xylose and 2,3,4-tri-*O*-methyl-D-glucuronic acid in the molar proportions 2·0:2·5: 29·5:3·5:1·0:1·2. Glucose and xylulose were previously proved to be components of this hemicellulose, although they were not detected in these methanolysis products. The hemicellulose has a levorotation of $[\alpha]^{25}_D - 64{\cdot}3°$. These results suggest that the hemicellulose has a "backbone" of D-xylopyranose units with β-linkages through positions 1 and 4, and branchings at the 3 position probably terminated by arabofuranose, xylopyranose or glucopyranose residues.

* * *

Disinfective pre-treatment of molasses for industrial yeast production. E. BERGANDER and I. KÖNIGSTEDT. *Nahrung*, 1965, **9**, 229–246; through *S.I.A.*, 1966, **28**, Abs. 267.—The use of disinfectants in the preparation of beet molasses for baker's yeast production was investigated. Formaldehyde was considered the most promising out of a range of disinfectants. The normal molasses clarification process consisted of diluting with acidified water to 50°Bx, heating at 90°C for 30 min at ~pH 4·6, diluting with superphosphate extract to 22–26°Bx at 65°C, and clarification at ≮60°C for 12 hr. Microbiological tests showed a 90% reduction in bacteria numbers up to the beginning of clarification, until the original molasses count was greatly exceeded. Addition of 0·1% of formaldehyde before clarification prevented any significant increase in the bacteria count. It was then found that, provided the formaldehyde was added during clarification, a preliminary heating to 60°C gave results as good as heating to 90°C, with consequent steam savings. Three-fold dilution of the clarified molasses before culture of baker's yeast gave a formaldehyde concentration which was tolerated by the growing yeast, although it appeared to decrease alcoholic fermentation. The use of formaldehyde did not influence either the yield or the raising power of the yeast, and resulted in a mean increase of 38 hr in the time during which the yeast could be stored (an increase of 33%). The disinfection of molasses is reviewed and discussed with 20 references to the literature.

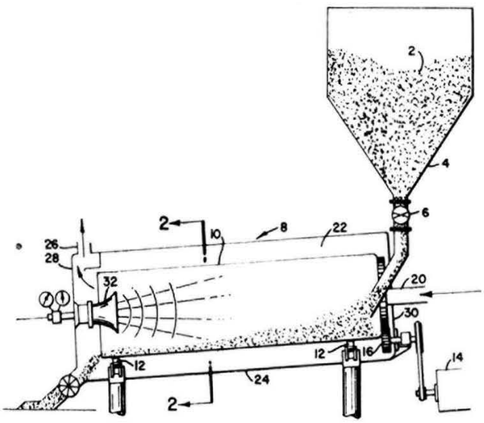
[1] PATHAK: *I.S.J.*, 1964, **66**, 92.

Patents

UNITED STATES

Sugar dryer. R. M. G. Boucher, assr. American Sugar Co., of Jersey City, N.J., U.S.A. **3,175,299.** 2nd August 1961; 30th March 1965.

Partly dried sugar 2 in hopper 4 is delivered by way of valve 6 into one end of a sloping dryer drum 10. This rotates and is provided with longitudinal vanes so that the sugar is carried to the lower end of the drum, falling at intervals through a hot dry air stream which may be supplied through port 20 and leave through port 26 or vice-versa.

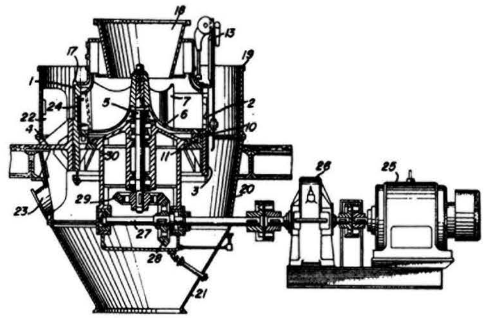


An acoustic generator 32 develops a sound intensity within the drum of the order of 0·001 watt/sq.cm. or 130 decibels, the frequency being such that the long dimension of the drum is an integral number of half-wavelengths for sound of that frequency; this sets up a standing wave system within the drum.

