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Assistant Editor:
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SOMMAIRES · ZUSAMMENFASSUNGEN · SUMARIOS

Sulfate de fer comme décolorant pour des produits sucrés. S. G. SMART. *Pages* 65–68

En précipitant d'impuretés d'avec de solutions de mélasse et de sucre brut au moyen de sulfate de fer on a obtenu 80,0–95,5% de décoloration, dépendant de la longueur d'onde. Le chauffage des solutions a 55°C avant l'addition du sulfate de fer a réduit l'effet décolorant a 65,1–94,0%. Quelques des matières colorantes ont été séparées d'avec d'extracts de bagasse par sulfate de fer, ce que ne fut pas possible par benzène. On pense, que la méthode devrait être étudiée pour application possible dans l'usine.

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Contrôle de poussière dans une sucrerie betteravière. 3-ème partie. T. RODGERS, P. SWIFT et J. J. GILBERT. *Pages* 68–72

Dans cette dernière partie, les auteurs discutent l'emploi de dépoussiéreurs électrostatiques et à voie humide. Ils présentent une table dans laquelle les efficacités dépoussiérages de quelques dépoussiéreurs à voie seche se comparent et qui donne leurs frais capitaux et d'utilisation. Apres une section sur de ventilateurs centrifuges, on considère les trois facteurs qui sont d'importance pour une explosion aussi que des mesures, par lesquelles on peut limiter l'effet d'une explosion.

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Recherches sur canne à sucre en Trinidad. *Pages* 72–74

C'est un sommaire du rapport annuel (1965) de la station centrale de recherche d'agriculture de Tate & Lyle en Trinidad. Il traite de tels sujets comme la maturation chimique de canne, la résistance de quatre variétés de canne populaires à sel, des essais avec des engrais nitrogénés, des nouvelles variétés de canne, et le contrôle de la cercope (*Aeneolamia varia saccharina*) qui est l'insecte la plus nuisible en Trinidad en ce concerne la canne.

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Une méthode spectrophotométrique améliorée pour la détermination de l'amidon dans des cristaux de sucre. WEI-CHEN et MEI-WEI CHEN. *Pages* 74–78

On compare des méthodes pour déterminer l'amidon dans des cristaux de sucre et propose une technique sur la base de celles de BALCH et de TU et autres. On doit précipiter l'amidon avec l'alcool acidifié d'avec la solution à pH <7, de sorte que les matières colorantes dans le cristal soient retenues en solution. La solution de chlorure calcique doit être chauffer pour dissolution de l'amidon sur un bain-marie à un peu au-dessous du point d'ébullition afin d'empêcher la dégradation. On sépare les matières insolubles de préférence par la centrifugation plutôt que par la filtration. L'absorption de lumière doit être mesurée à 570 mμ plutôt qu'à 700 mμ.

Eisensulfat als Entfärbungsmittel für Zuckerprodukte. S. G. SMART. *Seiten* 65–68

Die Fällung von Unreinigungen aus Melasse- und Rohzucker-Lösungen durch Zusatz von Eisensulfat hatte zur Folge eine 80,0–95,5% Entfernung von Farbe, in Abhängigkeit von der Wellenlänge. Im Falle der Erhitzung der Lösungen auf 55°C vorm Zusatz des Eisensulfats, sank der Entfärbungseffekt auf 65,1–94,0%. Durch Eisensulfat wurde auch Farbstoffe in Bagasse-Extrakten zum Teile entfernt, was durch Benzol unmöglich war. Der Verfasser meint, dass die Methode untergesucht sollte, um die Möglichkeit von Anwendung der Methode in Fabriken zu bestimmen.

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Staubkontrolle in einer Rübenzuckerfabrik. Teil III. T. RODGERS, P. SWIFT und J. J. GILBERT. *Seiten* 68–74

In diesem letzten Teil, besprechen die Verfasser über die Anwendung von elektrostatischen und Nass-Staubfängern. Sie stellen eine Tabelle dar, in der die Entstaubungsleistungsfähigkeiten mehrerer Trocken-Staubfänger miteinander verglichen werden und ihre Kapital- und Betriebskosten gegeben. Auf eine Besprechung über Schleuderventilatoren folgt eine Sektion über Staubexplosionen; hier betrachten die Verfasser die drei Hauptvoraussetzungen einer Explosion, auch Massnahmen für die Begrenzung des Effekts einer Explosion.

* * *

Die Zuckerrohr-Untersuchung in Trinidad. *Seiten* 72–74

Dieser Aufsatz ist eine Abkürzung des Jahresberichts (1965) der zentrale landwirtschaftlichen Forschungsstation von Tate & Lyle in Trinidad. Man betrachtet solche Themen wie chemische Reifung von Zuckerrohr, die Widerstandsfähigkeiten von vier populären Rohrsorten gegen Salz, Versuche mit stickstoffhaltigen Dungmitteln, neue Rohrsorten, und die Kontrolle der Schaumzirpe (*Aeneolamia varia saccharina*), welche das verderblichste Rohr-Schädling in Trinidad ist.

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Eine verbesserte spektrophotometrische Methode zur Bestimmung von Stärke in Zuckerkristallen. WEI CHEN und MEI-WEI CHEN. *Seiten* 74–78

Die Verfasser vergleichen Methoden für Bestimmung von Stärke in Zucker-Kristallen und schlägen eine Methode, die auf jenen von BALCH und TU mit Arbeitern beruht, vor. Die Stärke sollte mit ansauertem Alkohol bei pH <7 aus der Lösung ausgefällt werden, um den Farbstoff im Kristall in Lösung zu halten. Die Auflösung mit Calciumchlorid-Lösung sollte durch Erhitzung der Stärke auf einem Wasserbad bei einer Temperatur ein bisschen unter Kp. durchgeführt werden, um Abbau zu verhüten. Die Entfernung von unlöslichen Stoffen wird vorzugsweise durch Zentrifugierung eher als durch Filtrierung durchgeführt. Die Lichtabsorptionsfähigkeit ist bei 570 nm eher als 700 nm zu messen.

Sulfato ferroso como agente decolorizante para productos azucareros. S. G. SMART. *Pág.* 65–68

Precipitación de impurezas desde melaza y soluciones de azúcar crudo con sulfato ferroso dió como resulta una disminución de color en 80,0–95,5%, según la longitud de onda. Cuando las soluciones se calientan a los 55°C antés de adición del sulfato ferroso, el efecto decolorizante se reduzca a los 65,1–94,0%. Material colorante en extractos de bagazo, que no puede mudarse con benzena, se remueve en parte por aplicación de sulfato ferroso. El autor considera que el método requiera estudio quizás para aplicarse en la fábrica.

* * *

Control de polvo en un azucarera remolachera. Parte III. T. RODGERS, P. SWIFT y J. J. GILBERT. *Pág.* 68–72

En esta final parte, los autores discutieron el uso de colectores de polvo electrostaticos y húmedos. En una tabla se presenta una comparación entre las eficiencias de colección de various colectores secos de polvo. Después de una sección sobre el sujeto de abanicos centrifugos es un otra sobre explosiones de polvo, en que los autores consideran los tres factores principales que se envuelven en la ocurriencia de una explosión, así como medidas para limitación de los efectos de un tal incidente.

* * *

Investigaciones sobre la caña de azúcar en La Trinidad. *Pág.* 72–74

Este es un condensación de la reporte anual (1965) de la Estación Central de Investigaciones Agrícolas de Tate & Lyle Ltd. en la Trinidad. Se concierne tales sujetos como maduramiento quimico de caña, toleración a sal de cuatro variedades populares de caña; experimentos con fertilizantes nitrógenos, nuevas variedades de caña, y control del salivazo (*Aeneolamia varia saccharina*) la peor plaga de la Trinidad.

* * *

Un método spectrofotométrico mejorado para la estimación de almidón en cristales de azúcar. WEI CHEN y MEI-WEI CHEN. *Pág.* 74–78

Métodos para la estimación de almidón en cristales de azúcar se comparan y una técnica que se basa sobre las de BALCH y de TU *et al.* se recomienda. El almidón debe precipitarse con alcohol acidificado desde la solución a un pH menos de 7, para que la material colorante del cristal se retiene en solución. Se disuelve el almidón en una solución de cloruro de calcio por calefacción en un baño de María a una temperatura apenas bajo del punto de ebullición, para que su degradación se previene. Es preferible mudar los insolubles por centrifugación que por filtración, y medir la absorbencia a los 570 mμ longitud de onda que a los 700 mμ.

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Notes & Comments

World sugar statistical position.

F. O. Licht, K.G., have recently published their estimates of the world sugar balance for the crop year September 1966/August 1967, with comparative figures for 1965/66 and 1964/65, the figures being reproduced below:

	1966/67	1965/66	1964/65
	(*metric tons, raw value*)		
Production	66,351,310	63,407,952	67,004,070
Imports	20,364,150	20,481,117	20,652,734
Initial stocks	17,688,601	17,678,385	10,773,342
Total	104,404,061	101,567,454	98,430,146
Final stocks	18,328,326	17,688,601	17,678,385
Deliveries	86,075,735	83,878,853	80,751,761
Exports	20,441,300	20,435,166	20,765,300
Consumption	65,634,435	63,443,687	59,986,461
Production difference	+2,943,358 (+ 4·64%)	—3,596,118 (- - 5·37%)	
Consumption difference	+2,190,748 (+ 3·45%)	+3,457,226 (— 5·76%)	

Commenting on their figures, Licht state that consumption in 1965/66 was much better than expected last year, especially in the Near East countries and other parts of Asia where consumption was nearly 700,000 tons more than estimated. Some 385,000 tons was used for animal feeding purposes in Western Europe and consumption in the U.S.A. and Mexico was higher than expected by 175,000, and 70,000 tons. Consumption was also greater than had been estimated for the U.S.S.R.

Production, on the other hand, was almost a million tons less than was forecast a year ago, with major reductions noted in Cuba, Argentina and Brazil. As a consequence of reduced production and increased consumption, the stock figure as at September 1966 is thus some 18 million tons, little more than the figures for the previous two years. This indicates that consumption should soon, owing to natural population increase if to nothing else, be overtaking production, leading to the disappearance of the burden of stocks and so ensuring a return to normal sugar prices and a sound basis for the industry's economy.

Sugar price improvement.

In the last week of January the world free market price of sugar which had been gradually sinking for months took a sudden rise with the report of a quantity of sugar sold to Publicker Industries Inc., a U.S. manufacturer of alcohol and glycerine. The details of the transaction have not been made public at the time of writing but it is believed that the sugar was in the form of Brazilian whites held by a second hand and rumours of the amount involved ranged from 100,000 to 300,000 tons.

The possibility that a sizeable outlet might be tapped for sugar as an industrial raw material led to the improvement in values, which fell slightly when further reports indicated that the original amount was between 100,000 and 150,000 tons and that 50,000 tons of the order had been cancelled.

At this time, F. O. Licht K.G. published their highly-regarded estimations of the world statistical position, giving the world stock figure at some 2,000,000 tons less than had been the guess of many others. In addition, the sale of 165,000 tons of high-test molasses, equivalent to 100,000 tons of crystal sugar, to Japan for non-food uses, was also reported, and the combination had a buoyant effect which offset the depression caused by the previous factors. The net effect has been to raise the world price by some £4 10s per ton to £17 5s, at which it stands at the time of writing.

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Sugar stocks and prices.

C. Czarnikow Ltd. have recently pointed out[2] that sugar stocks are figures rarely published as regularly-supplied information so that calculated estimates may be at considerable variance, although the stock figure is one of the major factors affecting the world sugar market.

[1] *International Sugar Rpt.*, 1967, **99**, (4), 1–3.
[2] *Sugar Review*, 1966, (794), 237.

A minimum stock of ten or eleven week's supply is currently estimated to be required to meet normal storage and distribution demands but if and when a new International Sugar Agreement comes into operation all exporting members will be expected to hold stocks from one season to another. The minimum stock provision of previous Agreements has been 10%; if this could be applied to all production, and not merely to that portion which is destined for the world market, the current pressure would be lifted and future discussions on price levels and quotas could be held in a more favourable climate. Quite apart from the advantages which would follow from the segregation from the market of a large tonnage of sugar, it is noteworthy that, in those countries where substantial physical stocks are carried forward from one season to another, there is a tendency for a correction to be made to the crop size in the following year.

Heavy stock holding has contributed to the reduction in the area sown to beet in France in the past two years while in the United States sowings were deliberately curtailed a few years ago after surpluses had arisen. In the Argentine, where the government is controlling the stock situation, production is being reduced, while the Indian authorities are building stocks as a matter of policy.

This governmental regulation of crop sizes and stocks is needed if a return to a more balanced statistical position is to be achieved. Indeed, without stocks being brought again under the control of producing countries, working either unilaterally or, preferably, collectively under the auspices of UNCTAD, there can be little chance of the major price improvement that the sugar community so badly needs.

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U.K. sugar surcharge.

Following the sharp increase in the world price of raw sugar during the last week in January and first week in February, the U.K. Minister of Agriculture, Fisheries & Food made orders under the 1956 Sugar Act whereby the surcharge of 4¼ per lb (39s 8d per cwt) was reduced with effect from the 8th February 1967 to 4d per lb (37s 4d per cwt).

* * *

U.S. sugar quota, 1966.

On the 16th December the U.S. Dept. of Agriculture announced additional deficits in the 1966 sugar quotas, totalling 26,000 short tons, raw value. Of this total, 19,000 and 4,595 tons represent additional deficits from Puerto Rico and the Virgin Islands, respectively, and 958 and 1447 tons represent deficits in the quotas for Bolivia and India, respectively. The deficits for the first three countries have been prorated to Western Hemisphere countries and the deficit in the Indian quota was prorated to non-Western Hemisphere countries other than the Philippines and Ireland. Prorations have been made to those countries for which no deficits have been determined. Most of those countries had sufficient over-quota sugar arriving in 1966 to fill the prorations without resorting to additional shipments. The deficits and prorations and revised quotas are tabulated elsewhere in this issue.

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E.E.C. sugar proposals[1].

In the face of continuing depression on the international sugar market, the E.E.C. Commission is hoping to be able to persuade GATT member countries to accept a world reference price of about 70 or 80 dollars (£25 to £28 11s 5d) per ton, or about double the recent prices on the free market. The Commission believes that this reference price would help to bring some sort of unity into the sugar market as a whole, where there are enormous divergencies between the free market price and the prices paid under various preferential systems (which cover almost half the international trade). The Commission is further proposing that the level of self-sufficiency should be fixed for each country, taking into account production, consumption, and exports. This should have the effect of freezing production, since any country upsetting the balance of world trade by overproducing would itself be responsible for dealing with the surplus. Other proposals are that the support level, or difference between the world reference price and the prices paid by the countries concerned to their own producers, should be consolidated and that the market should be regulated by an international storage policy.

Draft proposals for the operation of the E.E.C. sugar market during the interim year 1967/68 have now been submitted by the Commission to the Council of Ministers[2]. In essence the regulations are in accord with those agreed in July 1966[3] but it is noteworthy that it is stipulated that the Council must fix for each member country a maximum level of initial stocks for the crop year commencing 1st July 1968. This measure is intended to prevent a substantial expansion of production in 1967/68 aimed at building stocks which can then be disposed of to the European Fund at a guaranteed price. It should, incidentally, help to allay external fears that substantial tonnages of sugar will be forthcoming each year from the E.E.C. and that the Fund will always be ready to provide the necessary subsidies.

The E.E.C. Agricultural Committee has, in fact, agreed on an overall sugar production quota of 6,335,000 metric tons for member countries, including 2,300,000 tons for France, 1,700,000 tons for West Germany, 1,230,000 tons for Italy, 575,000 tons for Holland and 530,000 tons for Belgium[4].

[1] *Agra Europe*, 23rd November 1966.
[2] C. Czarnikow Ltd., *Sugar Review*, 1967, (797), 17–18.
[3] *I.S.J.*, 1966, **68**, 257–258.
[4] *Public Ledger*, 11th February 1967.

Ferrous Sulphate as a Decolorizing Agent for Sugar Products

By S. G. SMART, A.R.C.S.T., A.R.I.C.

A CERTAIN amount of colour contained in the raw sugar crystal and molasses would undoubtedly be due to the presence of anthocyanins and saccharatin obtained from sugar cane during the extraction process, particularly in the cases where alkaline maceration water is used or where milk-of-lime is added to the bagasse for preliminary clarification during the extraction process. It is also known that iron reacts with both these "dyes" to produce dark green or almost black "inks". It was therefore decided to investigate the action of ferrous sulphate on the clarification and colour removal from molasses and raw sugar. The reason for the choice of ferrous sulphate was that it is comparatively cheap and readily obtainable.

For the purposes of this investigation a 2% solution of a Cuban molasses was prepared and filtered, 75 ml of the filtrate being taken for the test. To this 75 ml of solution was added 10 ml of a ferrous sulphate solution, made up by dissolving 10 g $FeSO_4,7H_2O$ in 500 ml water. The mixture was well stirred in the cold at approx. 20°C, while powdered hydrated lime was added to bring to pH 11·0. The alkaline mix was then filtered. To the clear filtrate was added, whilst stirring, sufficient monoammonium orthophosphate to reduce the pH to 6·6 which corresponded to the pH of the original filtered molasses solution. The resulting mix was again filtered to give a clear solution a sample of which was read in a cell of 10 mm optical depth in a photo-electric colorimeter. A sample of the original filtered molasses solution was also read in the same cell. Both transmittancy figures referred to water as 100 contained in a further cell of 10 mm optical depth alongside the sample treated. The results were as follows:

Filtered molasses solution, transmittancy 20
Treated „ „ 85
Brix of original solution ..... 2·3°
„ treated „ ..... 1·5°
Colour/100 Bx original = 100 (100 — 20)/2·3 = 3478 units.
treated = 100 (100 — 85)/1·5 = 1000 units.
Decolorization % = 100 (3478 — 1000)/3478
= 71·2%

The colour filter used in the colorimeter was Ilford No. 625 having a transmission range of 510–590 mμ.

Encouraged by the above result it was decided to investigate a similar procedure using a West Indian (Trinidad) raw sugar to which was added a small amount of molasses. The procedure was as follows: the sample of raw sugar with a small amount of added molasses was completely dissolved in distilled water and filtered, and the filtrate adjusted to 18°Bx by adding distilled water. The pH of this filtrate was 6·0 and the transmittancy reading 55.

To 100 ml of this solution was added 20 ml of the ferrous sulphate solution used in the previous test, whilst stirring, followed by some powdered lime to bring the pH to 10·7. The mixture was then filtered and to the clear filtrate was added with stirring sufficient monoammonium orthophosphate to adjust the pH to 6·0. This mixture was then filtered, to give a slightly coloured clear filtrate. Using the same colour filter as before the transmittancy reading was 97. The Brix of the filtrate was 15·1°. The efficiency of the decolorization was calculated as follows:

Transmittancy of the filtered solution of raw sugar + molasses 55
„ „ „ treated solution 97
Brix of original filtered solution ..... 18·0
Brix of original treated solution ..... 15·1
Colour/100 Bx original filtered solution
100 (100 — 55)/18 = 250 units
Colour/100 Bx treated solution
100 (100 — 97)/15·1 = 19·9 units
Decolorization = 100 (250 — 19·9)/250 = 92%

The results using various colour filters with the above treated and original solutions are given in Table I.

It will be seen that in the cold there is quite a considerable decolorization of both molasses and raw sugar solutions treated with ferrous sulphate solution. This could mean that a considerable reduction in sulphur requirements could be made in factory operations. The action of the acid ferrous sulphate solution on sucrose was not investigated but it is reasonable to assume that in the cold, and bearing in mind the rather short interval between addition of the acid solution and the powdered hydrated lime (less than 2 minutes), the sulphuric acid attack, if any, on the sucrose present was not appreciable.

