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On donne des détails de méthodes polarographiques employées dans la détermination de plomb dans le sucre blanc, le sucre brun, mou, le sirop d'affination et la mélasse (on pouvait déterminer aussi peu que 0,2 p.p.m. de plomb ajouté dans 10 g d'échantillon original) et de cuivre dans le sucre brun, mou, le sirop d'affination et la mélasse de canne. Le contenu minimum de Cu ajouté, duquel presque tout fut récupéré, était 2,5 p.p.m. dans 10 g d'échantillon original.

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La raffination de sucre—Remarques sur des procédés individuels. 3-ème partie. La filtration des écumes. F. M. CHAPMAN. p. 293–296

On discute le sujet sous les rubriques suivantes: la qualité des écumes, l'amélioration de la filtrabilité des écumes, les facteurs ayant d'influence sur la filtration et le lavage des tourteaux, la récupération du sucre dans le torteau, l'effet de la sécheresse du tourteau et du Brix de l'écume. Les types de filtres d'écumes, les filtre-presses à cadres et à plateaux, les alternatives à des filtre-presses à cadres et à plateaux pour la boue de carbonatation, les filtre-presses Sweetland, la capacité calculée d'un filtre-presse Sweetland à fond peu profond, et l'evacuation des écumes lavées par le mélange avec des cendres.

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La détermination polarimétrique directe de la saccharose dans la présence de glucose et de fructose par l'addition de borate de soude. J. LÓPEZ HERNÁNDEZ. p. 296–297

C'est une lettre concernant des essais effectués par J. FERNÁNDEZ BERTRÁN et autres (*I.S.J.*, 1967, **69**, 107–111). On discute trois questions dans l'article au sujet de l'efficacité de la méthode.

* * *

Etudes sur la valeur pH dans la production du sucre. 1-ère partie. L'effet de la température sur la valeur pH. D. P. KULKARNI, M. K. PATIL et K. C. VORA. p. 297–301

On donne des détails d'essais sur le rapport entre le pH et la température de jus et de produits de sucrerie dans la production du sucre blanc et brut. Les résultats démontrent comment le pH se réduit quand les produits sont chauffés. Les données sont disposées en tables.

Polarographische Bestimmung von Blei und Kupfer in Raffinerie-Produkten. R. W. PLEWS. S. 291–293

Es wird beschrieben polarographische Methoden, die zur Bestimmung von Blei in Weisszucker, in weichem Braunzucker, in Affinationssirup und Melasse (so wenig wie 0,2 Millionstel von hinzugefügtem Blei war in 10 g der Anfangsprobe bestimmbar) wie auch von Kupfer in weichem Braunzucker, in Affinationssirup und in Rohrmelasse angewandt wurden. Die kleinste Menge von hinzugefügtem Kupfer, von welchem beinahe 100% rückgewonnen wurde, war 2,5 Millionstel in 10 g von Anfangsprobe.

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Zuckerraffination—Anmerkungen über Einzelverfahren. Teil III. Schlammfiltration. F. M. CHAPMAN. S. 293–296

Das Thema wird unter einigen Rubriken besprochen. Diese sind: die Schlammqualität; die Verbesserung von Schlammfiltrierbarkeit; die Parameter, welche auf die Filtration und die Waschung von Filterkuchen einwirken; das Absüssen von Filterkuchen; die Einwirkung von Kuchentrockenheit und Schlammtrockensubstanz; die Schlammfilterarte; die Kammer- und Rahmenpressen; die anderen Möglichkeiten für Scheideschlammverarbeitung, anders als mit den Kammer- und Rahmenpressen; die Pressen Art Sweetland; die berechnete Verarbeitungsfähigkeit eines flachbodigen Filters Sweetland; und die Beseitigung von Schlamm durch die Mischung mit Aschen.