* * *

Beet slicer. I. P. Lichko, V. M. Kamensky and K. A. Dery, of Kiev, U.S.S.R., assrs. Kievski Mashinostroitelny Zavod "Bolshevik". **3,191,650.** 18th April 1961; 29th June 1965.

The slicer includes a vertically mounted drum 1 having, around its circumference, knife-carrying frames 2 sliding in grooves, with blind frames 3 mounted beneath which can be raised by winch 13 for removal of frames 2 for adjustment or replacement of the knives. The drum is secured to its supporting structure by brackets 4 while a rotor with a conical base 6 is mounted on a vertical shaft within the drum. The rotor blades 7 are provided with adjustable tips to provide a required clearance from the knives. Replaceable bands 10 and 11 mounted on the rotor aid removal of material from below the rotor.



Beets fed through hopper 18 into the drum are sliced into cossettes which pass through knife frames 2 into the surrounding housing 19 and down through cone sections 20 and 21 to process. A pocket 22 with a discharge port 23 is provided so that, by removal of the appropriate knife frames, the drum can be enptied by centrifugal force in an emergency. The rate of slicing depends on the speed of the rotor which is driven by motor 25 through gearing 26–29 either at a fixed speed for batch diffusion or at a variable speed for continuous diffusion.

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Clarifiers. J. Diaz Compain, of New York, N.Y., U.S.A. **3,197,336.** 14th December 1962; 27th July 1965.—See *I.S.J.*, 1966, **68,** 117.

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Beet harvester. G. F. Gay and S. M. Sassier, assrs. Massey-Ferguson S.A., of Paris, France. **3,198,260.** 4th March 1963; 3rd August 1965.

* * *

Producing sucrose benzoates. R. W. Griscom, R. W. Ingwalson and H. F. Reeves, of Chattanooga, Tenn., U.S.A., assrs. Velsicol Chemical Corp. **3,198,784.** 25th July 1962; 3rd August 1965. —Benz-

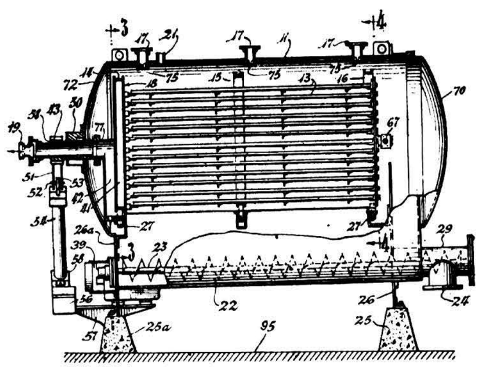
Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C.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

oyl chloride is dissolved in a solvent which also dissolves sucrose benzoate, i.e. benzene, toluene, xylene, ethyl benzene, chlorobenzene, chlorotoluene, methylene dichloride, chloroform, carbon tetrachloride, tetrachloroethylene, diethyl ether, or di-*iso*-propyl ether. Sufficient solvent is used for the benzoate to comprise 10–75% of the solution. The solution is mixed with an aqueous ($12\frac{1}{2}$–33° Brix) sucrose solution, such that there are 6–10 moles of benzoyl chloride per mole of sucrose, and the mixture agitated and kept at —10° to + 50°C while adding a base (NaOH or KOH). This produces a sucrose benzoate having 6–8 benzoate groups per molecule, which is recovered from the solvent after washing with alkali.

* * *

Pressure leaf filter. A. C. KRACKLAUER and F. H. PASSALAQUA, assrs. SPARKLER MFG. CO., of Conroe, Texas, U.S.A. **3,195,729.** 3rd March 1961; 20th July 1965.

The cylindrical tank 11 contains horizontal leaf filter units 13, spaced apart in a vertical stack with their filtering surfaces uppermost and non-filtering surface facing downwards. The hollow interior of each leaf communicates with the filtrate-receiving manifold 18 and thence with conduits 43 and 19 through which pressure in the manifold can be reduced. Liquid to be filtered is introduced into tank 11 through inlets 17, air in the tank being ducted through vent 21, and is separated into a filtrate which passes via leaves 13 to manifold 18 and conduit 19, and a filter cake which accumulates on the top surfaces of leaves 13.