Using the above solutions a further test was carried out generally in accordance with the above procedure except that the filtered sugar and molasses solution was first heated to 55°C before adding the ferrous sulphate solution, liming to pH 11 and filtering. The cooled filtrate was again heated to 55°C before further treatment as above, the final pH being 6·0. It was ascertained that the Brix of the clarified and decolorized solution was 16·5°. The decolorization values only are shown in the last column of Table I.

It will be noted that the decolorization in this latter case is not as high as with cold solutions. This may be partly due to the formation of dark coloured compounds when the highly alkaline solution was reheated from 25°C to 55°C before adjusting the pH. As expected there was an initial release of ammonia which soon ceased when the pH was lowered.

Table I

Filter No. Ilford		Wavelength range	Transmittancy Original	Transmittancy Treated	% Decolorization Cold	% Decolorization Hot
625	(yellow-green)	510 — 590 mμ	55·0	97·0	92·0	84·8
621	(violet)	370 — 515 mμ	35·0	89·0	80·0	65·1
608	(red)	620 mμ upwards	79·0	99·2	95·5	94·0
623	(yellow)	545 — 635 mμ	63·3	98·5	95·0	91·0

In addition to the above a qualitative test was carried out with regard to the presence of calcium in the clarified solutions. On addition of sodium oxalate a precipitate was formed in both hot and cold solutions, but in the latter the amount of precipitate was judged to be much greater. The presence of iron was also tested by using both potassium ferro- and ferricyanides; both ferric and ferrous ions were found to be completely absent.

The Mauritius Sugar Industry Research Institute very kindly supplied two bagasse extracts obtained using milk-of-lime in one case and 3% sodium carbonate solution in the other. The calcium extract was very much lighter in colour than the sodium. The colouring matter present in either solution could not be extracted with benzene. On treatment with ferrous sulphate solution a dark green precipitate was formed and on treatment of the supernatant with powdered lime the excess iron was precipitated. The filtrate was coloured yellow in both instances. On further treatment with monoammonium orthophosphate partial decolorization resulted but colour could not be completely eliminated.

It is hoped that the above investigation will result in further work being carried out at a sugar factory in order to obtain data on the economics of clarification with ferrous sulphate. Plantation white and raw sugar factories may directly benefit from the initial decolorization for, in the former case, less sulphur may be required whilst in the latter the refiner will most probably require less decolorizing material.

Summary

It is demonstrated that up to 95·5% decolorization can be obtained using ferrous sulphate as the colour-removing agent for molasses and raw sugar solutions, primarily by the removal of saccharitan colouring matter in the raw juices and present in the sugar crystal and the molasses. The clarified solutions obtained were very bright and sparkling.

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 III

Electrostatic collectors

This collector is mentioned only because it is a well known principle for dust collection. We have, however, little experience with its use in beet sugar factories. In general, it is not a type particularly suitable for the applications being considered. With this type of collector it is extremely difficult to predict its efficiency on a new application. The only satisfactory design technique has been on practical, of pilot plant tests, with the dust to be collected. Properly applied, electrostatic precipitators can collect dusts of small particle size, but it is probably on high temperature duties that this type finds its best application. The theory of collection, of course, is based on a flow of ions through the dirty gas, the ions colliding with the dust particles thus giving the latter an electric charge, and sweeping them to one of the electrodes. Some apprehension may be felt about electrically charging small organic dust particles, because of explosion hazards.

Wet collectors

There are many designs of wet collectors but we will concentrate on two distinct types in use in our factories The most simple arrangement is a form of inertial collector, in which the dust-laden gas is blown on to a wetted surface to which the particles adhere, and which has thus an enhanced efficiency. Examples are the irrigated cyclone, which has previously been described, and the old type "wet-box" which is still used in some B.S.C. factories for scrubbing dust-laden air from granulators. Another example is a packed tower, in which the surfaces of various solids are wetted, and lime kiln gas is passed over these, leaving the particles adhering to the surface. These types in general are bulky and require relatively large amounts of water to achieve a reasonable efficiency.

The second type of wet collector, of more sophisticated design, operates on the principle of water droplets colliding with dust particles, thus entraining the latter and removing them from the gas stream. The most simple form of this arrangement is the spray tower, in which the water droplets fall by gravitational force through the dust-laden air. This tower collector is no longer frequently installed, as more efficient designs are now available. The explanation of the improved efficiencies is apparent from the theory on which this collision of particles is based. Without going into fundamental considerations, the efficiency of collection increases with decrease in droplet size and with increasing relative velocity between the particles. Thus, with normal gravitational forces only, it is apparent that the two requirements are mutually contradictory.

The methods of achieving these requirements can be done in several ways, of which the following two are the most important. Firstly, by designing an arrangement in which the droplets are formed by entrainment from a liquid by the gas flow. The droplets are initially at rest, and during the acceleration period very high relative velocities will occur between the droplets and dust particles. Secondly, by shooting the water droplets at the dust particles so that very high relative velocities occur, even if only for short periods. In B.S.C. factories two such types have been used, both in the first category mentioned above.

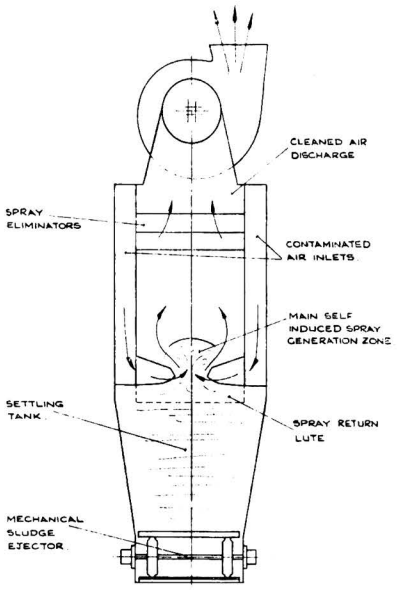


Fig. 7. Typical high-efficiency self-induced spray wet deduster

Fig. 7 shows the diagrammatic arrangement of a wet deduster used for a granulator dust box. The dust-laden air is drawn through the unit by the main fan, and an intense spray zone is created by the entrainment alone. A unit of this design has a performance independent of size—unlike cyclones—i.e. a 50,000 c.f.m. unit will have an efficiency as high as a 2000 c.f.m. unit, and is also very compact. On the debit side the creation of this spray zone has to be paid for by pressure drop, and hence it has relatively high energy requirements—higher than fabric filters, and much higher than cyclones. Even with the very high efficiencies it is not generally feasible to recirculate the clean air within the working area, for both contamination and humidity reasons. However, when large volumes of dusty gases have to be treated at very high collection efficiency, and where it is convenient to collect sugar in the dissolved form, this type of collector is a good solution to the cost/performance problem. A collection efficiency curve for this unit operating on sugar dust is shown in Fig. 8. It would be quite possible to collect other dusts, including pulp, in the same manner and discharge as a sludge, but the wet cyclones previously described can provide a satisfactory efficiency from the effluent aspect, and their capital and power costs are lower.

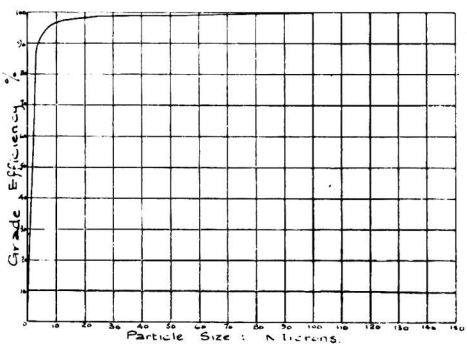


Fig. 8. Grade efficiency curve for M.G. wet deduster collecting sugar dust

The wet deduster depends for its efficient operation on maintenance of correct water levels, so that make-up water must compensate exactly for water lost either as liquor or through evaporation. An advantage in sugar factories is that one can achieve a comparatively high concentration of sugar in the water without impairing the collection efficiency.

The second type of wet collector commonly used is the impingement scrubber, which combines the principle just described with an inertial one. This arrangement is used on new installations for scrubbing lime kiln gas. The cleaning arrangement is a tray with many holes through which the gas is forced. A water level is maintained on this tray, and directly over each hole and above the water level is a "target" plate. The dusty gas passes through the holes in the plate giving rise to the formation of spray droplets. Again, the initial relative velocities are very high, producing the previous effect. The gas then impinges on the plate, and this action gives both an additional inertial effect plus a removal of the entrained droplets.

Table V. Efficiency and cost of dry dust collection equipment for 60,000 c.f.m. dusty gases at 20° C

Equipment	Efficiency on standard dust %	Capital cost £	Capital cost £ per c.f.m. capacity	Space required (cu.ft.)	Average pressure drop (in w.g.)	Power cost £/annum	Maintenance, etc. £/annum	Total Running cost £/annum	Capital charges £/annum	Total Cost including capital charges £/annum	Total Cost including capital charges pence per 100 c.f.m
Inertial collectors	58·6	10,900	0·18	13,000	1·7	780	100	880	1,090	1,970	0·016
Low efficiency cyclones	65·3	7,900	0·13	6,000	3·7	1,690	60	1,750	790	2,540	0·021
Medium efficiency cyclones	84·2	15,300	0·25	12,000	4·9	2,260	60	2,320	1,530	3,850	0·032
Electrostatic precipitators	99·0	74,000	1·23	50,000	0·9	1,000	400	1,400	7,400	8,800	0·073
Shaker-type fabric filters	99·7	52,000	0·87	60,000	2·5	1,870	3,200*	5,070	5,200	10,270	0·086
Low velocity fabric filters	99·8	48,000	0·80	42,000	2·0	1,690	3,000*	4,690	4,800	9,490	0·079

* Filter medium replaced annually.

In B.S.C. factories it is common to use these collectors after a wet cyclone, when larger particles have previously been separated, and it can operate on finer dust. A series of such trays may be used, but on this specific duty one is satisfactory.

This collector is well suited to cleaning lime kiln gas. It can handle large volumes at comparatively low pressure drops (about 3 in w.g. per tray) and, because of the violent agitation of the gas/water mixture beneath the target plates, it is comparatively free from chokage. From what has been said, however, it will be appreciated that the gas flow rate is quite critical for highest separation efficiency. Therefore the gas pumps should be ideally operated at constant rate, and control of process gas demand should be met by recirculating gas to the suction of the washer. From the gas cleaning aspect, this is preferable to speed—or some other volume—control of gas pumps.

Finally, with regard to dry dust collection in general, a recent most comprehensive survey[1] of modern units has been presented. A table compares collection efficiency of these units with their capital and operating costs. We have reproduced this information in Table V, but omitting certain collectors which we feel are not applicable to our conditions. It must be emphasized that a comparison of this sort must be done in general terms on industrial dusts, and it is not suggested that various values quoted will apply exactly in our specific case. For example, with fabric filtration we have found it unnecessary to change the filtering medium as frequently as suggested. Nevertheless, making allowances for these considerations, it was felt that the inclusion of this comparison table would be useful to illustrate the collectors available and their expected results.

Fans

Many established designs of centrifugal fans are available for inducing air flow within plenum systems. It will be readily appreciated that the duties imposed by any dust control system calls for fairly high pressure differences, generally between 8 in and 16 in w.g. Ventilation fans, or other light duty types, are not applicable, and selection is usually restricted to heavier duty fans of the following basic designs, each with its own pressure/volume characteristics.

Paddle bladed fan

The paddle bladed fan presents the simplest concept in fan design. Employing usually up to a maximum of 12 straight flat blades, it will perform reliably for extended periods of time, even when subject to the severe operating conditions experienced when handling dust-laden air. Efficiencies are usually low, of the order of 55%, and noise levels relatively high, particularly at the higher pressure differences.

Forward inclined fan

This type of fan has a rising characteristic, whereby an increase in air flow increases the velocity of whirl at the exit and so increases the pressure rise in the volute and impeller. This fan has, therefore, the ability to overload where the air flow is unrestricted. It is used on installations requiring higher pressure drops and can often require acoustical treatment to obtain acceptable noise levels.

Backward inclined fan

The converse is true for the backward inclined design of impeller, which has a falling characteristic. It is non-overloading and will tend to run with a lower noise level. An improved form of this design employs hollow section blades conforming to the true aerofoil section. This produces a much higher efficiency, between 72% and 80%, and a relatively low noise level. Capital costs are higher, but on dry applications the reduced energy consumption is well worthwhile, with its saving in power costs.

A further development of the aerofoil type is the semi-aerofoil fan; this conforms, as far as possible, to the aerofoil profile while avoiding the necessity for a hollow bladed impeller. This is achieved at some cost to efficiency, but the resulting design is perfectly suitable for use on wet dedusting applications.

Both designs are fairly self-cleaning, and can be used, if necessary, on lightly contaminated air flows.

[1] STAIRMAND: *Chem. Engineer*, 1965, (194), CE 310–CE 326.

Explosion Prevention

Any material which is combustible will present an explosion hazard when it is dispersed in a finely divided state in air. Sugar and pulp dust are both in this category, and sugar dust explosions have occurred in sugar factories in recent years. Certain requirements are made in the British law appertaining to dust control, including precautions to be taken to avoid explosions or minimize their effect. In recent years, every B.S.C. factory manufacturing white sugar has had to install precautionary measures, and this has been done after consultation, and in co-operation with H.M. Inspector of Factories.

Fundamentally, favourable explosion conditions exist when heat is evolved from some initial ignition at a rate greater than it can be dissipated to the surroundings. There follows a chain reaction, with pressure developed by thermal expansion of nitrogen and the formation of gaseous combustion products. A number of factors influence the explosive conditions. The concentration of dust is perhaps the most important.

All mixtures of dust and air will not burn with explosive violence, and there is a range of concentration outside of which there is no danger. This range, normally expressed as upper and lower concentration limits, is not however absolute but is a function of particle size, shape and moisture content.

Also, particle size and concentration influence the maximum rate of pressure rise and the maximum pressure attained—both factors being important in designing explosion vents. Again, from the fundamental consideration, it is apparent that some ignition source must start the explosion.

The precautions to be taken at factories are therefore twofold:—

(A) To minimize the chances of an explosion.

(B) To limit the effect of an explosion should one occur.

We shall consider these in a little more detail under the two headings.

(A1) *Source of Ignition:* The highest surface temperature to which a sugar dust cloud can be safely exposed—termed the maximum ignition temperature —is variously quoted in the literature as between 350°C and 540°C. Presumably the variations are due to use of different particle sizes in the tests. It gives some indication of the scale of temperature, and there is no doubt that the greatest dangers arise from hot foreign objects contacting the dust cloud. For example, welding or burning within a dust area (a tremendous risk), hot metallic surfaces or sparks due to friction, electric sparks due to breaking of an electric circuit for any reasons, lighting, etc. The danger from electrostatic charges on sugar particles is perhaps not so real as was once thought, but this is a remote possibility and in all air conditioning systems the lower limit of R.H. desired is 50%. Again, we ensure in our installations that all plant is properly earthed electrically, belt elevators are used instead of chain, and all hot surfaces, including lighting fittings, are enclosed. We also prefer now to use the underfloor electric system for space heating in sugar silos, to avoid any high temperature points in the area.

(A2) *Dust Concentration:* Avoidance of the dangerous range of concentrations will prevent explosions. Minimum concentration values between 17·5 and 35 g/cu.m. have been variously quoted—and perhaps this variation is hardly surprising as it is the surface area per unit volume, rather than weight per unit volume, which is important. It is a pity that references consulted seldom refer to particle size, although this is most important. A theoretical calculation for lower limits gives a value of 18·4 g/cu.m. The upper explosive concentration is somewhat ill-defined, but is of the order of 7000 g/cu.m. Again, no precise value applies, but those quoted give an indication of the range to be avoided, and it is apparent that the dust concentration has to be very severe even to reach the lower limit! In fact, it would be almost inconceivable to have working areas with such a high concentration, and so undoubtedly the greatest hazard lies in the accumulation of dust on ledges, etc. If a minor explosion should occur, causing disturbance of this settled dust, than a dangerous condition would follow. Therefore the great safeguard for working areas is to avoid this deposition of dust in corners, ledges, etc.

(A3) *Air Concentration:* There is another method, and a rather special one, of preventing a major explosion, although this is very often brought into use by the initial primary explosion. It is to liberate an inert gas in the atmosphere (usually triggered off by the primary explosion) thus reducing the oxygen concentration, and stopping the larger secondary explosion. Because of very large air volumes involved, this is often not a practical solution in normal factory activities, but it is used in one factory where icing sugar is produced and dangerous concentrations can be more readily reached.

To limit the effect of any explosion we require the following precautions:—

(B1) As far as possible to sub-divide the conveying plant into a number of sections using some type of choke as the means of isolation. If we can divide the air volume within the plant by these chokes, we can limit the energy release to any one section, if an explosion occurs. They can consist of rotary valves, or they may be a plate placed in the top of a screw conveyor coinciding with a break in the flights, so that the conveyed material itself builds up in the bottom of the trough, and a barrier continuously exists within the conveyor.

In the same way as sub-divisions are placed within the plant, so the working space should also be divided off with bulkhead walls and doors.

(B2) Partly as a further precaution, and partly to operate in conjunction with the chokes, explosion relief vents should be placed at certain of the more vulnerable points in the system. Furthermore, it is

important that these vents should be carried through any working space and be discharged to atmosphere. Seals must be placed in these vents to avoid weather conditions penetrating the plant, but which will also rupture to liberate any internal pressure build-up.

Vents are most commonly fitted on elevators, storage bins, and on the collectors of dust control systems. In the case of a sugar silo, the roof is considered the vent, and calculations indicate that this would lift at an internal pressure of about 1·5—2 p.s.i.g.—which is within the rupturing range of the walls. Vent design is very much dependent on two factors; these are the maximum explosion pressure, and the maximum and mean rate of pressure rise. The maximum explosion pressure in an unvented vessel appears to be in the range 70–90 p.s.i.g., a theoretical calculation giving 74 p.s.i.g. Values quoted for the rate of pressure rise vary tremendously. In a booklet[2] produced by H.M. Factory Inspectorate, values for sugar dust indicate vent ratios of 1 sq.ft. per 20 cu.ft. of dust laden gas volume. Other authors[3] indicate slower rates of build-up, when vent ratios of 1:30 would limit the maximum internal pressure to 1 p.s.i.g.

In our applications we chose to use the 1:20 vent ratio as far as possible, as this covers the worst conditions. Vents must not be too long, and often not exceeding 15 ft is recommended. This is not always possible with existing installations, but in some instances plant has been re-arranged, in others we have closely approached the desired conditions, and with all new installations we conform to the recommended, and agreed standards.

For further details of isolating and venting procedures, the booklet "Dust Explosion in Factories"[2] should be consulted.

Sugar Cane Research in Trinidad

Annual Report, 1965, Tate and Lyle Central Agricultural Research Station, Trinidad

THIS massive report, extending to 520 pages, is packed with detail concerning experimental work in progress at the sugar cane research station at Carapichaima in Trinidad. Much of it might be described as fundamental or long range research work. The report is divided into four main sections—Agronomy, Entomology, Plant Physiology and Microbiology. The first of these occupies nearly half the report and includes a full account of the extensive work on weeds and weed control, with trials of new herbicides.

In the introductory remarks by the Chairman it is stated that the Research Station has produced some extremely interesting results in 1965 and that in some respects the year 1965 may turn out to have been a pivotal year. The problems or difficulties facing Trinidad as a sugar producer are explained. It is pointed out that in Trinidad neither the soil nor the climate is ideal for sugar production and vast sums have still to be spent in controlling the froghopper. Poor juice quality is a notable feature of Trinidad cane because of late rains just preceding harvest. These are retained by the heavy clay soils leading to further vegetative growth at a time when the cane should be storing sucrose more rapidly than it uses it. Better ratios of cane to sugar occur as the soils dry out but often this does not happen until well into the harvest season. The optimum sucrose ratios or TC/TS (tons cane/ton sugar) are reached between mid-March and May, but juice quality tends to deteriorate again towards late May coinciding with the onset of the rainy season.