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Die direkte polarimetrische Bestimmung von Saccharose in der Gegenwart von Glukose und Fruktose durch die Hinzufügung von Borax. J. LÓPEZ HERNÁNDEZ. S. 296–297

Dies ist ein Brief betreffs einiger von J. FERNÁNDEZ BARTRÁN und Mitarbeitern durchgeführten Versuche (*I.S.J.*, 1967, **69**, 107–111). Drei Punkte, von den Verfassern bezüglich der Wirksamkeit der Methode gemacht, werden besprochen.

* * *

Studien der pH-Werte in der Zuckererzeugung. Teil I. Die Einwirkung der Temperatur auf die pH-Werte. D. P. KULKARNI, M. K. PATIL und K. C. VORA. S. 297–301

Man beschreibt Versuche an der Beziehung zwischem pH-Wert und der Temperatur von Säften und Zuckerfabrikprodukten bei der Roh- und Weisszuckererzeugung. Die Ergebnisse haben gezeigt, dass der pH-Wert vermindert sich wenn die Produkte gewärmt werden. Die Daten werden in Tabellen dargestellt.

Determinación polarográfica de plomo y cobre en los productos de la refinería. R. W. PLEWS. Pág. 291–293

Se presentan detalles de métodos polarográficos para determinar plomo en azúcar blanco y azúcar blando pardo, miel de afinación y en melaza (tan poco que 0,2 p.p.m. de plomo añadido se puede determinar en 10 g de la muestra original), y cobre en azúcar blando pardo, miel de afinación y melaza de caña (la cantidad minimum de cobre, casi todo de la cual se ha recuperado, era 2,5 p.p.m. en 10 g de la muestra original).

* * *

Refinación de azúcar—Notas sobre procesos unitarios. Part III. Filtración de cachaza. F. M. CHAPMAN. Pág. 293–296

Se discute el sujeto de filtración de cachaza debajo las rúbricas que siguen: calidad de cachaza, mejoramiento de filtrabilidad de cachaza, factores que influyen la filtración y lavado de tortas de filtro, recuperación de azúcar de la torta, efecto de sequedad de la torta y densidad de la cachaza, diseños de los filtros de cachaza, filtro-prensas y filtros alternativos para cachaza de carbonatación, prensas Sweetland, la capacidad calculado de un filtro Sweetland de fondo poco profundo, y la disposición de torta de filtro por mezclado con cenizas.

* * *

Determinación directa polarimétrica de sacarosa en la presencia de glucosa y fructosa por adición de bórax. J. LÓPEZ HERNÁNDEZ. Pág. 296–297

Es una carta que se concierne con ensayos ejecutado por J. FERNÁNDEZ BERTRÁN *et al.* (*I.S.J.*, 1967, **69**, 107–111). Se discuten tres puntos hecho por estos autores en su artículo con respeto a la eficiencia del método.

* * *

Estudios sobre pH el la fabricación de azúcar. Parte I. El efecto de temperatura sobre pH. D. P. KULKARNI, M. K. PATIL y K. C. VORA. Pág. 297–301

Se dan detalles de experimentos sobre la relación entre pH y temperatura de jugos y productos azucareros en la fabricación de azúcar crudo y azúcar blanco. Estos experimentos han demonstrado que el pH baja cuando los productos se calentan. Los dados se presentan en la forma de tablas.

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Notes & Comments

UNCTAD sugar conference.

A United Nations conference will be held next April to negotiate a new agreement for regulating the international sugar market. Dr. RAUL PREBISCH, Secretary-General of the United Nations Conference on Trade and Development, announced in Geneva on the 4th September that expert consultation on the market would open on the 23rd October.

He told the UNCTAD Board that another sugar conference was originally envisaged for this autumn but his recent consultations with major producing and consuming countries showed that this would have been premature. Delegates from 67 countries failed to reach a proposed world marketing agreement in Geneva two years ago because of various basic differences between exporters and importers. They asked Dr. PREBISCH to prepare the ground for a resumption of negotiations as soon as a successful outcome appeared likely.