Following filtration, the cake is washed and dried with steam, introduced through inlets 17, and the stack of leaves then rotated so that they became vertical. This is possible because the leaves and their supporting brackets and rings 15, 16, manifold 18 and conduit 43 all rotate as a unit, supported on rollers 27 within the tank, the conduit 43 being supported by bearing 50. The rotation is achieved by means of a hydraulic cylinder 54 from which a piston rod 53 extends to an arm 51 pivoting about pin 52 and secured to the collar 58 fastened around conduit 43.

When the leaves are vertical they are vibrated by means of a unit (not shown) which dislodges the cake from the leaves to fall into the trough portion 22 of the tank, from which it is removed by screw 23 to outlet 24. The leaves are then returned to their original position for a new cycle.

* * *

Method of eliminating bacterial contamination of molasses medium in the production of citric acid by fermentation. R. J. KARKLIGN and V. K. BERKOLDE, of Riga, U.S.S.R. **3,202,587.** 22nd June 1962; 24th August 1965.—Bacterial contamination in molasses to be used for citric acid fermentation is eliminated by adding 10–15 mg/litre of 5-nitro-2-furaldehyde semicarbazone as an antiseptic. This does not harm the growth and citric acid-producing capacity of *Aspergillus niger*.

* * *

Continuous cane diffusion process. R. M. STEWART and E. P. BOYNTON, assrs. CHEMETRON CORPORATION, of Chicago, Ill., U.S.A. **3,203,833.** 18th August 1959; 31st August 1965.—Sugar cane is cut into slices $\frac{1}{8}$–$\frac{3}{8}$ inch thick and these slices mixed with two parts of hot (at least 160°F) cane juice of 10–17°Bx. The mixture is pumped to a countercurrent diffuser where the slices are conveyed against a countercurrent stream of hot water (at 160°F). The exhausted slices are removed at the tail end of the diffuser while juice is removed from the head end, some being recycled to be mixed with the fresh cane slices.

* * *

Continuous centrifugals. W. DIETZEL and H. HILLEBRAND, assrs. BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT, of Braunschweig, Germany. **3,205,095.** 12th July 1963; 7th September 1965.—See U.K.P. 990,490.[1]

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Continuous centrifugals. W. DIETZEL and H. HILLEBRAND, assrs. BRAUNSCHWEIGISCHE MASCHINENBAU-ANSTALT, of Braunschweig, Germany. **3,207,627.** 23rd November 1962; 21st September 1965.—See U.K.P. 971,234.[2]

* * *

Stabilized compositions of cyanoethyl sucrose. G. P. TOUEY and J. E. KIEFER, assrs. EASTMAN KODAK CO., of Rochester, N.Y., U.S.A. **3,212,910.** 20th February 1962; 19th October 1965.—Material suitable for electrical insulation purposes comprises cyanoethyl sucrose, in which at least five hydroxyl groups of the sucrose molecule are replaced by cyanoethyl groups, containing at least 0·001% (0·05 – 1%) of a (phenolic or amino) anti-oxidant stabilizer (a thio-*bis*-propionic acid ester, 4,4′-thio-*bis*--(6-*tert*-butyl-*m*-cresol), hydroquinone, dinaphthyl-*p*-phenylene diamine, 2,6-didodecyl-*p*-cresol, N-cyclohexyl-*p*-aminophenol, diphenylamine). The composition may be used for saturating paper or fabric.

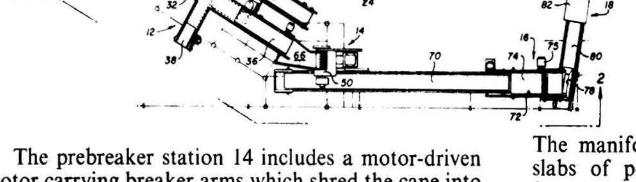
[1] *I.S.J.*, 1966, **68**, 186.
[2] *ibid.*, 123.