In other cane growing countries better climatic conditions exist for ripening, as a rule, vegetative growth slowing down well in advance of harvest because of lack of rainfall, low temperatures, or a combination of these factors. In an average year in Trinidad, factories must process 10 tons of raw cane to produce a ton of 96° sugar. In some parts of Australia, by contrast, it takes only 6·9 to 7 tons of cane to make one ton of sugar. This situation in Trinidad has focussed increased attention on the possibilities of ripening sugar cane chemically and a good deal of research on the subject has been done at the station.

Chemical ripening experiments

During the year under review ripening experiments were carried out with several petroleum oil fractions. Previously a highly refined oil "Sucrol" had been found to improve the juice quality of mature stands of the variety B 41227. The most noticeable effect on juice quality was at 22 to 28 days after application of the oil to the foliage. During the year 1965 "Sucrol" was re-evaluated in large-scale field trials. Four

[2] "Dust Explosion in Factories", *Ministry of Labour, Safety Health and Welfare Booklet, New Series*, 1963, (22).
[3] MEEK and DALLAVALLE: *Ind. Eng. Chem.*, 1954, **46**, (4).

fields of second ratoons of variety B 41227, were treated (by aeroplane) another area being used as control. The results of the experiment confirmed earlier results, viz., that applications of "Sucrol" to B 41227 result in an initial deterioration in juice quality at about two weeks after treatment. This is followed by improved juice quality at three and four weeks after treatment.

Despite a rainfall of 3·13 inches between the 16th and 23rd days after treatment "Sucrol" caused a highly significant improvement in juice quality. Over the same period the juice quality in the control plots deteriorated from 9·93 to 10·22 TC/TS. "Sucrol" had no effect on juice quality at 37 days after treatment, since by this time "natural" ripening had proceeded favourably in controls. It is thought the optimum reaping time with "Sucrol" may be fairly critical.

With regard to five other petroleum oils tested it was found that all arrested stem elongation, but in variable amounts. There was no noticeable difference in leaf damage. All the oils appeared to satisfy, to some extent, the requirements for a potential cane ripener. An interesting result was that fact that the oils with the lowest unsulphonated residue contents were those which caused the greatest suppression of growth. In addition to the oils mentioned above, mixtures of 2,3,6-trichlorobenzoic acid and 2-methyl-4-chlorophenoxyacetic acid (i.e. "Pesco 1815") have been effective in improving cane:sucrose ratios.

One of the limiting factors to applying chemicals on a large scale, by air, in Trinidad, is the lack of adequate aircraft to do the job. It is not possible to apply these materials by hand as the cane is nearly mature at the time the treatment has to be made. The development of chemical spraying as a routine practice on a large scale will have to await the local development of aerial spraying.

Salt tolerance

An evaluation of salt tolerance of four popular varieties of sugar cane was carried out during the year, the varieties being B 41227, B 49119, B 50112 and H 37-1933. It is considered that in the selection for saline conditions the salt tolerance of the variety during the early stages of growth is an important factor. In this experiment young sugar cane plants were grown for a period of seven weeks in nutrient solutions of varying degrees of salinity in a greenhouse. Growth measurements were recorded at weekly intervals. Fresh weight of shoots and roots was recorded after seven weeks.

All varieties showed a progressive decrease in growth rate and fresh weight synthesis with an increase in salinity. At the higher salt levels B 50112 showed the best adaptation and B 41227 the least. Salt effects were manifest first as a "rolling-up" of the lower leaves in all varieties growing in the salinized solution. The effect became more pronounced with increase in salt concentration. Symptoms of potassium deficiency, i.e. a marginal yellowing (bright yellow) of the lower leaves followed by necrosis, were induced by salt in the nutrient solutions. This has been recorded in salt tolerance studies on sugar cane by other workers.

Nitrogen fertilizer experiments

In these experiments four different nitrogenous fertilizers, applied in different areas on different kinds of soil, were compared. The fertilizers were sulphate of ammonia, calcium ammonium nitrate, urea and a slow-release nitrogen fertilizer—"Floranid". The first three, applied at equivalent amounts of nitrogen, produced no significant differences in yield. Calcium ammonium nitrate appeared to be the most economical nitrogen source in the trial when assessed on a profit per acre basis.

With the slow-release nitrogen fertilizer there was again no significant difference in yield when compared with the other fertilizers. Urea was the most economical form of nitrogen on the sandy soil used, while sulphate of ammonia was the most economical nitrogen source on loam and clay. The yields from "Floranid" were not significantly different from the other nitrogen sources and it was relatively expensive.

A number of other (NPK) fertilizer experiments, including placement and time of application, are described in the report. Results varied greatly with type of soil involved.

With regard to mineral deficiency a number of varieties of sugar cane were grown in liquid nutrient culture to induce deficiency symptoms. The object of this was to obtain coloured photographs of the most pronounced symptoms in order to be able to distribute copies to field personnel to facilitate easy recognition. In the case of nitrogen deficiency, by the end of the third week all plants had become pale green, the chlorosis being particularly marked in the older leaves. Yellowing of the leaf tips and margins spread gradually inwards followed eventually by necrosis. The roots developed a striking dark brown colour in contrast to the bright white roots of normal plants.

New varieties

An intensified variety selection programme was initiated with the object of producing varieties better suited to the climatic or environmental conditions prevailing in Trinidad. The need is for a sugar cane variety with an improved TC/TS ratio (tons cane/tons sugar). It should also be erect and free-trashing. In order to increase the chances of obtaining a variety of this sort a more intensive selection programme has been put into operation. Seed produced at the British West Indies Central Sugarcane Breeding Station (in Barbados) is now germinated at Carapichaima and the resultant seedlings studied under local conditions. In addition all of the "first year" selections (which are carried out at the Variety Testing Station in Barbados) are also received. It is of course likely to be some years before the impact of this intensified breeding programme is felt.

A large number of field variety trials (35) in progress during 1965 are described. The results obtained are reported in detail under the following headings:

Comparison of B 41227, B 49119 and B 50112; Barbados Series 1954–1960; Other foreign varieties. Progress with the Barbados 1961–1965 Series is also reported.

With regard to the Barbados 1957 Series (reaped at Brechin Castle) B 5736 and B 57150 continued to show promise. Both varieties yielded as well as, or better than, the standard variety B 41227. The juice quality of B 5736 was consistently good during 1965 while that of B 57150 has been rather erratic. B 57133 was also promising.

Among other varieties the Puerto Rican PR 980, reaped in seven trials, performed as well as B 41227 and produced more sugar in one ratoon trial. Other promising varieties were the Demerara variety D 141/46, Cuba 693/47, Mauritius 147/44 and Hawaii 50-7209.

Froghopper control

The lengthy report of the Entomology section (over 200 pages) is concerned with studies on the froghopper, *Aeneolamia varia saccharina*, Trinidad's worst sugar cane pest, and on improving means of control or reducing their cost to the grower. The finding of new means of combating the froghopper is regarded as of the utmost importance. Apart from immediate control measures, much attention has been given to improving knowledge of the ecology and physiology of this troublesome insect.

As stated in the report "Although froghopper has been kept under control by means of insecticides, the control measures are expensive." The present methods also require logistical precision and must be carefully supervised. In recent years the primary control measure has been to destroy the nymphs which abound in the soil surrounding the base of the sugar cane stool. A number of chemicals (as dusts or granules) are effective for this purpose. Some compounds are less expensive than others and from 1959 to 1965 research has been able to assist in introducing savings in the per acre cost of the chemicals used to control the froghopper nymph.

At the present time, "Toxaphene" and "Trithion" are used most extensively as "stool dusts" while "Malathion" is used as a "drift dust" to control adult froghoppers. Several new approaches to froghopper control have been under study. One of these, aerial application of insecticidal sprays to foliage to control adult froghoppers, has shown considerable promise in the 1965 field trials." Two insecticides ("Sevin sprayable" and "Imidan") have shown the most promise and it was intended to treat about 2000 acres in 1966.

Active steps are being taken to explore fully the possibilities of biological control by the use of possible predators from Uganda and East Pakistan, where the climate along the coast is very similar to that of Trinidad. It has been reported that 19 species of froghopper occur in East Pakistan.

Basic studies carried out on the froghopper and reported on include: site of feeding of the froghopper, froghopper nutrition and physiology, aetiology of froghopper blight, structure and development of the egg, and influence of pH of the substrate on froghopper oviposition.

Experiments were made with a nematode (coded DD 136) which feeds on decaying insect tissue. It enters a living insect and penetrates into the gut where it releases a lethal toxin. In this way the parasitic nematode may continue to feed on the dying tissues, grow to maturity and reproduce. "Froghopper nymphs were exposed to sub-cultures of DD 136. The results to date indicate that the nematode enters and feeds on the nymphs, but it has not been established whether entry is made before or after the nymphs have died."

An interesting feature of this report is the photographic reproductions on the cover, for these are electron micrographs showing two types of chloroplasts isolated from a sugar cane leaf. They were obtained with the co-operation of the Botany Dept., University of California.

F.N.H.

An Improved Spectrophotometric Method for the Determination of Starch in Sugar Crystals

By WEI CHEN and MEI-WEI H. CHEN
(Taiwan Sugar Experimental Station, Tainan, Taiwan)

Paper presented to the 12th Congress, I.S.S.C.T., 1965 (here somewhat rearranged)

THE determination of starch in sugar crystals is not a simple problem since it is associated with closely related carbohydrates which affect its separation. The colour of the sugar itself, if not properly allowed for, will usually affect the accuracy of the later photometric examination of the starch-iodine complex formed. Spectrophotometric methods conventionally used for this purpose are, however,

Table I

Effects of kieselguhr, settling time and methods of separation on the recovery of starch in the determination process

— *Kieselguhr added*—		*Time*	*Method*			*Loss*	*Loss*
In solution	*As precoat*	*of settling*	*of separation*	*Starch added*	*Starch recovered*	*in determination*	*in filtrate*
1·2 g	0·8 g	Overnight	Filtration	50 mg	17 mg	66%	0%
1·2 g	0·8 g	2 hr	Filtration	50 mg	15 mg	70%	4%
1·2 g	—	Overnight	Centrifugation	50 mg	32 mg	36%	—
0·5 g	—	Overnight	Centrifugation	50 mg	41 mg	18%	—

generally accepted for practical purposes, although, owing to the above-mentioned interfering factors, some improvement in the techniques used is desirable.

Recent reports in the literature indicate that studies of this nature are still proceeding.

In this investigation emphasis is laid on factors affecting the loss of starch in the course of the determination owing to inefficiency of the absorbent, i.e. kieselguhr, used for inducing flocculation, hydrolysis of starch by excessive heating, methods used for the precipitation of the starch from the sugar solution, solubilization of the starch precipitate obtained from the sugar crystal, factors concerned with the properties of the starch-iodine complex formed, i.e. the absorption maximum and the effect of acid and base upon the absorption equilibrium between the colouring substances and the starch in the sugar solution which in turn influences the accuracy of determination of the starch iodine complex.

Experimental

The conventional procedure generally adopted for the determination of starch in sugar solutions was followed. The starch in the raw sugar was first coagulated by means of alcohol together with 1–2 grams of kieselguhr. To the mixture either a neutral salt or an acid was added for the purpose of hastening flocculation and improving filtrability. The mixture was allowed to stand in the vessel for various lengths of time. The separation of the precipitate was effected either by means of filtration or centrifugation. The starch extracted from the precipitate was converted to starch-iodine complex which was determined colorimetrically. The results are given in Table I.

These data indicate that even when a large amount of kieselguhr is used the loss of starch during the determination process can not be prevented. Time for settling of the precipitate should be lengthened from two hours to overnight to ensure complete absorption of the starch. Centrifugation is preferable to filtration for separation of the starch from the solution.

Using hydrochloric acid instead of potassium chloride as a coagulation aid for inducing flocculation and improving the filtrability of the precipitate will decrease or even remove the colour absorbed from the sugar solution. Data listed in Table II show that where potassium chloride was used as a coagulation aid there was definitely more colour transferred from the sugar solution than when hydrochloric acid was used for the same purpose. This effect was increased where old yellowish sugar (samples 6–7), as compared with fresh sugar (samples 1–5), were subjected to the same tests. In the latter case the average increase in absorbance was 3·08% while in the former it was 36·9%.

Table II

Effect of hydrochloric acid and potassium chloride as coagulation aid on the determination of starch in sugar crystals.

Sample	*Starch (mg/100 g sugar)* KCl	HCl
1	48·9	48·0
2	49·1	47·9
3	50·7	48·1
4	50·8	49·4
5	51·0	49·6
Average	50·1	48·6
Difference due to colour transfer	1·5	
Difference % $\left(\frac{1·5}{48·6} \times 100\right)$	3·08%	
Sample		
6	46·7	33·1
7	45·2	34·1
Average	45·0	33·6
Difference due to colour transfer	11·4	
Difference % $\left(\frac{11·4}{33·6} \times 100\right)$	36·9%	

In Fig. 1 appear absorption curves of the starch-iodine complex obtained from raw sugar solutions containing 31·0 mg starch per 100 g sugar (a) and 40·8 mg starch per 100 g sugar (b), measured against blanks containing pure white sugar. Curves c and d are from solutions of starch separated from the raw sugars above. The optical density of the starch solutions prepared from the respective sugars varied in relation to the starch contents, while the optical densities of the sugar solutions were not related to their starch contents because of the effect of the sugar colour itself. The starch solutions were prepared by using potassium chloride instead of hydrochloric acid as coagulation aid for starch precipitation.

The effect produced by using hydrochloric acid instead of potassium chloride as coagulation aid for inducing flocculation of the starch, whereby the colour of the starch solution is reduced, may be explained by the hypothesis[1] that all such adsorption colouring matters are ionic or capable of ionizing. Anionic colouring matter consists of anions of weak acids and cationic matter of cations of weak bases. Acid-base equilibria, which are controlled by the pH of the solution, must always be considered, therefore, together with the adsorption equilibria.

The colour in the sugar crystal is a weak acid which in neutral solution gives an anion which is adsorbed on the starch. When the pH is lowered to below 7·0

[1] WALTON: Principles and methods of chemical analysis. (Prentice-Hall, New York). 1955, pp. 226–7.

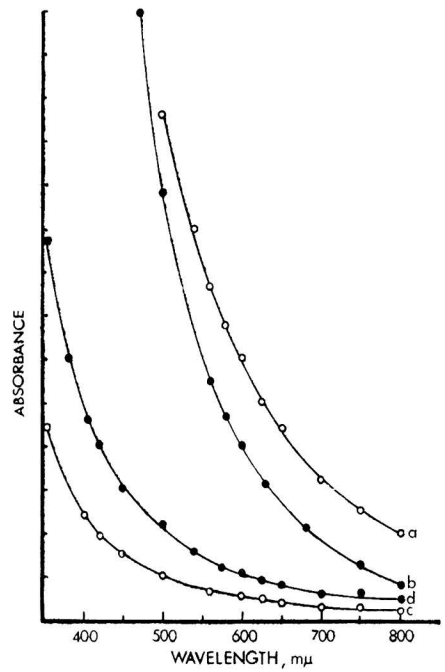


Fig. 1. Absorption curves for starch solutions prepared from sugars with different optical densities and starch contents:
(a) raw sugar measured against a blank containing pure white sugar and the same chemical and amounts (starch, 21 mg/100 g sugar);
(b) same as (a), but with higher optical density (starch, 41 mg/100 g sugar);
(c) starch solution prepared from (a), measured against same chemical and amounts;
(d) starch solution prepared from (b), measured against same chemical and amounts.

by adding hydrochloric acid, the undissociated acid molecules predominate in the solution and are no longer adsorbed by the starch. This explanation is in accord with the observations recorded in Fig. 2.

In Fig. 2, the absorption curve *c* is that of the starch-iodine complex in a solution from which the starch had been removed by alcohol under acid conditions. The optical density is higher than in curve *d* where the starch content had been removed from a starch solution which was originally colourless, because, under acid conditions, colouring matter remained in solution instead of being carried away with the starch during its separation. However, curve *c* is lower than curve *a*, owing partly to dilution by alcohol and partly to the removal of the starch.

In Table III the results obtained with two conventional methods for the determination of starch in sugar are compared.

Method A, developed by Tu *et al.*[2], is typified by measurement of the absorbance at its maximum, use of 0·5 g kieselguhr and of potassium chloride as coagulation aid, separation of the precipitate by centrifuge, solubilization of starch by heating on a waterbath, and washing of the residue with hydrochloric acid followed by water.

Table III

Sample	*mg Starch per 100 g sugar*		*Ratio*
	Method A	*Method* B	A:B
1	49·2	28·3	1·74
2	56·2	29·1	1·93
3	45·5	25·1	1·77
4	23·0	18·3	1·26
5	37·6	24·6	1·53
6	23·2	21·5	1·31

Method B, developed by Balch[3], is typified by measurement of the absorbance at 700 mμ, use of 2 g of kieselguhr and of hydrochloric acid as coagulation aid, separation of the precipitate by filtration, and solubilization of starch by direct boiling with calcium chloride solution.

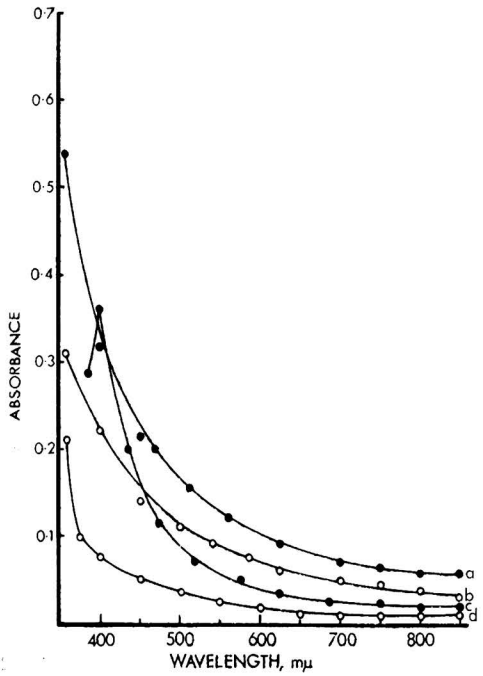


Fig. 2. Absorption curves for starch and sugar solutions prepared by different methods.
(a) starch solution (with yellowish coloration) extracted from raw sugar with KCl as coagulant aid for precipitating starch out of sugar solution;
(b) starch solution (colourless) extracted from raw sugar with HCl as coagulant aid for precipitating starch out of sugar solution;
(c) solution (a) after starch precipitated out by alcohol;
(d) solution (b) after starch precipitated out by alcohol.

Note: all solutions were measured against a blank containing the same chemicals and amounts.

[2] *Rpts. 10th Meeting, Hawaiian Sugar Tech.*, 1960, 119-123; *I.S.J.*, 1962, **64**, 23.
[3] *Sugar J.* (La.), 1963, **15**, (8), 11; *I.S.J.*, 1953, **55**, 191.

The data in Table III show that the starch values obtained by Method B were lower than those obtained by Method A, and inconsistency of the ratio A:B in the last column of the table indicates that the two methods gave results which were not related. The reasons for this may be loss of starch through the filtering medium, retrogradation and hydrolysis of starch during prolonged boiling in slightly acid solution, incomplete extraction from the large dosage of kieselguhr used and the use of the insensitive 700 mμ for the absorbance reading instead of 570 mμ.