A report submitted by Dr. PREBISCH to the UNCTAD Board said that the Conference's consultative committee had concluded that world sugar supplies continued to exceed demand and "that in the absence of any international action the situation would deteriorate further to the serious detriment of all exporting countries".

If various proposed measures to stabilize the international sugar market were adopted the experts believed that "a reasonable balance could be achieved by about 1970".

During the six years since the regulatory clauses of the 1958 International Sugar Agreement became ineffective the price of sugar has fluctuated between values more than £100 and as little as £12 per ton. Thus consumers have suffered at times because of high prices, while, as at the moment, producers are making losses which have driven numbers out of business and have made it necessary for Governments to provide loans and subsidies to their local industries. It is to be hoped that the delegates to the Conference in April will be successful in their efforts to reach agreement whereby the violent fluctuations of the past six years can be brought to a halt.

World sugar prices.

At the time of writing the London Daily Price is £17 per long ton c.i.f. U.K., little more than a third of the Negotiated Price under the Commonwealth Sugar Agreement which, it will be remembered, provides a reasonable profit to an efficient producer. The decline was surveyed recently by C. Czarnikow Ltd.[1], as follows: "The downward movement in values commences early in June, since when prices have moved steadily lower, with only the occasional rally lasting for a few days. The crisis in the Middle East had caused a nervous attitude in the sugar market and fears that the outbreak of fighting might lead at least to a major interruption in the flow of supplies and possibly even to an international conflagration caused an upsurge in values and the establishment of a London Daily Price of £32·00 per ton. Fortunately the actual armed conflict did not last for more than a few days and the only impediment to the smooth movement of sugar around the world has been the closure of the Suez Canal. Not surprisingly the end of hostilities brought a fall in prices as rapid as the upward movement had been, but this did not end when values reached their pre-crisis level. Partly this might have been explained by the fact that there was considerable momentum in the downward trend, but by this time the market was also aware that European beet sugar production was likely to be well in excess of earlier expectations. It is still far too early to reach any firm conclusion as to the final level of production in Europe but beet tests which have so far been received indicate that in almost every country a very good output can be anticipated.

"Many producers are already anticipating that they will have substantial surpluses to dispose of and offers of white sugar are appearing at levels not very different from raw sugar quotations. This is no new phenomenon, as it happens whenever large surpluses are available in Europe, and, peculiar though the economics of the situation may be, the governments of the countries concerned appear for the time being prepared to accept this method of marketing as it is they who in almost all cases supply the subsidies."

[1] *Sugar Review*, 1967, (831), 165.

The basic reason for the low prices is the large volume of sugar stocks in the world. Following the huge increase in production in the 1964 crop, stocks rose to 18 million tons and have remained at this level or thereabouts ever since. F. O. Licht has recently published[1] his revised estimates of world sugar balance for 1964–1967 and considers that stocks at August 1967 were likely to be 18,193,000 metric tons, raw value. C. Czarnikow Ltd. consider that this figure is low and thinks stocks were nearer 19,500,000 tons. Whichever is the more correct, this means that for the last two years consumption has been more or less in line with production and, assuming that the steady rise continues, it could well be that stocks will start to reduce during the next year. In any case at present consumption levels of 66 million tons the stocks represent 27·5 or 30% of a year's requirements. It is only 4–5 years since the stock figure was 10 million tons or 21% of a year's requirements at the then consumption level of 48 million tons, and the price levels were high enough to make sugar production worth-while. It is to be hoped that the stocks will be reduced sufficiently next year to bring a return to such conditions.

* * *

U.K. sugar surcharge increase.

As the world price of raw sugar has again fallen, the U.K. Minister of Agriculture, Fisheries and Food has made Orders under the Sugar Act 1956 adjusting the surcharge in conformity with this price movement. The existing surcharge of 3¾d per lb (35s 0d per cwt) was increased to 4d per lb (37s 4d per cwt) from the 25th August 1967.