Producing L-glutamic acid by fermentation. K. Kono, Y. Iijima, A. Osaki and N. Miyachi, of Tokyo, Japan, assrs. Ajinomoto K.K. and Sanraku Ocean K.K. **3,212,994.** 6th May 1963; 19th October 1965. L-Glutamic acid is produced by suitable bacteria in a culture medium containing biotin in excess of that required for optimum growth of the bacteria [or a substance or substances having bacterial growth-promoting properties substantially equal to that of biotin (biotin derivatives, a biotin parent substance or 7,8-diaminopelargonic acid)], an alcohol (an aliphatic monohydric alcohol, diacetone alcohol, furfuryl alcohol, or tetrahydrofurfuryl alcohol) being added in a minor proportion (0·03–1·5%) sufficient to increase the yield of L-glutamic acid, the alcohol being added when the broth, diluted thirty times, shows an optical density value between 0·08 and 0·70 at a wavelength of 610 mμ. The biotin or growth-promoting substance is added in at least two steps, the second being when the growth of bacteria reaches the stationary phase.

* * *

Cane diffusion system. C. A. Rietz and J. H. Payne. **3,207,628.** 12th July 1963; 21st September 1965.

Freshly-cut pre-washed cane is delivered on conveyor 26 to a retractable receiving endless-slat-conveyor 28 and thence to an elevator 30 which carries it to a rock separation station indicated at 12. This comprises a tank 32 filled with water into which the cane slides from conveyor 30. Rocks, gravel and soil fall to the bottom of the tank while cane floats and is picked up by an elevating slat conveyor 36 which discharges it to the pre-breaker station 14. The heavy material which falls to the bottom of tank 32 is removed by elevator 38 and water is circulated from conduit 46 to a pump discharging through conduit 42 and riser 44 which is directed to circulate water across the surface of the tank, assisting conveyance of the cane towards conveyor 36. The latter discharges into chute 66 feeding the pre-breaker.



The prebreaker station 14 includes a motor-driven rotor carrying breaker arms which shred the cane into fragments which are discharged onto conveyor belt 70 to the accumulator section 16. This is essentially a storage hopper 72 fed by an elevating slat conveyor 74 operated by a variable speed drive and holding a 5–10 minute supply of cane. The hopper delivers to a conveyor 80 which elevates it and discharges it to a disintegrating station 20. The latter includes an inlet hopper 98 and vertical disintegrator 100. This embodies a vertical driven rotor with impact disintegrating hammers surrounded by a cylindrical screen through which the cane passes directly into the extraction station 22.

This is a diffuser in the form of a steam-jacketed inclined tank through which the cane passes from inlet end 122 to discharge outlet 124 under the action of a dual helical conveying unit, against a flow of hot water supplied at inlets 130. This gives a juice which is sent to process, and an exhausted bagasse which is elevated by conveyor 132 to the hopper 134 of a dewatering press 136. The press water obtained is returned to the diffuser while the pressed bagasse is discharged along the conveyors 138 and 140.

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Purifying sugar solutions (by ion exchange and ion exclusion). C. B. Mountfort, assr. The Colonial Sugar Refining Co. Ltd., of New South Wales, Australia. **3,214,293.** 12th October 1962; 26th October 1965.—See U.K.P. 1,005,428.[1]

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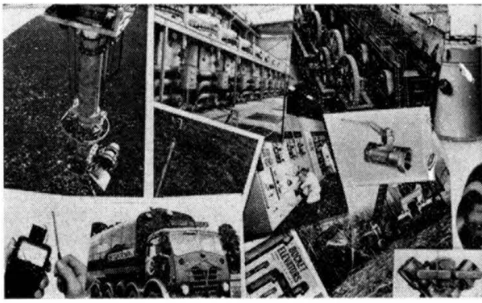
Preparing caramel colour. H. Meisel, of Englewood, N.J., U.S.A., assr. Corn Products Co. **3,214,294.** 17th June 1963; 26th October 1965.—A carbohydrate liquor [of 35–44°Bé (39°Bé)] consisting essentially of a food-grade carbohydrate material (starch hydrolysate, sucrose, dextrose, invert sugar, molasses, etc.) is heated (within one minute) [in the presence of a reagent (ammonium bisulphite) to assist caramelization] to a temperature sufficient to produce caramelization [170°–200°C (179°–188°C)]. The rapid heating is achieved by passing the liquor under pressure into a heat exchanger, having a scraped transfer surface, after which it is maintained at this temperature, with agitation, for a sufficient time [1–10 min (5 min)] to obtain the necessary degree of caramelization, after which the caramel colour is cooled.