HARVEY *et al.*[4], measuring the spectrum of a series of solutions containing starch, potassium iodine and iodine between wavelengths of 425 and 700 mμ, found that an increase in the proportion of iodine caused the absorption maximum to increase in value and to shift towards red, while an increase in the proportion of potassium iodide caused it to decrease and to shift towards blue. The same result was observed by MOULD[5]. Hence, sufficient and definite amounts of iodine and potassium iodide must be taken to ensure a linear relationship between the colour intensity and the amount of starch in the solution.

In HARVEY's work it was observed that after twenty minutes' development the optical density of the starch-iodine complex obtained increased in absorbance by 0·3–0·5% and then began to decrease slowly. In our experiments the starch-iodine solutions with an absorbance of about 0·3 to 0·4 were able to keep a constant value even after 50 minutes; however for solutions of 1·3 or 1·4 absorbance a rapid decrease was observed on standing. Hence it is advisable to take the reading as soon as possible after five minutes' development of colour.

The accuracy of any spectrophotometric method used for starch determination that depends on the formation of the starch iodine complex is limited by the differences in the ranges of the colour produced. This difference is influenced not only by the starch in the cane plant of different varietal origins but also by the different methods used for extraction of the starch from the cane or sugar which is subjected to the determination. The methods used for the extraction naturally modify the property of the starch iodine complex formed therefrom, particularly its optical density.

It is only natural, therefore, that to avoid any error, the starch used for the preparation of the standard curve should preferably be of similar origin or obtained by appropriate methods of preparation. In this investigation several absorption curves were drawn for starch iodine complexes prepared from pure starch (Baker-brand analysed starch) and starch extracted from raw sugar. The methods of preparation of the complex were those conventionally used in the Methods A and B mentioned above.

The absorption spectra were determined with a Beckman DU spectrophotometer through the wavelength range 400 to 800 mμ. The data are plotted in Fig. 3. The absorption curves all showed a maximum around 570 mμ much higher than the absorptions at 700 mμ, so that it is advisable to use 570 mμ for the measurement and not 700 mμ in order to obtain better sensitivity. Different concentrations of the starch solutions were used deliberately in order to avoid overlapping of the curves.

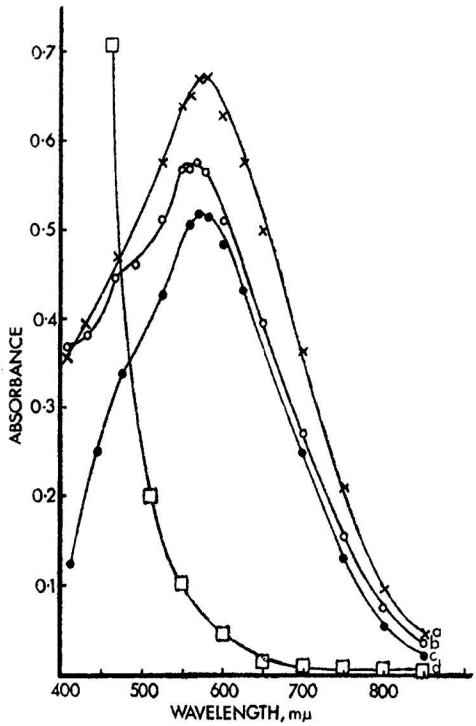


Fig. 3. Absorption curves for starch-iodine complex by different methods:
(a) prepared from Baker-brand soluble starch by Method A;
(b) prepared from raw sugar starch by Method A;
(c) prepared from Baker-brand soluble starch by recommended method;
(d) absorption curve for pure iodine/potassium iodide solution, measured against pure water.

RECOMMENDED METHOD

Arising from these investigations a method, essentially similar to those of BALCH and TU *et al.*, is proposed.

Procedure

A 100-gram sample of sugar is dissolved in 100 ml of water and 3 ml of 6N HCl, and 240 ml of 95% ethyl alcohol added in a 500 ml tall form beaker. The mixture is stirred vigorously to aid precipitate and after standing overnight is subjected to centrifuging at 4000 r.p.m. for 10 minutes. The supernatant portion of the liquid is discarded and the precipitate washed once with 70% ethyl alcohol and separated from the solution by centrifuging at 4000 r.p.m. for 10 minutes, again discarding the supernatant portion.

[4] *TAPPI*, 1959, **42**, 878.
[5] *Biochem J.*, 1954, **58**, 593.

To the washed precipitate is added 40 ml of saturated calcium chloride solution together with 3 ml of 0·8% acetic acid and the whole mixed thoroughly. The mixture in a covered beaker is heated over a water bath at a temperature just below boiling point for 18 minutes and the contents of the beaker transferred quantitatively to a 100-ml volumetric flask with water. After cooling to room temperature and making up to the mark the mixture is transferred to a 200 ml centrifuging tube and the insoluble portion spun out at about 1800 r.p.m. for 10 minutes. An aliquot of the clear solution, containing 2–5 mg of starch, is transferred to a 100-ml volumetric flask and diluted to about 75 ml with water. To this are added in sequence 5 ml of 10% acetic acid, 1 ml of 10% potassium iodide and 10 ml of 0·01N potassium iodate for colour development. After making up to volume the absorbance of the colour is measured after 5 minutes against a reference solution containing similar quantities of the reagents used. From the transmission reading the unknown is read off in terms of starch from the standard curve.

Preparation of the standard curve

Into a 250 ml beaker is weighed 200 mg of soluble starch, corrected for moisture, and to it is added 0·5 g kieselguhr, 40 ml of neutralized calcium chloride solution (s.g. 1·3) and 3 ml of 0·8% acetic acid. This is heated for 18 minutes on a water bath at just below boiling point and, after cooling, transferred to a 200 ml volumetric flask and diluted to the mark with water. One ml of this solution is equivalent to 1 mg of starch.

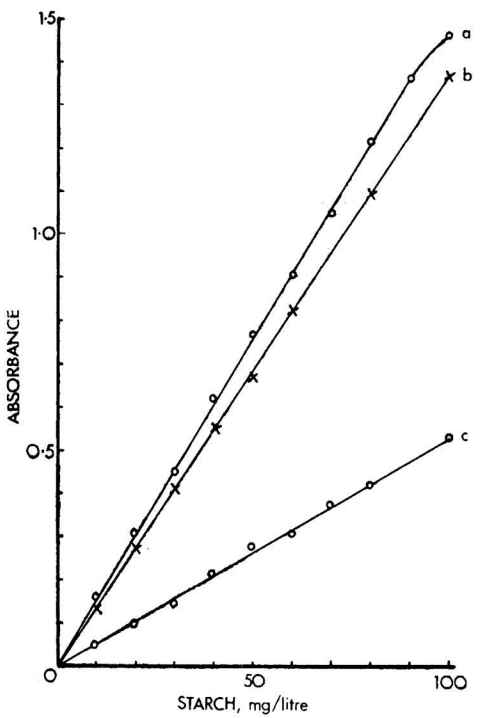


Fig. 4. Standard curves prepared by using Baker-brand starch.
(a) recommended method, at 570 mμ;
(b) Method A at 570 mμ;
(c) Method B at 700 mμ.

Eleven 100-ml volumetric flasks are marked from 0 to 10 and to each is added about 70 ml of water, 5 ml of 10% acetic acid and 1 ml of 10% potassium iodide. The flask marked zero is to be used as a blank. To flasks 1 to 10 are added 1 to 10 ml of starch solution, respectively, followed by 10 ml of 0·01N potassium iodate solution. Each flask is diluted to the mark with water and shaken well to ensure complete mixing. After 5 minutes the absorbance of each is read and the results plotted as a standard curve.

It was found that no advantage was gained by using 10 blanks instead of one so that the concentration of calcium chloride in each blank corresponded to that in the series 1 to 10 starch solutions for purposes of comparison when preparing the standard curve.

Standard curves shown in Fig. 4 were prepared from Baker-brand soluble starch. Curve *a* was obtained by the recommended method at 570 mμ; curve *b* by Method A at 570 mμ and curve *c* by Method B at 700 mμ. It may be noted that curve *a* gave readings higher than curve *b*, although their absorbance readings were both measured at 570 mμ. Loss of starch owing to retrogradation and hydrolysis by direct heating, etc., in the conventional method may account for the lower values obtained, while the very low values obtained in curve *c* at 700 mμ show this wavelength to be unsuitable for the purpose of starch determination. It may also be noted in curve *a* that Beer's Law is obeyed up to an absorbance of 1·4 but above this deviation from linearity is observed.

In Table IV is presented a comparison of results obtained using Method A, modified to the extent of using HCl instead of KCl as coagulation aid, and the recommended method for the determination of starch in sugar.

Table IV

		Modified Method A		Recommended Method		
Sample	*Test*	*Absorbance*	*Starch (mg per 100 g sugar)*	*Absorbance*	*Starch (mg per 100 g sugar)*	*Ratio of Results*
1	1	0·339		0·365		
	2	0·327		0·360		
	Ave.	0·333	21·6	0·365	23·6	0·917
2	1	0·654		0·704		
	2	0·588		0·714		
	Ave.	0·621	40·2	0·709	45·8	0·876
3	1	0·433		0·495		
	2	0·409		0·489		
	Ave.	0·426	27·7	0·492	31·9	0·876
4	1	0·299		0·325		
	2	0·309		0·345		
	Ave.	0·302	19·6	0·335	21·8	0·902

The table shows that the results of the determinations obtained by the two methods were closer as indicated by the more consistent values of the ratio of results in the last column of the table. The readings

by the modified Method A were lower than those obtained with the recommended method and were not so reproducible. This was due to the fact that the strong acid used in Method A hydrolyses some of the starch to dextran.* Dextran gives a purple colour with iodine which in turn reduces the optical intensity of the starch-iodine complex.

* This can be proved by amperometric titration of the starch, a test performed by the second author in connexion with other investigations.

Summary and Conclusions

Conventional methods used for the determination of starch in sugar crystals are compared. It is found advisable to measure the absorbancy of the starch-iodine complex at its peak (around 570 mμ) rather than at 700 mμ as is done conventionally, although the absorption maximum wavelength of the colour substances in the sugar crystal is far removed (around 420 mμ) from the peak of the starch iodine complex. The colour substances of the sugar crystal should be retained in solution by addition of an acid to a pH below 7·0 where the colour substances, existing mainly as undissociated acid molecules, are not adsorbed by the starch. In order to eliminate the source of error due to the retrogradation and hydrolysis of starch the sample should be heated on a water bath just below the boiling point. Centrifuging is preferable to filtration because the latter not only induces loss of starch in the process of filtering but the penetration of the filter paper fibre particles into the filtrate often produces light scattering which affects the absorbance measurement of the starch iodine complex.

Large quantities of kieselguhr (e.g. 2 g) should be avoided since subsequent separation of the starch from it will not be complete. However, the use of a small quantity of kieselguhr (0·5 g) as a coagulation aid is to be encouraged and its effect on the retention of starch is found to be negligible.

Based on the above findings an improved spectrophotometric method for the determination of starch in sugar crystals has been developed. This method has been applied for analysis of the starch contents of some 94 samples of raw sugar from different milling periods of eleven sugar factories. The relationship between the starch and its respective raw sugar filtrability was found to be in agreement with actual manufacturing experience. This part of the work is to be published separately.

C. W. Murray Award

Subjects for technical papers

The following are the subjects from which competitors for the C. W. Murray Award[1] are to make their choice.

1968

1. Corrosion and erosion problems in a sugar factory and their treatment.
2. Removal of non-condensible gases from heaters and vessels with minimum heat losses.
3. Critical survey of formulae for assessing cane milling capacity and cane milling efficiency.
4. "Undetermined losses". The definition and location of these and the economics of minimizing them.
5. The training within industry (TWI) of operation personnel having a low standard of basic aducation.
6. Comparison of alternative types of cane cleaning plant, wet and dry.

The technical papers on the above subjects must be submitted before 31st March 1968.

1969

1. Efficient beet washing with re-circulation of wash water.
2. Comparison of methods of thick juice filtration.
3. The relative merits of cane milling and cane diffusion in terms of pol extraction and boiling house recovery, with comparison of the respective capital and operating costs, and also the heat balances.
4. Survey of performance of continuous centrifugals.
5. The basic analysis of the function of a vacuum pan and the resultant effects on design, with particular reference to regularity of grain.
6. The use of steam accumulators and steam compressors.

The technical papers on the above subjects must be submitted before 31st March 1969.

All competitors should obtain details regarding the preparation and submission of technical papers from Fletcher and Stewart Ltd., Bucklersbury House, 83 Cannon Street, London E.C.4.

Polish sugar factory for Iran[2].—Under the terms of a contract signed recently, Poland will supply the equipment for the Khoi sugar factory in Iran. This factory will have a daily processing capacity of 1500 tons of beets, with a possibility of later expansion to 2500 tons.

* * *

Denmark sugar production[3].—Sugar production in Denmark totalled 293,000 metric tons, extracted from about two million tons of beet this autumn, according to A/S De Danske Sukkerfabrikker. This compares with 198,000 tons in 1965 and 287,000 tons in 1964. Domestic consumption is estimated at around 225,000 metric tons, about 20,000 tons will be held as stock and the balance will be available for export.

Italy sugar production, 1966/67[4].—Sugar production in Italy in the 1966/67 campaign is set at 1,260,000 metric tons, white value. For the period August 1966—July 1967, the initial stocks totalled 180,000 tons and imports authorized up to 15th December 1966 totalled 49,000 tons, to give a total availability of 1,489,000 metric tons, white value. Consumption for the period is estimated at 1,270,000 tons, which should leave a final stock figure of 219,000 tons.

[1] *See I.S.J.*, 1967, **69**, 46.

[2] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (36), 9.

[3] *Public Ledger*, 7th January 1967.

[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (1), 13.

Sugar cane agriculture

Mechanical aids to planting. I. J. STEWART. *Cane Growers' Quarterly Bull.*, 1966, **29**, 117–118.—The cleaning of seed cane for planting by means of the "Ezestripper" is described. This hand implement, invented by a Queensland grower, makes it possible to clean from two to three times as much cane with no damage to the operator's hands.

* * *

Performance of new varieties. G. H. WHITAKER. *Cane Growers' Quarterly Bull.*, 1966, **29**, 119–120.—The performance of three new varieties in Queensland, over a limited area, is described. They are Q 78, Q 82 and Q 83. All showed better c.c.s. or sucrose content than the established variety, Pindar. Q 78 is suited to soils of above-average fertility in which other varieties, e.g. Q 57, may sprawl and lodge. Q 83 is suited to a wide range of soils of average fertility and Q 82 to the poorer soil types.

* * *

The problem of rich land canes. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1966, **29**, 121–123.—The performance of varieties grown so far in pockets of rich alluvial soil in Queensland where severe lodging is liable to occur is described as is the search for more suitable varieties. The two main characteristics desired are (1) anti-lodging of the plant crops under good seasonal conditions and (2) good ratooning under dry spring and early summer conditions.

* * *

A new American chopper-harvester, the Duncan. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1966, **29**, 131–132.—This massive three-wheeled self-propelled harvester is described. It is reputed to be capable of handling fully recumbent crops of 100 tons per acre, at rates of up to 3 tons per minute. Owing to its great size and capacity it is considered better suited to plantation work rather than the small-scale cane farm that prevails in Australia.

* * *

A ratoon fertilizer programme for the Woongarra area of Bundaberg (Queensland). K. C. LEVERINGTON. *Cane Growers' Quarterly Bull.*, 1966, **29**, 135–136. Experiments are reported to ascertain the most profitable rates of nitrogen fertilizer for the variety N:Co 310 in the Woongarra area of Bundaberg where it is much grown. This variety has a reputation for being able to take high levels of nitrogenous fertilizer and still produce high quality juice. The most economical yields followed applications of about 480 lb of ammonium sulphate per acre. With early harvesting this could be reduced to 320 lb.

The sugar cane scale insect. G. A. CHRISTIE. *Cane Growers' Quarterly Bull.*, 1966, **29**, 137–138.—Increased incidence of this pest in southern Queensland in recent years is considered to have been due to abnormally dry conditions and sub-normal rainfall.

* * *

Moth borer—here and overseas. B. E. HITCHCOCK. *Cane Growers' Quarterly Bull.*, 1966, **29**, 139–140. It is pointed out that some of the worst moth borer pests attacking cane in other countries are not found in Australia, thanks to quarantine measures. The two borers present, the large moth borer and the gelechiid moth borer, which are occasionally troublesome, are described.

* * *

BHC—Timing and incorporation are important. C. L. TOOHEY. *Cane Growers' Quarterly Bull.*, 1966, **29**, 143–144.—"Dieldrin" and crude BHC dust (308 lb of 20% dust per acre) broadcast before planting, give good control of soldier fly. BHC also controls cane grubs. It is pointed out that, with BHC ploughed-in on sandy soils, some damage to planting setts may take place. The chemicals should be in the soil when the larvae emerge.

* * *

Raoul grass susceptible to sugar cane mosaic. ANON. *Cane Growers' Quarterly Bull.*, 1966, **29**, 144.—Raoul grass (*Rottboellia exaltata*) is considered to be a threat in the cane fields of Louisiana as it has been shown to be susceptible to sugar cane mosaic disease.

* * *

Imported sugar cane varieties in Brazil. F. DE MENEZES VEIGA. *Brasil Açuc.*, 1966, **67**, (4), 22–25.—An account is given of preliminary trials with 22 American (Canal Point) and 8 Coimbatore varieties, with emphasis on yield and early maturity.

* * *

Yellowing of sugar cane. ANON. *Indian Sugar*, 1966, **15**, 763.—This malady has been causing heavy losses in some parts of India. Investigations at Udaipur have shown that it may be controlled by spraying a mixture of citric acid and ferrous sulphate solution. It is caused by the inability of the plants to obtain or make proper use of iron in the soil, and may be recognized by the yellowing of the leaves and the appearance of green lines on the yellow leaves. As the malady increases these lines become white and the plant stops growing. Spraying should commence as soon as the first symptoms are noticed; 12·5 g

citric acid is added to each gallon of 1% ferrous sulphate solution. About 150 gallons are needed per acre.

* * *

Sugar cane pests problem in South India. A. N. KALRA and H. DAVID. *Indian Sugar*, 1966, **15**, 769–773. With the rapid expansion of the sugar cane industry in South India in recent years the insect pest problem has become more acute. Brief notes on the major pests are given with suggestions for control. It is pointed out that moth borers are the most serious pests. These include the top borer, shoot borer, internode borer, pink borer and root borer. Termites, leaf hoppers, white fly, scale insect, mealy bug and white grub may cause severe damage in some areas. Pests of minor importance include aphids, army worm and grass hoppers.

* * *

New canes can accept more nitrogen. ANON. *Australian Sugar J.*, 1966, **58**, 23.—It is pointed out that cane varieties bred in Queensland in recent years are more tolerant to nitrogen than their predecessors which were prone to lodge or lose sucrose content with heavy dressings of nitrogen. Some years ago 2½–3 cwt of ammonium sulphate per acre was considered to be the right quantity. Today up to 9 cwt may be used in some areas.

* * *

Chopper harvester to stay. B. HENDERSON. *Producers' Review*, 1966, **56**, (4), 7.—It is pointed out that in the 1965 season 571 chopper harvesters harvested more than 30% of the Queensland crop and with their transport bins constitute a heavy investment. The chopper harvester is the only machine that has proved usable to harvest all types of cane crops under all conditions. It is considered that there are features of chopper harvesting which far outweigh, both economically and in handling, any possible loss by deterioration of quickly milled cane.

* * *

Some ideas on bin trailers. J. B. HELSHAM. *Producers' Review*, 1966, **56**, (4), 64–65.—The writer describes the development of a bin trailer that is claimed to operate successfully under soft and wet conditions in Queensland, the low-pressure tyre and wheel equipment being a special feature.