* * *

Continuous filter washing. H. V. Miles, assr. Dorr-Oliver Inc., of Stamford, Conn., U.S.A. **3,215,277.** 24th September 1963; 2nd November 1965. Water used for washing the cake formed on a continuous rotary filter is supplied through a battery of primary feed pipes delivering into manifolds mounted across the filter. The manifolds discharge onto the cake by way of slabs of porous fibrous material, e.g. polyurethane foam slabs, which ensures great uniformity of water supply.

[1] *I.S.J.*, 1966, **68**, 221.

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.

Dust collector. Airmaster Engineering Ltd., Chapel Works, Balm Walk, Leeds 11, England.

Details are available of the "Airvent" filter unit which has been developed to meet the requirements of pneumatic handling systems, e.g. in the case of sugar being unloaded from a bulk tanker. The unit has a filter area in the range 50–375 sq.ft. and is made of mild steel. "Terylene" filter fabric is used because of its high durability and resistance to moisture absorption, and the filter elements are cleaned, when no air is passing through the filter, by a ½-h.p. vibratory shaker motor operated from a control panel or by pressure switch. A weather-cowl is fitted on top of the unit.

* * *

"Flowmaster" control valves. Flow Regulators Ltd., 24 Worple Rd., Wimbledon, London, England.

A new range of "Flowmaster" control valves is announced. Operated by pneumatic or "Teleflex" systems, the valves are coupled to a pneumatic cylinder or "Teleflex" fork and swivel by a clevis and pin through the handle to form a complete unit ready for mounting in position. Conversion to manual control is possible merely by disconnecting the air supply or removing the clevis pin. Micro-switches, solenoid air valves or other controls can be mounted on the base plate adjacent to the air cylinder. The valves range in size from 4-in to 12-in bore, and are claimed to be light in weight, inexpensive, compact, easy to install and operate and require minimum attention.

* * *

Oil-free compressors and vacuum pumps. Northey Rotary Compressors Ltd., Alder Rd., Parkstone, Poole, Dorset, England.

Leaflets are available describing Northey oil-free single- and two-stage compressors, and single- and two-stage vacuum pumps. The compressors are designed specifically for applications where gases or air in contact with the material under treatment must be absolutely clean and free from oil or oil vapour. They normally operate directly coupled to electric motors operating at 1450 r.p.m. and have no rubbing contact with the surfaces of the working chamber, so that cylinder lubrication is not necessary. The vacuum pumps, also obtainable as lubricated models, are also driven direct from an A.C. motor and are suitable for handling saturated vapours and liquids in finely divided suspension.

* * *

Anti-foaming agent for agricultural sprays. Hodag Chemical Corp., 7247 North Central Park Ave., Skokie, Ill., U.S.A.

A new technical bulletin describes an additive, MG-89, which is designed to be added, after dispersion in water, to concentrates in use-dilution tanks before mixing and dilution, so as to prevent foaming. MG-89 is a white, creamy emulsion (at 25°C) with a s.g. of 0·97–1·0. While the amount required varies with the type of spray and equipment used, one ounce controlled foaming in 200 gal of spray emulsion containing "Karmex" herbicide. The agent is particularly effective in sprays applied from aircraft.

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PUBLICATIONS RECEIVED

POLISH SUGAR FACTORIES FOR PAKISTAN. CEKOP, P.O. Box 112, Mokotowska 49, Warsaw, Poland.

Issue No. 4, 1966, of "Cekop News" contains an article by S. Gielzyski which gives details of the equipment to be installed in two factories that are being supplied by CEKOP to West Pakistan. Each is designed for a daily crush of 1500 tons of cane, expandable to 2000 tons. One factory is to be erected at Chistian, Bahawalnagar region, for the Bahawalnagar Sugar Mills Ltd., while the other will be sited at Tando-Allahyar, Hyderabad region, for the Mehran Sugar Mills Ltd. A supplementary list of plants exported by CEKOP includes 23 sugar factories, details of which are given, and 17 DDS diffusers.

* * *

RENOLD CHAINS. Renold Chains Ltd., Renold House, Wythenshawe, Manchester.

A folded brochure gives lists of Renold BS Series roller chains, spare parts and stock wheels for these chains, "Coventry" Mark 5 chains, attachments and wheels, couplings, sprag clutches, stock conveyor chains and attachments, stock conveyor wheels, and tools for chain servicing.

* * *

FILTER PAPERS. J. Barcham Green Ltd., Hayle Mill, Tovil, Maidstone, Kent.

Catalogue G 65 gives details of the various types and grades of filter paper manufactured by this company, which has been making them since 1914. Apart from full descriptions of the papers, the booklet also contains a table indicating the grade numbers of other brands of filter paper corresponding more or less to Green's papers, and an ash chart showing the various ashes which enables a paper with a suitable ash to be selected very quickly. Specialties are also described; these include bench mats, seed germination papers, filter pulp, and Soxhlet extraction thimbles.

World Sugar Production Estimate, 1966/67[1]

	Estimate 1966/67	1965/66
BEET SUGAR		
West Europe		
Austria	360,000	240,400
Belgium-Luxembourg	385,000	421,000
Denmark	325,000	246,000
Finland*	71,300	47,322
France	1,800,000	2,395,600
Germany, West	2,000,000	1,596,514
Greece	113,000	109,667
Ireland	100,000	117,660
Italy	1,330,000	1,256,811
Netherlands	551,390	607,998
Spain	500,000	531,218
Sweden*	232,000	201,961
Switzerland	55,000	45,690
Turkey	645,000	579,595
U.K.	955,000	955,587
Yugoslavia	480,000	370,629
TOTAL	9,902,690	9,723,652
East Europe		
Albania	15,000	12,000
Bulgaria	175,000	175,000
Czechoslovakia	980,000	720,000
Germany, East	790,000	672,000
Hungary	474,000	458,277
Poland	1,780,000	1,504,892
Rumania	440,000	427,681
U.S.S.R.	9,500,000	9,400,000
TOTAL	14,154,000	13,369,850
TOTAL EUROPE	24,056,690	23,093,502
Other Continents		
Afghanistan	10,000	8,222
Algeria	5,000	—
Azores	12,000	12,000
Canada	140,000	139,703
Chile	163,000	121,469
China	570,000	500,000
Iran	200,000	181,000
Iraq	30,000	30,000
Israel	40,000	40,333
Japan	240,000	262,019
Lebanon	8,000	4,000
Morocco	35,000	30,000
Pakistan	6,000	7,059
Syria	25,000	23,700
Tunisia	6,200	5,111
Uruguay	82,000	57,800
U.S.A.	2,600,000	2,583,817
TOTAL	4,172,200	4,006,233
WORLD BEET SUGAR PRODUCTION	28,228,890	27,099,735
CANE SUGAR		
Europe		
Spain	45,000	44,547
North and Central America		
Antigua	9,000	7,839
Barbados† (*t*)	200,000	174,661
British Honduras	76,000	44,149
Costa Rica	120,000	110,000
Cuba	6,200,000	4,455,000
Dominican Republic	725,000	700,000
Guadeloupe (*t*)	140,000	167,280
Guatemala	169,900	165,119
Haiti	60,000	59,418
Hawaii	1,135,000	1,130,000
Honduras	34,300	32,897
Jamaica (*t*)	514,000	503,000
Martinique (*t*)	70,000	66,000
Mexico	2,200,000	2,176,208
Nicaragua	115,000	72,574
Panama	55,000	55,000
Puerto Rico	800,000	792,338
St. Kitts (*t*)	38,000	38,357
Trinidad (*t*)	250,000	213,073
U.S.A.	1,100,000	1,000,284
Virgin Islands	10,000	7,300
TOTAL	14,141,200	12,072,497
South America		
Argentina	1,000,000	1,359,965
Bolivia	100,000	89,878
Brazil	3,900,000	4,557,051 (*t*)
Colombia	560,000	530,000
Ecuador	200,000	200,000
Guyana (*t*)	355,000	294,100
Paraguay	34,000	39,625
Peru (*t*)	840,000	830,000
Surinam	18,000	17,000
Uruguay	10,000	10,556
Venezuela	380,000	382,700
TOTAL	7,397,000	8,310,875
Africa		
Congo (Brazzaville)	30,000	31,000
Congo (Léopoldville)	40,000	38,300
Egypt	425,000	366,387
Ethiopia	79,000	76,290
Ghana	11,000	—
Kenya‡	78,000	41,400
Madagascar	110,000	108,620
Madeira	3,000	3,500
Malawi	5,000	—
Mauritius (*t*)	575,000	664,403
Nigeria	20,000	13,630
Portuguese East Africa	170,500	163,889
Portuguese West Africa	70,500	66,921
Réunion (*t*)	224,000	245,805
Rhodesia	265,800	231,331
Somalia	20,000	20,000
South Africa (*t*)	1,540,000	908,798
Sudan	22,000	17,800
Swaziland (*t*)	140,000	120,000
Tanzania‡	86,000	77,300
Uganda‡	155,000	141,400
TOTAL	4,069,800	3,336,774