* * *

Johnson grass and mosaic disease worse. L. L. LAUDEN. *Sugar Bull.*, 1966, **44**, 240.—Johnson grass (*Sorghum halepense*) infestation is reported to be bad on many Louisiana cane farms. Improper timing of application of herbicides, on account of frequent rainfall, may be an important factor. Much of the spread of mosaic disease took place in the autumn of 1965, after early-planted cane had come up, but growers should continue to rogue.

Sugar cane smut: an epidemic disease. F. O. BRIEGER. *Brasil Açuc.*, 1965, **65**, (2), 78–80; through *Rev. Appl. Mycology*, 1966, **45**, 220.—Three important outbreaks are reported, one constituting the first record of *Ustilago scitaminea* in Minas Gerais. Varieties found to be resistant in trials at the São Paulo Biological Institute are listed.

* * *

Weed control for Florida sugar cane. J. R. ORSENIGO. *Proc. Soil Sci. Soc. Fla.*, 1964/1965, **24**, 466–474; through *Hort. Abs.*, 1966, **36**, 428.—At present no post-emergence herbicide will selectively control grass weeds in sugar cane without crop injury, but proper application equipment facilitates the use of post-emergence chemicals. "Fenac" showed promise for pre-emergence annual grass weed control in organic soil. Work is recorded on effective "Dalapon" dosages and methods of application for control of emerged grasses without injury to cane.

* * *

Considerations on the availability of water for sugar cane growing in Catende, Brazil. F. A. LAROUCHE. *Turrialba*, 1965, **15**, 178–183; through *Weed Abs.*, 1966, **15**, 428.—The available water supply, depending on the method of calculation, is 500–800 mm per annum, which is too low for sugar cane. Trials suggest that sprinkler irrigation in Oct.-March would increase cane yield by 60%, reduce labour per ton of cane and permit the reduction of the area cultivated by at least half.

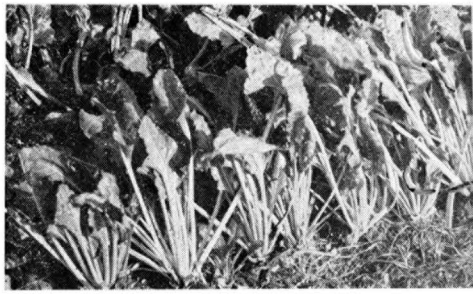
* * *

Pre-emergence herbicide screening in sugar cane on sand soils. J. R. ORSENIGO. *Mimeo Rep. Everglades Expt. Sta.*, 1964, 65–69; through *Weed Abs.*, 1966, **15**, 87.—A preliminary evaluation trial on a sandy soil is reported, herbicides being applied before emergence in 50 gal of water/acre (cane variety CP 50–28). Principal weeds present were *Cynodon dactylon* (Bermuda grass), *Setaria* sp. and *Ambrosia* sp. Only "Bromacil" and "Isocil" (at 2–4 lb per acre) markedly reduced the stand and growth of cane, toxic symptoms becoming apparent 2–3 months after treatment. Six months after treatment the following appeared to have had the most beneficial effects—"Chloramben" (6 lb/acre), "Fenac" (6 and 9 lb/acre), "Diuron" (4·8 lb/acre) "Atrazine" (4 lb/acre), "Propazine" and "Simazine" (4 lb/acre) and "Norea" (8 lb/acre).

* * *

Topping sugar cane. L. G. DAVIDSON. *Agric. Res., Wash.*, 1965, **14**, (4), 10; through *Hort. Abs.*, 1966, **36**, 433.—Studies are briefly reported which show that sugar cane should be topped so that the juice contains 11% sucrose. This economically optimum topping height varies between varieties from year to year. It is therefore recommended that a sample cut be made at the normal height. If the juice contains less than 11% sucrose, a second sample cut should be made 12 inches lower. In some cases a third sampling may be necessary.

Sugar beet agriculture



Wider-interval drilling: some experiences in Suffolk. A. C. G. GIBBS. *British Sugar Beet Rev.*, 1966, **34,** 181–182.—Improved techniques, e.g. precision drilling, high grade seed and chemical weed control, have opened up the possibility of wider spacing of seed in the rows. Results of trials are given. Some fields drilled at 5-inch and 6-inch spacing gave excellent results, others for various reasons were disappointing. The saving in labour and costs with the wider spacing technique could be considerable.

* * *

Monogerm seed in the west Midlands. N. A. WYKE. *British Sugar Beet Rev.*, 1966, **34,** 185–190.—Competition for farm labour by industry in the west Midlands and the shortage of labour for the beet farmer at critical periods is referred to. It is concluded that, in parts of Shropshire, there is a place for some monogerm seed on any farm where labour shortage at singling time compels the grower to sow after the end of April, and that the lower cost arising from the use of monogerm seed may justify a lower return.

* * *

The present position and prospects of beet sugar production in India. R. R. PANJE. *Indian Sugar*, 1966, **16,** 177–181.—The possibilities of sugar beet production in India, based on extensive trials commenced in 1960–62 in several different regions, are discussed and the difficulties of commercial production pointed out. For climatic reasons it must be grown as a winter crop and fuel for processing is liable to be a difficulty, sugar cane providing its own fuel in the form of bagasse.

* * *

Observations on host range and vector relations of beet mild yellowing virus. K. BJÖRLING and B. NILSSON. *Socker Handl.* II, 1966, **21,** 1–14.—Sugar beet yellows is a complex disease caused by one or both of two distinct viruses, viz. the semi-persistent beet yellows virus (BYV) and the persistent beet mild yellowing virus (BMYV). They differ in host range and in other respects. Seven new hosts (mainly weeds) for BMYV in Sweden are reported. Virus isolates indistinguishable from BMYV were recovered from some samples of perennial nettle (*Urtica dioica*) collected in the fields. Methods for the identification of BMYV and for its separation from BYV by means of vector transmissions are pointed out. The minimum total transmission time needed for obtaining infections seemed to lie between 24 and 32 hours.

The critical cultural practice—harvesting. F. B. RUSSELL. *Sugar Beet J.*, 1966, **30,** (1), 4–5.—The causes of damage to sugar beet in harvesting and storage in the United States are discussed. Excessive speed with mechanical harvesters is regarded as the major factor in beet breakage which leads to rotting in the pile. Pockets of trash in the pile, which decompose and thus raise the temperature of surrounding beets, are another prolific cause of rotting. Green material going into a storage pile will heat within three days and restrict air movement. The importance of maintaining a harvester properly adjusted is stressed.

* * *

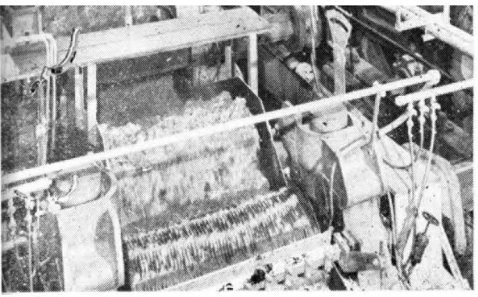
Sugar beet seed production. J. J. NIEDERER. *Sugar Beet J.*, 1966, **30,** (1), 6–7.—The two methods used in producing sugar beet seed are described, viz. the European or steckling method and the American-developed overwintering method. The latter is the easier and cheaper way where winter weather is not too severe or where a snow blanket gives protection. Commercial sugar beet seed is produced by this method in the Williamette Valley of Oregon, one of the two main sugar beet-producing areas in the United States, the other being the Salt River Valley surrounding Phoenix, Arizona.

* * *

Possibilities of increasing the yield in sugar beet growing by improving the environment. F. SCHEFFER. *Zucker*, 1966, **19,** 349–353, 363–366.—Attention is drawn to the danger of neglecting the soil under present-day conditions, when there is a strong urge to reduce costs in as many directions as possible. Reduction in cattle raising, which makes heavy labour demands, reduces the amount of humus and plant nutrients for the field. Reductions in phosphatic and other fertilizers and in lime are also commonly made. The need for magnesium and trace elements in some soils must not be forgotten.

* * *

Plant population—key to higher returns. D. J. GARNER. *British Sugar Beet Rev.*, 1966, **35,** (1), 13–16.—The need to obtain a high plant population in sugar beet fields is stressed. With acreage limited, an optimum plant population is an obvious method of obtaining higher yields. It must be combined with good husbandry, wise fertilizer use, early drilling, timely singling, control of weeds, pests and diseases, and efficient harvesting.



Cane sugar manufacture

A new preparation technique for sugar cane. G. NEIDL. *Zeitsch. Zuckerind.*, 1966, **91,** 328–331.—A description is given of a Hoelscher "Gorator", which comprises a centrifugal pump housing a shaft on which are mounted sloping toothed discs. It can be used for pumping such solids as pulp, filter mud and molasses as well as comminuting cane and extracting juice, in which capacity it is claimed to be capable of replacing cane knives, shredders, crushers and mills. Part of the housing is perforated to allow separation of the juice. An illustration shows shredded bagasse obtained from chopped cane. A scheme is suggested for cane juice extraction in three stages, and the power consumption of a 150 t.c.h. scheme with three "Gorators" compared with that of a crusher plus four mills, whereby the new scheme is shown to require less power (577 compared with 930 h.p.). The "Gorator" system is claimed to be able to give an overall extraction of 99·1% compared with a maximum of 94–95% with conventional mills.

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The performance of sugar factories in 1965. J. DUPONT DE R. DE ST. ANTOINE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1965, 117–123.—Among the information provided is mention of the installation of Donnelly-type vertical feed chutes at the last three mills in the 4-mill tandem at St. Felix factory. The value of the 0·44 gain in the reduced mill extraction percentage attributed to the chutes in 1965 exceeded the manufacturing and installation costs of the chutes. Milling data show an average specific feed rate of cane of 54 lb/cu.ft./hr for all the Mauritius factories, compared with an average of 46 lb/cu.ft./hr in South Africa. A mechanical agitator fitted to a low-grade pan at Riche-en-Eau reduced the duration of the strike from 8½ to about 3 hr. Double-curing of *C*-massecuite adopted by a number of factories has increased raw sugar filtrability, an increase in *C*-sugar purity from 83 to 92 by this means reducing the starch content of the sugar by 45%. No conclusions could be drawn from tests to determine whether raw sugar filtrability can be related to such variables as pH, turbidity and phosphate content of clarified juice. The extent of benefit to filtrability resulting from raw juice flotation (aeration at 75°C) could not be determined, while syrup flotation did not have any positive effect on raw sugar filtrability. Boiling back of *A*-molasses gave an *A*-sugar of average filtrability 7–9 points lower than that obtained with straight boiling. Remelting *C*-sugar instead of double-curing it was found to improve filtrability but is recommended only as a temporary measure.

Factors contributing to the figures of increased "total" losses and increased "undetermined" losses and steps suggested for keeping these low. R. B. L. MATHUR. *Indian Sugar*, 1966, **16,** 27–30.—Determination of losses in bagasse, filter-cake and final molasses by weighing is discussed and the factors affecting the sugar loss in bagasse are considered. The causes of undetermined losses, both mechanical and chemical, are enumerated and the possibility of reducing mechanical losses, particularly those caused by juice leakages and entrainment, discussed generally.

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Sugar cane agriculture in Australia. S. VON GNIELINSKI. *Zeitsch. Zuckerind.*, 1966, **91,** 393–399.—A survey is presented of the Queensland sugar industry, with a brief historical account of the industries in both Queensland and New South Wales.

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Remelting of sugars. C. G. M. PERK. *S. African Sugar J.*, 1966, **50,** 563.—Despite the remelting of all *B*-sugar and double-cured *C*-sugar in the majority of Natal sugar factories, the scheme has not always given the desired results. It is pointed out, however, that while recrystallization is the best way in which to raise the purity of a product, it will be effective only if the sugar is suitably washed before remelting, incomplete washing only increasing molasses circulation after remelting. Advice is given on *B*- and *C*-sugar curing. Removal of all the adhering molasses may be done in one stage with *B*-sugar by washing and steaming, while *C*-sugar must be cured in two stages, since *C*-sugar washing in the low-grade massecuite centrifugals is not permitted in Natal. The once-cured *C*-sugar is mingled and diluted (to remove fine grain) with properly heated *B*-molasses, so that the second stage removes the last of the final molasses before remelting. The *B*- and *C*-sugars should be remelted separately to allow the purities to be checked, and steam and water should be used, not juice or syrup which confuses the interpretation of the melt analysis. Both sugars should be melted to 70°Bx at 70°C. Grasshopper conveyors below the centrifugals are preferred to screw conveyors since these ensure that incompletely cured sugar is not discharged to the melter.

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Reducing the retention time of the juice at high temperatures. C. G. M. PERK. *S. African Sugar J.*, 1966, **50,** 565–569.—See *I.S.J.*, 1966, **68,** 361–363.

The achievement in bagasse saving during the last 20 years. P. C. KWAN. *Taiwan Sugar*, 1966, **13**, (3), 18–19, 31.—Two graphs are presented showing the decrease in total fuel consumption (expressed as tons of bagasse per 100 tons of cane ground) during the 20 years since the establishment of the Taiwan Sugar Corporation, and the increase in surplus bagasse on cane ground over the same period. During the three seasons up to and including 1964/65 the surplus bagasse figure has remained constant at about 39 tons/1000 tons cane ground. Measures that have resulted in these savings are discussed.

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Steam balance determination for mill improvement. C. J. LU. *Taiwan Sugar*, 1966, **13**, (3), 20–24.—The heat balances at four carbonatation and three defecation sugar factories, taken as representative of the Taiwan industry, were analysed over four consecutive years from and including 1962. Generally, the carbonatation factories used 19% more steam than the defecation factories, evaporation and boiling making up 13·6% of this difference. The heat distribution in the factories was as follows: 10–12% for power production, 70–75% for evaporation and pan boiling, 9–13% in condensate and 1·3–3·3% heat loss. The steam consumption was 8–9% lower in the middle of the season than at either end, the difference being due to heat losses and the heat consumed in evaporation and boiling. Suggestions are offered regarding vapour bleeding and boiler operation.

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The continuous centrifugal—its appraisal by actual tests. C. A. LEE. *Taiwan Sugar*, 1966, **13**, (3), 32–34. Although continuous centrifugals used for primary curing of white *C*-massecuite gave a sugar of low colour content at 2½–3 tons/hr throughput, crystal breakage occurred. This problem was not solved by reducing the viscosity of the magma to improve the molasses drainage nor by dissolving the crystal pieces in water to make a 88–90°Bx magma. A rubber lining around the inside wall of the curb casing failed to have effect because a sticky layer of sugar formed which subsequently caused crystal damage. Regulating the sugar moisture content by varying the massecuite feed rate was also ineffective, since high moisture sugar used as seeding or remelt leads to increased molasses circulation and boiling back. In tests to determine centrifugal throughput, it was found that the efficiency of the washing system is of great significance, washing with 78°Bx molasses instead of water resulting in a 100% increase in capacity. Using continuous centrifugals for primary and secondary curing gave sugar of 99·86 pol and the throughput was satisfactory.

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Kaohsiung port and (the) sugar industry in Taiwan. N. T. CHEN. *Taiwan Sugar*, 1966, **13**, (3), 37–39. Since at this Taiwan port it takes 6–8 days to load a 10,000-ton ship with sugar poured into the holds from sugar bags hoisted onto the deck, the Taiwan Sugar Corporation plans to build warehouses, suitable for both bulk and packaged sugar and a deep-water wharf. The conveyors to be installed for loading and reclaiming will also be used for other export commodities such as canned pineapples and mushrooms and bagasse board. All the sugar factories in the Corporation are to have bulk warehouses. An illustrated description is given of the harbour installations at Kaohsiung.

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The D.M.C. (defeco-melt crystallization) process—a critical review and suggestions for improvement. B. B. GAIROLA. *Indian Sugar*, 1966, **16**, 143—146. The details presented in an earlier paper[1] are studied critically and modifications to the process are proposed: the raw sugar (mixture of single-cured *A*- and *B*-sugars) should have a pol of 97–98 and should be mingled with affination syrup of about 86 purity and re-purged. (The remaining affination syrup should be used for *A*-massecuite boiling.) The affined sugar liquor should be boiled successively to RI, RII and RIII massecuites of 99, 98 and 96 purities, respectively. These massecuites should be single-cured and the sugar from all three combined. The molasses from the RIII massecuite, of 88 purity, should be used for *A*-massecuite boiling. Reference is made to the author's proposed defecation melt-carbonatation process[2], use of which, it is claimed, can reduce sulphur consumption to 0·005% on cane. It is pointed out that should it not be possible to use even this small amount of sulphur, carbonatated and filtered liquor can be treated with other agents such as bone char, active carbon and ion exchange resin as, for instance, in Japanese refineries.

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The effect of reduced sulphur consumption on the process of white sugar manufacture. D. R. PARASHAR. *Indian Sugar*, 1966, **16**, 147–153.—Observations on processing at sugar factories using varying amounts of sulphur are discussed. It has been found that in carbonatation factories sulphitation is still necessary to reduce the colour content and raise *A*-massecuite purities. Triple carbonatation is not a suitable substitute for SO_2, and a minimum sulphur consumption of 0·045–0·05% on cane is considered necessary for efficient juice purification. Optimum sulphur consumption, as dependent on the sugar and grain size desired, is discussed. Further investigation into the defeco-melt crystallization process[1] is considered necessary.

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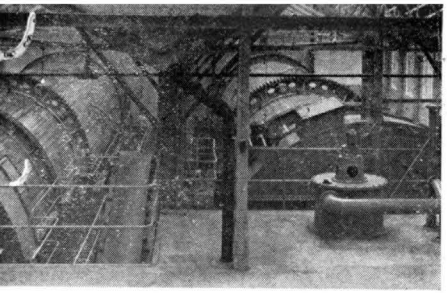
Recent advances in sugar technology in India. S. C. GUPTA. *Indian Sugar*, 1966, **16**, 133–136.—A survey is presented of research work and various technological developments in India in recent years.

[1] GUPTA *et al.*: *I.S.J.*, 1966, **68**, 340.
[2] *I.S.J.*, 1963, **65**, 50.



Beet sugar manufacture

Fluidization drying and cooling of crystal sugar. L. NEUŽIL. *Listy Cukr.*, 1966, **82,** 117.—A fluidization dryer-cooler was successfully tested in full-scale trials. About 3½ min was required for drying the sugar and less than ½ min for cooling it. The amount, moisture content and quality of the sugar entering the dryer fluctuated somewhat as a result of manual supervision of the centrifugals. The rated throughput is 10 tons/hr, but the dryer averaged 12 tons/hr during the tests with a maximum of 20 tons/hr. The sugar moisture content was reduced from 0·5% to an average of 0·04% and the temperature was reduced from 70–80°C to 35–45°C. (The temperature of the bagged sugar was 30–35°C.)

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Experience in installing and adjusting a KDA-25-59 (tower) diffuser. V. V. MODZELEVSKII. *Sakhar. Prom.*, 1966, **40,** (7), 23–29.—Information is given on the procedures used in setting up a Soviet KDA-25-59 tower diffuser of approximately 2000 metric tons daily capacity, which was put into operation towards the end of the 1965/66 campaign at Elan'-Koleno factory.

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Simplified method of controlling the degree of molasses exhaustion. G. N. MIKHATOVA. *Sakhar. Prom.*, 1966, **40,** (7), 30–32.—Four graphs are combined in such a way that by drawing straight lines through abscissae and ordinates alternately, it is possible to find the amount of sugar lost in molasses as a result of inadequate molasses exhaustion and inefficient washing of massecuite. Three of the graphs (molasses saturation coefficient *vs.* sugar content at 40°C, purity *vs.* sugar content, and purity *vs.* non-sugars: water ratio) are in the form of series of straight lines corresponding to various Brix concentrations. The fourth graph is of saturation coefficient *vs.* non-sugars:water ratio, and is a single line. The method involves knowledge of (i) the values of constants *a* and *b* in the expression: saturation coefficient $= a + b$ (non-sugars/water), (ii) molasses Brix and purity, (iii) the non-sugars: water ratio, and (iv) molasses standard Brix at the curing temperature. The graphs are based on analytical data, the non-sugars:water ratio being found from data gathered over a period of 3–5 years. A worked example is given.