	Estimate 1966/67	1965/66
Asia		
Burma	75,000	70,000
Ceylon	8,000	8,000
China	1,850,000	1,750,000
India: White sugar	3,500,000	3,900,000
Khandsari	280,000	280,000
Indonesia (*t*)	640,000	775,000
Iran	40,000	37,720
Japan (*t*)	97,000	87,424
Nepal	9,000	8,718
Pakistan	500,000	465,465
Philippines	1,600,000	1,431,875
Ryukyu Islands (*t*)	200,000	210,454
Taiwan	838,000(*t*)	1,001,834
Thailand (*t*)	212,000	265,385
Vietnam, South	3,000	3,000
TOTAL	9,852,000	10,294,875
Oceania		
Australia	2,425,000	1,981,685
Fiji	320,000	333,000
TOTAL	2,745,000	2,314,685
TOTAL CANE SUGAR PRODUCTION	38,250,000	36,374,253
TOTAL BEET SUGAR PRODUCTION	28,228,890	27,099,735
TOTAL WORLD SUGAR PRODUCTION	66,478,890	63,473,988

* Including sugar production from imported beets.
† Including "fancy molasses".
‡ Calendar year 1967, 1966.
(*t*) *tel quel.*

[1] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (33), 1–4.

Brevities

Taiwan sugar crop, 1965/66.—The sugar crop in Taiwan for 1965/66 reached 981,029 metric tons, white value, equivalent to 1,001,834 tons, raw value, and 12·76% in excess of the Taiwan Sugar Corporation's original target[1]. This was the second year in succession that production has been over one million tons, raw value, and thus higher than previous post-war years. It is expected that production will fall in 1966/67, however, since, because of the low price of sugar, cane payment to farmers is at an unattractively low level and planting is thus expected to be only 86,700 hectares or 91·71% of the target area, and sugar outturn is expected to reach only 837,000 metric tons. The Corporation plans to reduce its reliance on contract farmers by improved techniques on its own farms sufficient to raise their share of sugar production from 240,000 to 400,000 tons or 46%.

* * *

Semi-automatic surface irrigation in Hawaii[2].—A semi-automatic system is being tested at Waialua Agricultural Co. for irrigation of a 108-acre field, divided into 17 blocks. The system involves the use of special gates, a new system of flume and level ditches and a field layout which permits long-line irrigation. The gate system is designed to switch the flow of water—8,000,000 gallons per day—from block to block, using time-controlled mechanisms. Surface drainage will be handled by mould-board ditches which run across the tail end of each block and empty into larger drains. The new system will increase irrigation performance, will probably require adjustment only two or three times during the crop, and will permit night irrigation.

* * *

New U.S. beet sugar factory[3].—The site for the new Great Western Sugar Co. beet sugar factory reported earlier[4] has now been chosen. The plant will be built in Kansas, five miles west of Goodland, where a 640-acre site has been purchased. Growers in the area are undertaking early soil preparation for maximum production in 1967, when their beets will be processed in the Colorado factories of Great Western Sugar Co., the new factory being intended to start operations in 1968.

* * *

Bulk sugar terminal in Mozambique[5].—The first phase of the ultra-modern fully-mechanized bulk sugar terminal at Lourenço Marques, in Portuguese East Africa, has been completed. The terminal will be capable of transporting and loading at a rate of 750 tons per hour and the silos, which are completely waterproof, have a storage capacity of 80,000 tons.

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Ecuador sugar factory[6].—A sugar factory is to be built by Cía. Azucarera Tropical Americana S.A. in the Province of Cañar at a cost of 348m sucres. The plant will have a production capacity of 111,060 tons of raw and 23,760 tons of refined sugar, during the 180-day season.

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Morocco sugar factory[7].—Representatives of a group of West German firms and the Moroccan Minister of Industry and Mines have signed a contract for the construction of a sugar factory in Morocco. This factory, which is to be completed by 1968, will have an annual production capacity of 50,000 tons of sugar.

* * *

Mali sugar mill in production.—A modern sugar mill, of about 500 tons cane per day capacity, has started operations recently[8]. It is located at Dougabougou, 300 km northeast of Bamako, and is supplied with cane from over 500 ha of irrigated plantations.

Mexico-Egypt trade agreement[9].—Under the terms of a trade agreement recently signed in Cairo, one of the probable imports by Egypt will be Mexican sugar.

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Portuguese sugar refinery expansion[10].—It has been announced recently that authority to increase their overall production capacity to 300,000 tons per annum has now been granted to six Portuguese sugar refineries.

* * *

The late Dr. M. L. A. Verhaart.—We regret to report the death of Dr. Ir. M. L. A. VERHAART, Head of the Central Laboratory of N.V. Centrale Suiker Mij., Amsterdam, Holland, following an accident. Dr. VERHAART, who was 45, was well-known in sugar circles as one of the principal technologists of the Dutch sugar industry, having made important contributions not only in regard to factory process research but also in the important field of chemical control. He studied under Prof. H. I. WATERMAN at the University of Delft and the thesis for his doctorate, published in 1954, was concerned with the low-temperature diffusion of sugar beet with the aid of sulphurous acid. His work on lactic acid formation at different stages of sugar manufacture was reported to the C.I.T.S. congress in London in 1958 and led to a method of process control which decreased considerably the chemical losses in beet sugar factories. VERHAART contributed substantially to knowledge of the influence of colloids in purification of beet juice, particularly from frozen beet, while he also improved juice purification in the C.S.M. factories by development of the "effective alkalinity" concept. Other fields of study in which he worked included the industrial evaluation of sugar beet, the determination of potassium and sodium in beet brei at the beet reception station, saponins and foaming in white sugar, and the automatic detection of sugar contamination of boiler feed water. He was a member of the Scientific Committee of the C.I.T.S. and of I.C.U.M.S.A., and was the Dutch adviser for the Sugar Committee of the Codex Alimentarius Commission of the F.A.O. VERHAART was a friendly and likeable man with a good command of several languages which stood him in good stead at international meetings, where he made a host of friends who will be saddened at his premature end.

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Corrigendum.—We are advised that certain figures quoted in relation to the Zambia Sugar Co. Ltd. in our November 1966 issue[11] are incorrect. In addition to the £2,000,000 equity capital raised, the capitalization will be completed by raising a further £3,000,000 and not £5,500,000 as reported. Further, the refinery at Ndola cost £1,250,000 and not £250,000. By the middle of 1968 further capital expenditure is expected to amount to £100,000 and, when the present development programme is completed, capital invested in Zambia will be approximately £7,500,000.

1 YUAN: *Taiwan Sugar*, 1966, **13**, (5), 7.
2 *Sugar y Azúcar*, 1966, **61**, (12), 39.
3 *Willett & Gray*, 1966, **90**, 506.
4 *I.S.J.*, 1967, **69**, 31.
5 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (30), 18.
6 *Fortnightly Review* (Bank of London & S. America Ltd.), 1966, **31**, 605.
7 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (31), 17.
8 *Sugar y Azúcar*, 1966, **61**, (11), 62.
9 F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (30), 18.
10 C. Czarnikow Ltd., *Sugar Review*, 1966, (792), 231.
11 *I.S.J.*, 1966, **68**, 351.