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Forced ventilation of beet piles. A. HAVRÁNEK, L. SCHMIDT, J. ZAHRADNÍČEK, P. FEKETE and M. ČAPEK. *Listy Cukr.*, 1966, **82,** 129–137.—Beets (about 3300 tons) were stored for an average of 63 days in a pile measuring 100 × 24 m and 3 m high, which was divided into three equal parts, one part being unventilated and the other two ventilated naturally and artificially, respectively. Selected beet were placed in artificial fibre bags (40 beet per bag) and placed in five rows at a height of 1 m. The lowest sugar losses (daily and total) were found in the naturally ventilated pile, while the unventilated control had the greatest losses. The higher losses in the forced ventilation pile than in the naturally ventilated pile were attributed solely to the higher average temperature (5·17°C compared with 4·49°C in the naturally ventilated pile), and the consequent greater number of warm pockets. The losses were greater in the samples located between the air ducts than in those placed directly over the ducts. The magnitude of the losses in a beet pile is related to the temperature, which in turn depends on the impurities content, both mineral and organic. A height of 6 metres is considered essential, thus involving the use of beet pilers, and correct operation of the fans must be strictly observed.

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Scale-model method of planning. YU. A. VORONTSOV. *Sakhar. Prom.*, 1966, **40,** (7), 35–38.—The use of scale-modelling for factory planning is discussed and exemplified by illustrations of a model of a 1500-ton daily capacity beet factory to be built at Kedainyai in Lithuania.

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The Finnish sugar industry. S. ZEMAN. *Listy Cukr.*, 1966, **82,** 147–150.—An illustrated survey is presented of the Finnish sugar industry, which incorporates four white sugar factories, five refineries and one beet factory at Korela that sends 50°Bx thick juice to the refinery at Kotka. In 1964 production amounted to 54,888 tons of sugar from 394,730 tons of beet.

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Protection of sugar factory equipment by paint. E. COSTENS. *Sucr. Belge*, 1966, **85,** 337–349.—The use of paint to combat corrosion of sugar machinery is discussed with mention of the chemistry and forms of corrosion, its inhibition, types of pigment, surface preparation, the use of zinc-based paints, the painting of lime kilns, involving heat problems, and the treatment of metal frames inside factory buildings.

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Practical experience of automatically controlled boiling. H. F. KORN. *Zucker*, 1966, **19,** 337–348.—Information is given on the pan stations at the Rain-am-Lech and Plattling sugar factories of Süddeutsche Zucker A.G. For middle-product and low-grade strikes, the controls are based on conductivity, while for white sugar and raffinade strikes boiling point eleva-

tion is used as control parameter. Among the requisites considered for efficient boiling are: a precisely calculated number of crystal nuclei in the seeding charge, a homogeneous syrup charge, and a constant vacuum. Diagrams are presented showing the pan controls and details are given of the stages in the boiling of low-grade and *B*-sugar strikes. The formation of conglomerates in white sugar and raffinade strikes is discussed with reference to the importance of the optimal value of λ (the average distance between two adjacent crystals), which, according to GENIE[1], should be 0·1 mm for efficient boiling, while a value of 0·2 mm will mean a difficult strike. In a new 60-ton pan equipped with an agitator at Rain factory, the conglomerates constituted e.g. 25% of the crystals compared with 35% in pans without agitators. While fluctuations of 0·06 occur in the supersaturation in the pan having the mixer, over the complete process the supersaturation remains practically constant, while in the other pans the supersaturation rises by 0·12, and even 0·2 after a long strike. The boiling, including seeding, is controlled from a central panel; the seeding point and ideal boiling curve have to be determined at the start of each campaign.

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Danger of dust explosions in sugar silos. G. KÜHNEN. *Zucker*, 1966, **19**, 371–377.—A study made by the Staubforschungsinstitut (Bonn) of conditions in white sugar silos, in particular the fine dust concentrations during filling and the electrostatic charges arising, is reported. The results showed that under normal conditions no danger of dust explosions existed in the silos investigated. The danger of explosion due to faults in operation is discussed with especial reference to the three factors involved: dust concentration, ignition energy and oxygen availability[2]. Measures to eliminate explosion risks are described.

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Evaluation of the technological properties of sugar beet for selection. P. M. SILIN. *Priklad. Biokhim. Mikrobiolog.*, 1965, **1**, 90–94; through *S.I.A.*, 1966, **28**, Abs. 319.—Principles and methods of evaluating the yield of manufactured sugar S (% on beet) are reviewed with 10 references to the literature. A formula widely used in the U.S.S.R. is $S = (D - 0{\cdot}9)[1 - m(100 - q)/q]$, where D = beet sucrose content, m = melassigenic coefficient[3], which varies from 1·02 to 1·70 and is correlated with the (Na + K) content of the non-sugar in purified juice[4], and q = purity of the purified juice obtained by a laboratory carbonatation of press juice. A worked example is given.

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Influence of sulphitation of beet cossettes on sucrose inversion. V. M. PRIIMAK. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1965, (6), 56–58; through *S.I.A.*, 1966, **28**, Abs. 325.—No sucrose inversion could be detected after cossettes had been treated with SO_2 in a closed space for 30 min, to give a diffusion juice pH of 5·0–5·4. The juice contained 0·07% of SO_2. Glucose was analysed by colorimetry with aniline phthalate after paper chromatographic separation with *n*-butanol-acetic acid-water. The glucose concentration of the sulphited diffusion juice was slightly lower than in the untreated juice.

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Improving the centrifuging scheme for *B* and *C* products and affination magma at Tirgu-Mures sugar factory. C. SAVEL, I. HALMÁGYI and E. AVED. *Ind. Alimentara*, 1965, **16**, 517–520; through *S.I.A.*, 1966, **28**, Abs. 328. The use of continuous centrifuges for *C*-massecuite led to excessive formation of fine crystals, and resulted in excessive centrifuging times in subsequent affination. The scheme was modified by using batch centrifugals for *C*-massecuite, transferring the continuous centrifugals to *B*-massecuite, and dissolving the *B*-sugar without affination. Flow diagrams and results before and after the modification are given.

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Intensive purification of sugar juices by ion-exchange resins. V. I. MELESHKO, G. A. CHIKIN and T. A. KLOCHKOVA. *Teor. i Prakt. Ionn. Obmena* (AN Kazakh. S.S.R.), 1963, 164–167; through *S.I.A.*, 1966, **28**, Abs. 333.—In order to avoid a progressive fall in the pH of deionized juice leaving an anion-exchange resin column after previously passing through a cation-exchange resin column, it is proposed to operate the column in batteries of five each. As soon as the effluent from the anion-exchange column falls below pH 7·0, or the cation concentration in the cation-exchange effluent "breaks through", the effluent passes into another column in series; the first column is used for pre-treatment until it is completely exhausted, and is then regenerated. Two-three columns may thus operate in series in each of the cation- or anion-exchange batteries; cation exchange is completed before anion exchange begins. The resins are KU-2 and EDE-10 P, respectively. The deionized thin juice has a purity of 98–99.

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Purification of sugar solutions by means of electrodialysis with ion exchange membranes. Part I. C. SUZUKI and N. MOCHIZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 10–17.—The purification of beet juices using electrodialysis with ion exchange membranes was studied using a 9-chambered unit in which the membranes, of 100 sq.cm. area and 2 mm apart, were of "Unilex 18 GCZ 45" (anion) and "Unilex 13 GCL 55" (cation) resins, and were located between electrodes of monel metal. In preliminary experiments to determine the cause of the sharp pH drop noted by earlier workers, it was found that in electrodialysis at above the limiting

[1] *I.S.J.*, 1962, **64**, 232–236.
[2] *ibid.* 112, 113.
[3] *ibid.* 1964, **66**, 255–258.
[4] *ibid.* 1965, **67**, 121.

current density, the pH drop was caused by the concentration polarization on the anion membrane; by recycling enough of the waste solution from the cathode chamber and the concentration chamber into the incoming feed, to maintain its pH level at 9.0, the pH of the purified juice could be kept at above 6·8. Sugar solutions of lowest purity were found to be most suitable for treatment. While higher temperatures tend to shorten the life of the membranes, the experiments were conducted at 60°C because of the lower electricity consumption at that temperature. The optimum concentration was found to be 30°Bx. With lower current density the current efficiency was higher, i.e. ions removed per watt-hour, while the demineralization per unit area, i.e. ions removed per sq.cm. per hr, was lower. In practice the density chosen would have to be determined on a basis of economics.

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Observations on the use of CAL granular carbon in beet factory operations. A. CARRUTHERS, J. V. DUTTON and J. F. T. OLDFIELD. *Paper presented to the 18th Tech. Conf., Britsh Sugar Corp. Ltd.*, 1966. It was determined that no significant fall in purity, loss in polarization or loss of solids occurs during the treatment of thick juice with CAL carbon during normal beet sugar factory operations; it is recommended, however, that the temperature of the juice entering the CAL column should not be allowed to exceed 90°C because acid inversion occurs above this temperature. Microbiological inversion may occur if the temperature is allowed to fall in stagnant areas in the column or feed lines and it is considered that these low temperature areas should be avoided by manipulation of the feed valves rather than by raising the temperature of the bulk feed syrup. Sugar losses in crystallizers are normally low and it is considered that significant inversion will not occur unless the massecuite is allowed to fall below pH 6·0. Its bulk density alone is not a reliable measure of the capacity of CAL carbon to absorb saponin and floc; it is suggested that a saponin or floc adsorption test should be used in conjunction with bulk density measurement to determine the state of reactivation of the carbon.

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Pulp pressing. A. M. LLOYD and N. SNAITH. *Paper presented to the 18th Tech. Conf., British Sugar Corp. Ltd.*, 1966,—A Rose, Downs & Thompson Ltd. pulp press at Spalding factory was equipped with a variable-speed drive, and with equipment for measurement of pressures within the press, of the input to the press, speed of rotation, pH of the expelled liquid, liquid flow rate and distribution, and pulp temperature. The time of retention was determined by introducing sliced lemons into the feed and noting their emergence, and the moisture content of the pulp was also measured. Experiments carried out during the 1965/66 campaign showed that feeding efficiency could be improved, the most effective means being an independently driven feed screw in the inlet, to eliminate air and loosely-held water and thus increase the bulk density of the feed to the press proper; this has been shown to reduce the outlet moisture content. The highest efficiency of expression occurs at the lowest speeds. Higher throughput is achieved at constant speed when the pH is lower; however corrosion is then increased. At constant pH, an increase in speed produces higher throughput but at the expense of pressed pulp moisture. Operational conditions must therefore be a compromise between these three factors. For an existing press at speeds of above 3·5 r.p.m., it is better to operate with the choke removed as it is possible to increase throughput with the same pressed pulp moisture by a slight reduction in speed. For a press fitted with a feed screw it is better to operate with the choke removed as the throughput is more sensitive to speed variations and pressed pulp moisture less sensitive.

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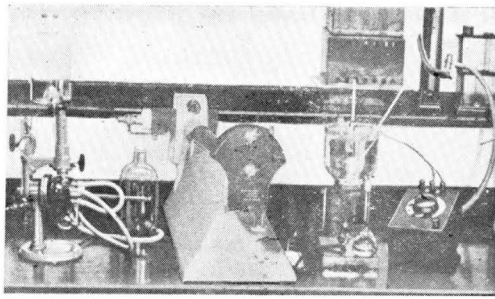
Pulp pressing. W. M. LANYON. *Paper presented to the 18th Tech. Conf. British Sugar Corp.*, 1966. Horizontal pulp presses are continuing to be installed in the B.S.C. sugar factories but their capacities, originally equivalent to 1000 tons of beet per day, have fallen to 925 tons for the Stord (giving 21·4% dry substance in the pressed pulp) and 809 tons for the Rose, Downs & Thompson press (giving 22·4% dry substance). A possible explanation is the increase (of up to 400%) in clearance between the spindles and screens as a result of wear over the years. The fine stainless steel screens have been subject to breakage by tramp metal and stones, and increasing their thickness from 0·7 to 1 mm. has not proved an adequate remedy. Backing screens of mild steel become corroded, particularly just after the end of the campaign before they can be removed, washed, cleaned and painted. Replacements are all of stainless steel, as are replacement keep bars which hold the screens. Other parts not in direct contact with the pulp can be protected by painting with "Araldite" or "Epilux 5". The spindles were originally protected with "Araldite" epoxy resin but have been clad with stainless steel 14-gauge sheet, welded in place. The flights have been covered with stainless steel weld, and new spindles are supplied covered with stainless steel. In new press batteries, one press is provided with variable speed control to allow for variation in pulp feed ; attention is being paid, however, to evening the supply from the diffusers. Mechanical breakdowns have been few since the initial difficulty with spindle breakage due to faulty metallurgy. Corrosion inside the R.T. diffusers used in British sugar factories is a serious problem and has only been partly met by painting with "Araldite" or "Epilux 5" epoxy paint. Stainless steel lifting screens and a perforated screen have been tested over one campaign and showed no measurable corrosion or erosion and, although the metal is costly, the rising cost of labour and its scarcity may make it the best material to use for certain parts of the diffuser and pulp press.

Laboratory methods & Chemical reports



Determination of glutamic acid in molasses by the method of paper electrophoresis. N. P. EGOROVA and V. P. MELESHKO. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1965, (5), 191–193; through *S.I.A.*, 1966, **28**, Abs. 273.—Molasses (10 g) is heated under reflux with 30 ml of HCl (s.g. 1·12) for 8 hr to hydrolyse pyrrolidone carboxylic acid. The solution is filtered, evaporated to dryness to remove HCl, redissolved and filtered again. A spot corresponding to ~25 µl of the concentrated solution is placed on the starting line of a slow chromatography paper in successive 5-µl lots, together with glutamic acid standards (10–30 µg). Electrophoresis is carried out in 0·2N acetate buffer at pH 3·7, at 450 *V* and 4–6 *mA*, for ~3 hr. The spots are revealed with 1% ninhydrin in acetone, and eluted with 6 ml of 0·2% $CdCl_2$ in 40% methanol to stabilize the colour. The latter is measured at 500 mµ. The precision of the determination is ±1·5%.

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Electrochemical measurement of sulphur dioxide and reducing decomposition products. P. SIEWERT and F. TÖDT. *Zeitsch. Zuckerind.*, 1966, **91**, 255–262, 320–328.—In the methods recommended by ICUMSA for quantitative determination of SO_2 in sugar factory products, the pH of the solution is changed so that the ratio of free SO_2:combined SO_2 is affected. The free SO_2 originally present in the solution cannot therefore be measured. The electrochemical method of TÖDT[1] was applied to alkaline solutions, and to thin juice in particular. It was found suitable for alkaline buffer solutions and pure sucrose solutions, giving a standard deviation of 0·495 mg SO_3^{--}/litre. The reactions between SO_2 and O_2, hydroxymethylfurfural and methylglyoxal were measured at 20°C in model solutions of pH 9. In the case of thin juice the measurements were distorted by the presence of reductones. Work on the formation of reductones from saccharides is discussed.

Anodic measurement of reductones in technical sucrose solutions was found to be practical, with a standard deviation of $1{\cdot}05 \times 10^{-5}$ moles of reductone/litre. This method was used to investigate the formation of reductones from sucrose, glucose, fructose and dihydroxyacetone, and the destruction of these at temperatures in the range 70–79°C and at pH 7·3, 9·0 and 12·0. The rate of reductone formation increases with progressive decomposition of sucrose from degradation products of a saccharide character. The rate increases further with increasing temperature, and yet further with increasing pH. Under certain circumstances the reductone concentration is proportional to the original invert concentration in the solutions for a given range of concentrations. Reductone decomposition decreases with falling temperature. Cathodic measurement of oxygen demand by heated alkaline solutions of fructose revealed a parallel between reductone concentration and the oxygen demand, 1·5 moles of O_2 being consumed per mole of reductone. Fifty-nine references are given to the literature.

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Use of the Bausch & Lomb precision sugar refractometer for chemical control of sugar factories. M. RANDABEL and F. LE GUEN. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1965, 132–133.—Various points of interest arising from use of the instrument in Mauritius are discussed. The refractometer, adopted by all Mauritius sugar factories in 1965 for chemical control, has presented no major problems, although some defects are noted.

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Influence of triose reductone on the browning reaction of sugar solutions. F. ONDA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 26–32.—Triose reductone was prepared from glucose by the von Euler method and served as the standard for identification and confirmation (by thin-layer chromatography of its 2,4-dinitrophenylhydrazone) of its extraction from raw sugar, green syrup and refinery molasses. Experiments on its reaction with glucose indicated that colour formation was greater at higher pH values, while the Maillard reaction between glucose and amino-acids in the presence of triose reductone was affected variably depending on the amino-acid concerned.

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Needle crystals of low-grade sugar in the refinery. Part I. The form of needle crystals in the final refinery massecuite. T. SHIRASAKI and M. KAMODA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 47–53.—Laboratory massecuites were prepared and their green syrups examined in relation to the variation from normal quadratic shape of the crystals produced. Examination of ash, reducing sugar, starch and total gums of each syrup indicated that these were not causal factors in the formation of needle-crystals.

[1] Elektrochemische Sauerstoffmessungen (Electrochemical measurements of oxygen). (Berlin, 1958). pp. 5–24.

Chemical determination of odour intensity in beet white sugar. K. KAGABU, H. ITO and M. KAMODA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 68–71.—Evaluation of odour by a panel of trained judges showed that there was a significant correlation between threshold concentration of beet sugars and volatile basic nitrogen content, and a method of determining the latter is described. A solution of 900 g beet white sugar, diluted with distilled water to 25°Bx is passed through 12 ml of "Amberlite IR-120" cation exchange resin, H^+-type, 80-mesh, at space velocity 10. The column is then rinsed with 300 ml of distilled water and then with 42 ml of 1·5N NaOH. This alkaline eluate, containing the amines, is aerated for 90 min with 220 litres of air, measured with a meter, into a vessel containing 10 ml of N/50 H_2SO_4. The aeration vessel is maintained at 70°C. The excess of N/50 acid is titrated with N/50 NaOH, using 0·2% methyl red as indicator, when the difference in ml, multiplied by 280/W (where W = weight of test sugar), gives the volatile basic nitrogen in p.p.m.

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Studies on the odour of molasses. Part IV. Volatile amines in beet molasses. H. ITO and M. KAMODA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 72–77.—Steffen factory molasses was diluted to 25°Bx and passed through a column of "Amberlite IR-120" strongly acidic cation exchanger which was then washed to remove sugar and eluted with N NaOH to remove amines; the eluate was treated with ninhydrin and steam distilled, the volatile amines being collected by absorption in HCl solution. They were examined by paper chromatography using 4:1:5 *n*-butanol:acetic acid:water as solvent, and monomethylamine, triethylamine, *n*-propylamine, diethylamine, monoethylamine and dimethylamine identified. Further purification and fractionation by extraction with *iso*-propanol, fractional distillation and thin-layer chromatography of 3,5-dinitrobenzamide derivatives is described, other amines identified including ammonia and trimethylamine.

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Determination of the stickiness of raw sugars. M. KAMODA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 78–83.—In cohesionless granular material the resistance to sliding on any plane depends on the direct pressure and on the angle of internal friction. The force required to overcome frictional resistance, or shearing strength τ, is expressed by $\sigma \tan \phi$, where σ and ϕ represent the normal stress on the plane and the effective friction angle. In the case of wet sands or sticky soils, the relationship is $\tau = C + \sigma \tan \phi$, C being the effective stickiness. This concept, devised for the shearing strength of soil, is applied to raw sugars, and a method of determining stickiness (in terms of kg/sq.cm.) using a shear box is described. The thickness of the molasses film on the sugar is found to be the most important factor affecting the degree of stickiness.

Filtration-impeding materials in raw sugars of various origins. I. The filtrability of raw sugars and affined sugars. T. YAMANE, K. SUZUKI and T. KAGA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 83–90.—See *I.S.J.*, 1965, **67**, 333–337.

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Filtration-impeding materials in raw sugars of various origins. II. The filtrability of laboratory carbonatation slurries. T. KAGA, K. SUZUKI and T. YAMANE. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 91–96.—See *I.S.J.*, 1966, **68**, 3–6.

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Colouring matter in refinery liquors. T. YAMANE and K. SUZUKI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 97–100.—Colouring matter in the regeneration effluent from a decolorizing resin used for sugar refining was concentrated by crystallization of the NaCl content followed by dialysis through a cellophane membrane. The remaining colouring matter, dried in vacuum, was subjected to oxidation with $NaIO_4$ and to catalytic hydrogenation using Raney nickel, according to the methods described by BINKLEY[1]. The products were examined by two-dimensional paper chromatography and aspartic acid, glutamic acid, glycine, alanine, γ-aminobutyric acid, valine and leucine or *iso*-leucine identified. Using a one-dimensional technique, ethylene glycol, glycerol and arabitol were also identified. Colouring matter absorbed on granular active carbon was also eluted with alkali, concentrated, dialysed, subjected to oxidation and hydrogenation and analysed. The nitrogen content of the carbon-adsorbed colouring matter was only half that of the colouring matter adsorbed by the resin, and amino acids could not be clearly identified. Ethylene glycol and glycerol were also identified, and another unidentified polyol, also present in the resin colouring matter degradation product, was detected.

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Factory scale tests of Australian raw sugar. TECHNICAL COMMITTEE, JAPAN SUGAR REFINERS ASSOCIATION. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1966, **17**, 101–102.—Analytical data for twelve shiploads of Australian raw sugar are tabulated and compared with corresponding data for sugar from Taiwan. The Australian sugar had almost identical pol, moisture content, reducing sugar and ash content, but its colour was considerably higher than that of the Taiwan sugar. Grain size was smaller and the sugar contained large amounts of needle grain, these factors hindering affination and requiring more wash water in the affination centrifugals. The higher washed sugar colour increased the load on the purification stage, and because of the lower affination yield, overall recovery is lower. The filtrability of Australian raws was also inferior to that of sugar from Taiwan.

[1] *I.S.J.*, 1957, **59**, 64; 1958, **60**, 165.

Transportable purification plant for experimental work. R. PIECK. *Paper presented to the 18th Tech. Conf., British Sugar Corp. Ltd.*, 1966.—See *I.S.J.*, 1966, **68**, 279.

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Sugar recoveries: how they affect the planter. J. P. STO. DOMINGO. *Sugarland*, 1966, **3**, (1), 20–40.—A thorough explanation is given of the meanings of mill extraction, boiling house recovery and overall recovery with also an account of factors affecting them, typical figures from Philippine sugar factories and other countries and other countries, the meaning of "reduced" recoveries, and of the Java ratio. Systems of sugar distribution are discussed, the two used in the Philippines being the s-j-m formula and the Warren method.

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Simplified determination of sugar losses in defecation mud. S. ZAGRODZKI and H. ZAORSKA. *Gaz. Cukr.*, 1966, 74, 105–108.—See *I.S.J.*, 1967, **69**, 57.

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Determination of moisture in massecuite sugars. Y. OZAWA, C. TSUTSUMI and T. NAGAHARA. *Rpt. Food Research Inst.* (Tokyo), 1964, (18), 111–114; through *S.I.A.*, 1966, **28**, Abs. 363.—Three vacuum oven methods were compared for the determination of moisture: direct drying of a 2-g sample on an aluminium dish, drying the sample mixed with 25 g of sand, and a plastic film method[1]. The direct method and the plastic film method gave nearly identical results at 70°C or 100°C under 25 mm Hg pressure. Replicable results were obtained after 5 hr at 70°C; results after 30 hr were 0·2–0·35% higher in moisture content than at 5 hr. Drying for 10 hr at 70°C by the plastic film method, followed by 5 hr at 100°C, gave results similar to those after 30 hr at 70°C: in this cases the direct method gave slightly low results. The sand method gave very low results after 5 hr at 70°C, comparable results after 30 hr at 70°C, and excessively high results after 10 hr at 70°C followed by 5 hr at 100°C. The direct and plastic film methods are therefore preferred to the sand method.

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Investigation of the nephelometric and turbidimetric behaviour of solutions of pectic substances. G. B. AIMUKHAMEDOVA and N. P. SHELUKHINA. *Trudy Soveshch. Fiz. Metod. Issled. Org. Soed. i Khim. Protsess.* (Frunze), 1962 (1964), 254–262; through *S.I.A.*, 1966, **28**, Abs. 374.—The pectin content of beet diffusion juice may be determined as follows: 50 ml of filtered juice and 5 ml of acetate buffer at pH 4·7–4·8 are boiled for 10 min to precipitate proteins. The solution is filtered, and pectins are precipitated by adding ethanol to 70% final concentration to two 2-ml portions of the filtrate. The pectins are centrifuged down, decolorized and re-dissolved by adding ~ 1 ml of 0·3M $NaClO_2$ and ~ 0·2 ml of 0·2M acetic acid, re-precipitated in 70% ethanol and re-centrifuged. The pectins are finally washed with 96% ethanol and with ether to remove saponins and lipids respectively. The pectins are determined by suspending in water at a concentration of 0·1–0·5% dry solids, and measuring either light scattering or absorption in a nephelometer or turbidimeter (absorptiometer) respectively. Light scattering and absorption were both linearly proportional to concentration. A calibration curve was constructed by means of air-dry specimens of beet juice pectins: the readings varied by ~ ± 10% according to pectin composition. The results of determinations agreed with those of the calcium pectate method with a relative error of ~ ± 10%.

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Influence of the invert alkaline degradation reaction on the viscosity of sugar solutions and on molasses formation. V. P. PALASH. *Izv. Vysshikh Ucheb. Zaved. Pishch. Tekhnol.*, 1965, (6), 21–23; through *S.I.A.*, 1966, **28**, Abs. 382.—Nearly saturated sucrose solutions were prepared containing 1 part of vacuum-dried invert sugar added to 9 parts of sucrose. The solutions were boiled with added NaOH or $Ca(OH)_2$ for 1–7 hr. The viscosity of the solutions increased markedly with time of boiling. The Ca-treated solutions were ~ 30% more viscous than the Na-treated solutions, the difference appearing in the first hr of boiling. Tests with refinery molasses showed that the addition of invert sugar increased both the viscosity and dynamic saturation coefficient of the molasses.

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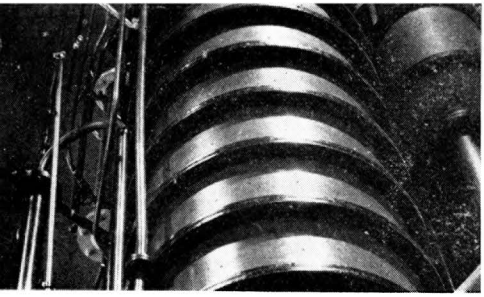
New results in the field of microbiology in beet sugar manufacture. H. KLAUSHOFER. *Zucker*, 1966, **19**, 366–371.—The significance of micro-organisms in beet factories is discussed and work carried out during the past 10 years in Austria on bacteriological control is reported. The need for a rapid method of determining bacterial counts is discussed and two methods are described: the so-called "small plate" method[2] and a fluorescence-serological technique. The discovery of *Clostridium hydrosulfuricum* in beet factory products[3] is mentioned and the sucrose-decomposing capacity of various aerobic and anaerobic thermophiles is discussed. These capacities were determined by static and continuous culture on various substrates and are expressed as "specific sucrose loss", which is defined as the quantity of sucrose (mg) decomposed by 10^9 bacterial per ml/hr. It was found that *Bacillus stearothermophilus* in raw juice caused 10-100 times as much sucrose destruction as did *Cl. hydrosulfuricum*. A knowledge of the bacterial count and sucrose-decomposing capacity of the bacteria is prerequisite for economical application of disinfectants.

[1] TSUTSUMI & NAGAHARA: *Nosan Kako Gijutsa Kenkyu Kaishi*, 1960, **7**, (2), 76.
[2] BARTELMUS & PERSCHAK: *I.S.J.*, 1958, **60**, 112.
[3] *I.S.J.*, 1966, **68**, 60, 152.



By-products

Protein recovery from cane juice and syrup. R. DE FROBERVILLE. *Ann. Rpt. Mauritius Sugar Ind. Research Inst.*, 1965, 135–136.—Tests were carried out on the recovery of protein from syrup. Juice was screened, heated to 90°C and neutralized with 15% NaOH solution. After evaporation, the syrup was fed to a Westfalia SAOH 205 separator provided with an automatic de-sludging device. A Westfalia SKOG 205 nozzle separator was also tried in series with the other separator. The effect of variation in Brix and de-sludging intervals was investigated as well as the protein recovery. In no case was it possible to clarify the syrup sufficiently, more than 90% of the protein remaining in the syrup after centrifuging. Moreover, the syrups retained a high proportion of microscopic solid impurities.

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Project study on bagasse pulp and paper. J. C. ESPINOSA, A. R. APACIBLE and G. J. PISON. *Sugar News* (Philippines), 1966, **42**, 192–200.—Data are tabulated showing the bagasse produced in each Philippine sugar factory, the level of paper and cardboard consumption and number of paper mills in various developing countries including the Philippines, and comparison of fibre shapes and cellulose contents of various fibrous raw materials including bagasse. These statistics are used to support the argument for establishment of a bagasse pulp and paper industry in the Visayas (Philippines).

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Pressure-vacuum method of ammoniation of fodder ingredients. S. ZAGRODZKI and K. SZWAJCOWSKA. *Przeglad Zbozowo-Mlynarksi*, 1965, **9**, 18–19; through *S.I.A.*, 1966, **28**, Abs. 353.—Dried beet pulp (88·8% dry solids) is placed in a vessel which is evacuated and then filled with ammonia under pressure. The N content is thereby increased from ~1·2% to ~ 4·5–6% by formation of a stable complex, so that the fodder value of the pulp is greatly increased.

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Utilization of by-products—bagasse. V. D. JHUNJHUNWALA. *Indian Sugar*, 1966, **16**, 95–97.—In this discussion of bagasse utilization for paper and board manufacture, emphasis is laid on the need for suitable incentives in the form of a cut in the excise duty on paper and board made from bagasse, and rail freight concessions for bagasse intended for this purpose. Research on the use of greater proportions of bagasse in paper and strawboard is also called for. A study group has suggested the use of bamboo for long-fibre pulp production (bagasse gives a short-fibre pulp) for high-quality paper manufacture. The establishment of bamboo and eucalyptus plantations near sugar factories is also proposed.

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New prospects in animal feed: sucroglycerides. J. PASSEDOUET, R. ANTOINE and B. LOISEAU. *Ind. Alim. Agric.*, 1966, **83**, 715–724.—Physiological and nutritional tests are reported in which a sucrose glyceride[1] has been added to calf starting feeds. The tabulated results show the positive effects of sucroglycerides on fat assimilation, and hence on weight gain, and on carcase quality and health on the calves during the first weeks of feeding. The preparation of calf starting feeds incorporating sucroglycerides is also discussed.

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The production of biogas and biofertilizer from the by-products of sugar cane processing. I. BARTHA. *Sharkara*, 1965, **7**, 70–76.—Preliminary experiments with wet and semi-wet processing of bagasse and cane trash in units of Hungarian design have demonstrated the feasibility of producing biogas and biofertilizer. The biogas contains 60–65% methane, 30–35% CO_2 and some hydrogen and possibly oxygen. Sulphur is present in trace amounts. The average calorific value is 5,200 kcal/cu.m., i.e. some 33⅓% greater than that of town gas. Biofertilizer may be natural or artificial, and incorporates the end-products from the decomposition process to which plant nutrients are added. The material used in the semi-wet process contains a large amount of dry matter, while in the wet process the dry solids content is only 8–10%. The semi-wet process can be used for batch or continuous fermentation, while the wet process is applicable only for continuous digestion. The amount of gas obtainable from bagasse, distillery wash water and distillery sludge has been found to have a calorific value equivalent to that of the air-dried bagasse when used as fuel in the distillery. The question of replacement of bagasse as fuel by biogas for factory power production is discussed in relation to both sugar factories and open pan systems for gur and khandsari manufacture. The estimated investment and operation costs of the wet process are given. Of the gas produced, 80–90% has proved to have good burning properties, while the manures produced were found to be better than the best Indian farmyard manures.

[1] *See* PASSEDOUET: *I.S.J.*, 1965, **67**, 123.

Patents

UNITED STATES

Method of producing sugar. F. G. LIPPE and E. P. G. HARSANYI, assrs. DETON A.G., of Vaduz, Liechtenstein. **3,215,559.** 15th November 1962; 2nd November 1965.—Sap-bearing raw materials, e.g. grated or sliced sugar bearing plants, including beet and cane, are subjected without prior heating, to a high-pressure gas (air) at room temperature (sterilizing by admission of nitric oxide-free ozone), and then the pressure suddenly released, thereby exploding and completely disintegrating the cellular structure of the materials to a pulp. The sugar content of the pulp is washed out by counter-current treatment with cold water in several stages, simultaneously concentrating the solution to produce a raw sugar syrup. This is purified (by aluminium sulphate, and/or electrophoresis, or by nitric oxide-free ozone) and concentrated at temperatures below freezing until the sugar crystals are continuously precipitated. These are separated by centrifuging and washed with alcohol until pure enough for marketing. The mother-liquor is treated with an ion exchanger to free it of mineral salts.

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Preparation of bagasse fibres (for pulp, board, etc.). R. KATZEN, of Cincinati, Ohio, U.S.A. **3,216,886.** 4th February 1964; 9th November 1965.—Bagasse (stored in the presence of enzymatic or pulping agents to destroy residual sugars) is moistened with water to about 20–60% (30–50%) water by weight, no pulping chemicals being added. The swollen and softened bagasse is milled (at 120–210°F) using a rotating-disc attrition mill having discs spaced at about 0·010–0·200 inches apart, partly separating the pith and fibre. The (pith is removed and the) once-milled bagasse is treated (at 120°–210°F) in a second mill having discs spaced 0·001–0·020 inches apart, this separating substantially all the pith and fibre contents. Fine fibres are recovered from the separated pith fractions.

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Roll screen for cleaning beets. J. W. SILVER and J. M. SILVER, assrs. OGDEN IRON WORKS CO., of Ogden, Utah, U.S.A. **3,217,346.** 15th July 1964; 16th November 1965.

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Method of producing sugar. F. G. LIPPE and J. O. ROEDER, assrs. DETON A.G., of Vaduz, Liechtenstein. **3,218,188.** 28th January 1964; 16th November 1965. Sugar-containing vegetable material is comminuted so as to form a mass of particles containing unbroken cells. The mass is subjected (at ambient temperature, and in a tubular conduit) to a series of liquid sparks so as to subject it to series of ultrasonic pressure increases reaching a pre-determined super-atmospheric pressure (>150 atm), and thereafter suddenly releasing this pressure, whereby the sugar-containing cells are burst and the mass can be separated into sugar-containing liquid and solid constituents. The liquid can then be (ozonized and) processed to recover its sugar content (by freeze-crystallization) without raising its temperature above ambient (a second freeze-crystallization following deionization of the mother liquor separated from the first crop of crystals).

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Glutamine production by fermentation. S. KINOSHITA, T. TANAKA, K. OSHIMA and K. KIMURA, assrs. KYOWA HAKKO KOGYO CO. LTD., of Tokyo, Japan. **3,216,906.** 3rd August 1962; 9th November 1965. See U.K.P. 981,132[1].

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Purification of sugars and their derivatives. B. M. SMYTHE and C. J. MOYE, assrs. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,219,484.** 2nd August 1962; 23rd November 1965. Solid sugars (sucrose, glucose or fructose) or sugar derivatives (sucrose mono-palmitate, sucrose distearate) are purified (e.g. from the impurities present in raw sugar) by dissolving at 100°–200°C (100°C, 124°C) in an anhydrous high-boiling alcohol, viz. a glycol monoalkyl ether, ethylene glycol monoalkyl (monomethyl) ether, ethylene glycol monoester, diethylene glycol monoalkyl (monomethyl) ether, diethylene glycol monoester, furfuryl alcohol, tetrahydrofurfuryl alcohol or 2-hydroxymethyl tetrahydropyran. Undissolved solids are separated and the hot solution cooled (to 0°C, 30°C) to effect crystallization.

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Saccharide polydicarboxylate half-esters. V. R. GAERTNER, of Dayton, Ohio, U.S.A., assr. MONSANTO COMPANY. **3,219,657.** 27th February 1961; 23rd November 1965.—The half-esters, suitable as anti-rust constituents of gasoline, are poly-O-(β-carboxyacyl) sugars in which the sugar (sucrose, or a mixture of sucrose and glucose) contains no more than two monosaccharide units and there is at least one (2–4) O-(β-carboxyacyl group) for each monosaccharide unit and the carboxyacyl group contains

[1] *I.S.J.*, 1966, **68**, 125.

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).

10–24 carbon atoms. The carboxyacyl group may be the carboxylic acid salt of a primary alkyl amine or a free carboxylic acid group (alkenyl succinic acid). The ester is made by reacting the sugar (sucrose and glucose) with a substantial excess on the molar basis, of an α,β-dicarboxylic anhydride containing 10–24 carbon atoms, by heating the sugars to a fluid mixture and adding the anhydride and a tertiary amine catalyst (triethylene diamine) with good mixing and heating for a sufficient time.

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Hydroxyalkyl sugar phosphites. L. FRIEDMAN, of Beachwood Village, Ohio, U.S.A., assr. UNION CARBIDE CORP. **3,219,658.** 7th September 1962; 23rd November 1965.—The phosphites, which can be used in the preparation of fire-resistant polyurethanes, are phosphites or phosphonates of hydroxy lower alkyl sugar, hydroxy lower alkoxy lower alkyl sugar, hydroxy poly-lower alkoxy lower alkyl sugar (in all of which the sugar may be a glycoside), or hydroxy phenyl ethyl sugar.

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Automatic sequential control system and method for sugar pan operation. W. C. HOWARD, of Decatur, Ga., U.S.A., assr. BAILEY METER CO. **3,220,883.** 1st October 1962; 30th November 1965.—The automatic sequential control system comprises, in combination, a push-button for energizing the system, means responsive to the button to activate the control elements, an absolute pressure programmer for programming atmospheric conditions in the pan, a syrup charge valve for admitting syrup to the pan once its atmosphere reaches a pre-selected value, a tonnage transmitter to control the syrup charge, a means of controlling the rate of evaporation of the charge, a boiling point elevation transmitter for determining the saturation level of the charge, a seed hopper and control valve for seeding the charge at a preselected saturation point, means for timing the seed addition, means for determining the completion of crystal growth, means for deactivating all control elements, a dumping valve for transferring the massecuite, spray nozzles and a control valve for washing out residual crystals from the pan, and suitable interlocks to allow subsequent operation only after completion of the prior one.

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Polyester polyol sucrose rigid foams. M. WISMER, L. R. LE BRAS and J. F. FOOTE, assrs. PITTSBURGH PLATE GLASS CO., of Pittsburgh, Pa., U.S.A. **3,222,357.** 26th February 1962; 7th December 1965. *See* U.K.P. 957,947.[1]

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Cyanoethylated hydroxyalkyl sucrose and its preparation. G. P. TOUEY and H. E. DAVIS, assrs. EASTMAN KODAK CO., of Rochester, N.Y., U.S.A. **3,222,358.** 6th December 1962; 7th December 1965. The derivatives, having properties making them suitable as plasticizers or for electrical insulation, include cyanoethylhydroxy (lower) alkyl sucrose (cyanoethylhydroxyethylsucrose and cyanoethylhydroxypropylsucrose) in which 3–8 of the sucrose hydroxyls have been replaced by the hydroxyalkyl groups and substantially all the hydroxy groups of these have been cyanoethylated. They are made, e.g., by dissolving sucrose in dimethylformamide, adding ethylene oxide and tetramethylammonium hydroxide, stirring for 24 hours at room temperature, removing the excess oxide, catalyst and solvent, and cyanoethylating with an excess of acrylonitrile. The product is dissolved in methylene chloride, washed with distilled water and recovered by distillation of the solvent.

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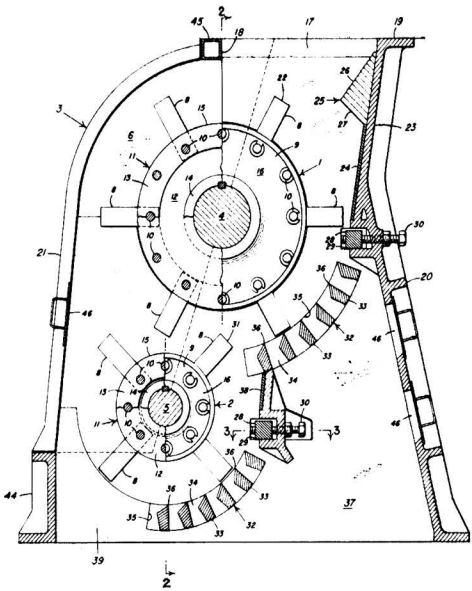
Cane shredder. R. E. BEITER, assr. HONOLULU IRON WORKS CO., of Honolulu, Hawaii, U.S.A. **3,224,688.** 22nd January 1962; 21st December 1965.

The shredder comprises a pair of beaters 1 and 2, rotating about parallel axes in a casing 3, their shafts 4 and 5 projecting through the walls and mounted in suitable bearings. The hammers 8 on the beaters are so arranged that those on beater 1 are aligned within the spaces between those of beate.· 2, providing a degree of overlap between the beaters. The blades are held by connecting rods 10 extending between the end discs 9 on the beaters, the spacing being maintained by washers.



Cane entering the housing through the feed inlet 17 is deflected by block 25 towards the beater 1 and carried downwards towards the upper anvil bar 28, and then to the outer bars 33 forming the upper anvil screen 32. Disintegrated cane will fall through into the bottom part 37 of the casing while that retained in the spaces between the hammers of beater 1 will be cleaned out by the hammers of beater 2 and carried to the lower anvil bar 28 and cutter bars 33 of the lower anvil screen 32, through which it also passes to the part 37 of the casing.

[1] *I.S.J.*, 1966, **68**, 122.

Commission International Technique de Sucrerie

13th CONGRESS, 1967

AS reported earlier[1], the 13th Congress of the C.I.T.S. will be held in Falsterbo, Sweden, during the 5th–9th June 1967. Technologists intending to participate are requested to write to Dr. J. HENRY, Secretary-General of the C.I.T.S., at 1 Aendorenstraat, Tienen, Belgium, advising him whether they wish him to reserve a single or double room, with or without bath.

As soon as the definitive programme has been completed, and the prices of the various rooms are known, these will be made known to the registered participants. There will also be sent in May the texts of communications which have been provided up to that time, while late texts will be distributed at Falsterbo.

A preliminary list of papers appears below; a number of other papers are expected to be presented. The papers are in two sections: the first is concerned with crystallization and the second with other topics.

Crystallization

P. M. SILIN and I. N. KAGANOV (U.S.S.R.): La vitesse de la croissance des cristaux de sucre.

A. VANHOOK (U.S.A.): Theories of sugar crystallization.

M. C. BENNETT and Y. FENTIMAN (U.K.): Superheating effects on sucrose crystallization under ebullition conditions.

P. DEVILLERS (France): Mesure de la vitesse linéaire de crystallisation. Influence de divers parametres.

S. HILL and W. J. M. ORCHARD (U.K.): Theory of continuous crystallization.

S. HILL (U.K.): Continuous crystallization with crystal size classification.

R. PIECK, J. HOUSSIAU and R. VANDEWYER (Belgium): Quelques données sur la variation de la solubilité de saccharose et d'autres propriétés physiques en presence de non-sucres sous forme K^+, Ca^{++} ou Mg^{++}.

H. E. C. POWERS (U.K.): Surface mechanisms of crystal growth and dissolution.

V. PREY (Austria): Der reaktionsfähige Stickstoff der Rübe und sein Einfluss auf die Kristallisation der Saccharose.

M. L. A. VERHAART†, P. N. VAN DER POEL and N. H. M. DE VISSER (Holland): The partition of non-sugars between sucrose crystals and the surrounding liquor.

F. SCHNEIDER, A. EMMERICH, E. REINEFELD and D. SCHLIEPHAKE (Germany): Einfluss von Nichtzuckerstoffen auf den Mechanismus der Saccharose-Kristallisation.

J. VAŠÁTKO and A. SMELÍK (Czechoslovakia): Kristallisation der Saccharose, D-Glukose and D-Fruktose aus übersättigten Lösungen de Metastabilgebietes.

S. ZAGRODZKI and H. ZAORSKA (Poland): Adsorption von Farbstoffen durch die Saccharose in Zuckerprodukten.

S. ZAGRODZKI and H. ZAORSKA (Poland): Geschwindigkeitsänderungen der Saccharosekristallisation in Abhängigkeit von der Menge der Farbstoffe in der Lösung.

Miscellaneous

G. ASSALINI (Italy): Application à l'industrie du sucre d'un appareil continu échangeur d'ions.

J. HENRY, R. VANDEWYER and R. PIECK (Belgium): Quelques essais en vue de comparer la qualité de betteraves effeuillées, scalpés ou décolletées.

A. LEMAITRE (France): Etude de laboratoire sur la corrosion des tubes d'evaporation; influence du pH, de l'aeration et de certains sels.

R. MADSEN (Denmark): Use of thickening filters for first carbonatation by the Danish Sugar Corporation.

F. SCHNEIDER, A. EMMERICH, H. P. HOFFMANN-WALBECK, E. REINEFELD and D. SCHLIEPHAKE (Germany): (1) Zur Viskosität hochkonzentrierter Zuckersirupe. (2) Isolierung von Farbstofffraktionen aus Rübenmelasse. (3) Uber Farbstoffadsorption an Entfärbungsharzen. (4) Entwicklung von Mikroorganismen in Rübensäften, Schwemm- und Waschwasser bei niedrigen Temperaturen.

K. VUKOV (Hungary): (1) Der Gehalt an reduzierenden Substanzen als Mass der Saftqualität. (2) Uber die Kristallisation des Kalziumkarbonats bei der II Saturation.

T. YAMANE, K. SUZUKI and Y. TAKAMIZAWA (Japan): The effects of molecular sizes of colorants in cane raw sugars and refinery liquors on their behaviour in the sugar refining process.

J. F. T. OLDFIELD and collaborators (U.K.) Surface-active constituents in beet sugar production.

Greece sugar production 1966[2].—The three sugar factories in Greece have ended their 1966 campaign with a record sugar production. The Hellenic Sugar Industry announced that 628,000 metric tons of sugar beets were processed, from which 105,295 metric tons of white sugar were produced, including 32,725 tons from Larissa factory, 39,520 tons from Platy and 33,050 tons from Serrae. In addition, the factories produced 37,700 tons of molasses and 27,000 tons of pulp. Sugar consumption for 1966/67 in Greece is estimated at some 140,000 metric tons so that only about 35,000 tons will have to be imported.

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Chile sugar production 1965/66[3].—In the 1965/66 campaign, a total of 3616 beet growers produced 767,613 tons of beet from 21,041·7 hectares and this was used to manufacture 109,216·81 tons of sugar and 21,965·9 tons of molasses.

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Hungarian sugar factory expansion.—Szerencs white sugar factory in Hungary is to be modernized at a cost of £3,000,000 and its annual production trebled to reach 15,000 tons of sugar, chocolate and confectionery. The factory has a present daily beet slicing capacity of 2500 tons.

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New sugar factory for Venezuela[4].—A new sugar factory, to be named Pedritas Blancas, is to be built in Arcarigua, in Venezuela. The factory is to start operation in 1969 and will reach its full capacity in 1970. Construction costs are estimated at some 60 million Bolivares (£5,000,000).

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[1] *I.S.J.*, 1966, **68**, 160.
[2] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (35), 12.
[3] *Zeitsch. Zuckerind.*, 1966, **91**, 714.
[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (1), 18.

The late Dr. William E. Cross

WE very much regret to record the death on 6th January 1967 at his home in Punta del Este, Uruguay, of Dr. WILLIAM E. CROSS, following a short illness. He was 79 years old.

Dr. CROSS was born in Leeds, Yorkshire, and attended the University there from 1904 to 1908, acquiring a first-class honours degree in Science. He then studied under Prof. TOLLENS at Göttingen University in Germany from 1908 to 1910 where he gained his Ph.D. He was recommended for the vacancy of Research Chemist at Audubon Park Experimental Station in New Orleans, which post he held until 1914, when he was appointed Research Chemist to the Agricultural Experiment Station in Tucumán, Argentina. Two years later he became Director of the Station, which post he occupied with distinction for over thirty years.

During Dr. CROSS' leadership of the Tucumán station, he carried out an immense amount of important work on most aspects of sugar production, but especially in the introduction of new cane varieties. He did much in the way of improving methods of planting, cultivating and harvesting, as well as carrying out fertilizer experiments throughout the whole of his tenure of office. Not only in the field was he active, however, since at various times he examined conditions prevailing in the factory and the distillery, carrying out notable investigations into clarification and pan boiling. He was a formidable proponent of proper chemical control and was also concerned with the introduction of projects for the utilization of by-products from the industry, particularly the use of molasses in cattle feed and fermentation to alcohol.

He retired in 1947, but in 1959 was engaged by the Provincial Government of Tucumán to draw up plans for the rehabilitation of the Experiment Station, which had deteriorated since he had left it twelve years before.

His contributions to the literature are far too numerous to list; suffice it to say that he was a prolific writer whose ideas and suggestions were the product of a sound Yorkshire commonsense, sometimes unorthodox but always practical. He continued active, until shortly before his death, in the work he had begun in 1947 as a Consultant and Technical Adviser to various sugar companies in Argentina and Uruguay.

He was a kindly and gifted man, who will be sadly missed by his many friends throughout the sugar world, not least in the industry of his adopted country.

Brevities

Sugar factory for Senegal[1].—A new sugar factory with an annual production capacity of 40,000 metric tons is to be constructed in the north of Senegal[2]. Estimates of the cost vary between 1800 and 2500m. francs and private capital is still being sought for the company, in which the State will probably participate.

* * *

Brazil sugar production target for 1967/68[3].—The Brazilian Institute for Sugar and Alcohol is reported to have announced that production for 1967/68 will not exceed the current season's output, the latest figure for which stands at 3,742,000 tons, *tel quel*. Allowing for some increase in domestic requirements this might permit stocks to be reduced after meeting existing commitments in the U.S. and world markets.

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Guyana sugar production, 1966[4].—Final production for 1966 in Guyana was 288,869 tons or 15% below the Sugar Manufacturers' Association's original estimate of 340,000 tons. The shortfall is attributed to unfavourable weather and an unprecedented number of strikes. The growing cane which will be reaped this year experienced fine weather during the later part of 1966 and a record output of 355,000 tons is expected in 1967.

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Bulgarian sugar expansion plans[5].—During the third Five-Year Plan, Bulgaria intends to raise sugar production from 171,000 to 315,000 tons, while per caput consumption is to be increased from 21·7 to 38·5 kilos.

Algerian sugar factory/refinery plans[6].—The Algerian Office of Industrialization plans the construction of a new sugar factory in the Guelma-Annaba region of Eastern Algeria. Annexed to this factory will be a refinery for the processing of imported raw sugar.

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Bulk sugar store in Cuba[7].—At the Héctor Molina sugar factory in the Mayabeque region of Havana Province, a bulk sugar warehouse is under construction. It will have a capacity of about 100,000 tons and is part of a series of improvements at the mill, including new turbogenerators and boiler plant.

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Slag fertilizer test in Hawaii[8].—A test planting at Kilauea Sugar Plantation in Hawaii yielded 127·2 tons of cane per acre compared with 105·6 tons as the average of control plots. The variety used was H 53-263 and the test involved the application of 3 tons/acre of a 60-mesh TVA calcium silicate slag. A similar slag is now being made in Hawaii by fusing local limestone with silica sand imported from Vietnam, and it is expected that its use will be increased.

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[1] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (1), 18.
[2] *See also I.S.J.*, 1966, **68**, 32.
[3] C. Czarnikow Ltd., *Sugar Review*, 1967, (797), 17.
[4] *Public Ledger*, 14th January 1967.
[5] *Zeitsch. Zuckerind.*, 1966, **21**, 660.
[6] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (31), 17.
[7] *Cuba Economic News*, 1966, **2**, (17), 15.
[8] *Sugar y Azúcar*, 1966, **61**, (12), 38.

Brevities

St. Kitts sugar production 1966.—The 1966 crop ended with an outturn of 37,926 tons of commercial sugar, equivalent to 38,730 tons of 96° sugar. This was produced from 348,335 tons of cane and compares with 38,921 tons 96° sugar made from 342,171 tons of cane crushed in 1965. Of the 34,343 tons available for export, the negotiated price quota of 33,959 tons was sold to the U.K. Sugar Board. While the three-year wage agreement signed for 1966–68 indicates satisfactory labour relations during the next crop, the drought which reduced the cane tonnage in 1966 has continued and the current forecast for the 1967 crop is not optimistic. An experimental plant on a semi-commercial scale will be functioning during part of the 1967 crop period in conjunction with the sugar factory, carrying out research on sugar cane by-products. The plant will incorporate new features in the processing of cane and provision of by-products and it is hoped that further tests, to be carried out on a factory scale, will in due ourse provide additional revenue to the sugar industry.

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Iran-Czechoslovakia trade agreement[1].—Under the terms of a three-year trade agreement signed recently by the governments of the two countries Iran will import sugar from Czechoslovakia to the value of U.S. $1,200,000 in the first year and $1,700,000 in each of the second and third years. In addition, Iran will also import sugar factory machinery and equipment.

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Japanese sugar factory for Pakistan[2].—Mitsubishi Heavy Industries Ltd. has received an order for a sugar factory of 2000 tons cane per day crushing capacity, to be built at Tando Allhyar in Hyderabad. The construction is to be financed from a loan of 1100 million yen ($3,000,000) by Japan to Pakistan. The Mitsubishi Company has previously received orders from Pakistan, two in 1964 for factories in East Pakistan, of 1500 tons capacity each, and one in 1965 for a 2000 t.c.d. sugar factory for West Pakistan.

* * *

Spanish-Colombian sugar refinery proposal.—It is reported that a proposal has been made for establishment of a sugar refinery in Spain with the aid of both Spanish and Colombian capital[3]. Negotiations are already being conducted between Spanish representatives and a group of independent sugar producers from the Cauca valley in Colombia who have stated that they are in a position to export 50,000 tons of raw sugar annually to the proposed refinery, the cost of which has been put at U.S. $2,500,000.

* * *

Bolivian sugar crop, 1966[4].—Operations on the 1966 crop in Bolivia ceased recently, with final output reaching a total of 80,875 metric tons of sugar, white value. This compares with production figures of 85,982 tons and 93,641 tons from the 1965 and 1964 campaigns, respectively. Following the record 1964 crop, production quotas were instituted in Bolivia; the quota for 1966 was set at 83,159 tons, of which approximately 97% was realized. A cane to sugar ratio of 10·46:1 was achieved in 1966 as against 10·35:1 in 1965.

* * *

Italian sugar beet area[5].—The Chairman of the Associazione Nazionale Bieticoltori, the Italian Sugar Beet Growers' Association, has recently announced that a considerable increase in sugar beet area is to be expected in 1967 since, following floods in northern areas of the country, substantial areas could not be sown to wheat and have instead been sown to beet. The beet area is consequently expected to be increased by about 15% and sugar production to expand to 1,360,000 metric tons.

U.S. Sugar Supply Quota 1966

AREA	*Deficit or Proration*	*Revised quota*
	(short tons, raw value)	
Domestic beet	—	3,025,000
Mainland Cane	—	1,100,000
Hawaii	—	1,200,227
Puerto Rico	— 19,000	711,000
Virgin Islands	— 4,595	5,405
Philippines	—	1,202,978
Argentina	+ 555	58,820
Australia	+ 659	187,786
Bolivia	— 958	4,681
Brazil	+ 4,511	478,143
British Honduras	+ 121	12,884
British West Indies	+ 1,669	176,886
Colombia	+ 477	50,597
Costa Rica	+ 675	71,527
Dominican Republic	+ 5,689	602,931
Ecuador	+ 656	69,570
Fiji	+ 145	41,209
French West Indies	+ 525	55,644
Guatemala	+ 569	60,277
Haiti	+ 251	26,564
India	— 1,447	73,403
Ireland	—	5,351
Malagasy	+ 31	8,867
Mauritius	+ 60	17,213
Mexico	+ 4,613	488,896
Nicaragua	—	19,000
Panama	—	13,000
Peru	+ 3,598	381,375
Salvador	+ 417	44,204
South Africa	+ 194	55,292
Swaziland	+ 24	6,781
Taiwan	+ 274	78,243
Thailand	+ 60	17,213
Venezuela	+ 227	24,033
TOTAL	—	10,375,000

Puerto Rico mill closure[6].—C. Brewer & Co.'s subsidiary in Puerto Rico is to close its Santa Juana mill after the 1967 harvest, owing to a shortage of cane supply. In 1966, although the mill capacity is 380,000 tons, it received only 202,000 tons for milling and this included 85,000 tons diverted from the nearby Juncos mill, also Brewer-owned.

* * *

New sugar factories for Rumania[7].—Construction of a new sugar factory has started in Corabia, Rumania. The factory, which is to be put in operation in 1968, will have a processing capacity of 3000 tons of beet per day. A second factory, also of 3000 tons/day capacity, is under construction near Ploesti[8], and a third is being built at Oradea[9].

* * *

Mexican sugar crop 1965/66,[10].—The 1965/66 sugar crop in Mexico produced 2,011,390 metric tons, tel quel, of sugar, including 1,039,765 tons of refined, 496,976 tons of plantation whites and 474,649 tons of raw sugar. The number of mills in operation was 71, as opposed to 73 in 1964/65, when 1,982,969 tons, tel quel, were produced. The cane crop in 1966 amounted to 23,132,076 tons, grown on 383,458 hectares, compared with 22,430,983 tons grown on 369,412 ha in 1965. Estimated sugar production for the 1966/67 crop is 2,222,000 metric tons.

[1] C. Czarnikow Ltd., *Sugar Review*, 1967, (797), 18.
[2] *Agence France-Presse*, 15th October 1966.
[3] C. Czarnikow Ltd., *Sugar Review*, 1966, (792), 231.
[4] C. Czarnikow Ltd., *Sugar Review*, 1966, (793), 234.
[5] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (35), 11.
[6] *Sugar y Azúcar*, 1966, **61**, (12), 39.
[7] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (34), 16.
[8] C. Czarnikow Ltd., *Sugar Review*, 1966, (794), 238.
[9] *I.S.J.*, 1966, **68**, 352.
[10] *Sugar y Azúcar*, 1966, **61**, (12), 40.