* * *

U.S. sugar quota, 1967[2].

On the 29th August the U.S. Dept of Agriculture declared additional deficits in the U.S. sugar quotas of Panama (4989 tons) and Nicaragua (7198 tons). The deficits were prorated among Western Hemisphere producers, as follows: Mexico 2344 tons, Dominican Republic 2764 tons, Brazil 2292 tons, Peru 1828 tons, B.W.I. 821 tons, Ecuador 334 tons, French West Indies 258 tons, Argentina 282 tons, Costa Rica 270 tons, Colombia 244 tons, Guatemala 227 tons, El Salvador 167 tons, Haiti 127 tons, Venezuela 115 tons, British Honduras 60 tons, Bolivia 27 tons and Honduras 27 tons.

* * *

Dominican Republic world market sugar sales to cease[3].

The Executive Director of the Sugar Council, Sr. GAETAN BUCHER, has announced that the Dominican Republic will make no more sugar sales to the world market this year. Dr. BUCHER confirmed that the Dominican Republic had recently sold 80,000 tons of sugar to the world market, of which 70,000 tons are to be shipped during the period January–March 1968. Production in the Dominican Republic would be sufficient to cover any possible reallocations in the U.S. quota up to 100,000 tons.

The state-owned sugar factories of the country have up to now ground 5,520,000 tons of sugar cane and have produced 535,479 tons of raw sugar as well as 38,085 tons of refined sugar. Total sugar production in the state-owned factories is expected to reach 550,000 tons, while, according to Licht, total sugar production in the Republic in 1966/67 is estimated at 885,000 metric tons.

* * *

E.E.C. sugar decision deferred[4].

The Common Market's Agriculture Ministers in July postponed a final decision on the community's common sugar market organization until its session on 25th and 26th September.

The "Six" are still disagreed about whether sugar quotas, on which price guarantees will be based, should be shared out between firms or factories in the member states.

The quotas and common prices were agreed on by the Common Market's Council of Ministers on 24th July 1966. They are due to come into effect on 1st July 1968.

* * *

Indian sugar production fall[5].

Six Indian sugar factories might close down in the 1967/68 season and a further nine are contemplating closure owing to the shortage of cane. This was disclosed by the Indian Minister of Food and Agriculture recently when he told the Government he did not propose to resume exports of sugar this year since domestic needs would be satisfied first. According to reports from India, sugar exports in 1967 are estimated at some 220,000 metric tons, compared with 441,000 tons in 1966.

All aspects of India's sugar policy, including decontrol and prices, are under active consideration, and a decision is soon expected. The Government proposes to announce an increase in the price of cane before the crushing season starts.

Indian sugar production during the 1966/67 season had reached 2,139,000 metric tons up to the end of June, compared with 3,466,000 tons produced during the corresponding period of 1965/66. Since June production was only 6000 metric tons, however, the total production for the season will not reach 2,200,000 tons. Deliveries for domestic consumption have been at a rather higher rate than in 1965/66 and stocks at end June, at 1,078,000 tons, are 923,000 tons less than a year before.

[1] *International Sugar Rpt.*, 1967, **99**, (25), 1.
[2] *Lamborn*, 1967, **45**, 140.
[3] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (20), 17.
[4] *Reuters Sugar Report*, 26th July 1967.
[5] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (22), 16.

Polarographic Determination of Lead and Copper in Refinery Products

By R. W. PLEWS (Tate & Lyle Refineries Ltd., Liverpool)

POLAROGRAPHIC methods for the determination of trace elements in foodstuffs have been reported in the literature; for example, JONES & BRASHER[1] described a procedure for the determination of lead in canned meat and fish which, however, is not suitable for materials with a lead content lower than 5 p.p.m. CONDLIFFE & SKRIMSHIRE[2] developed methods for the determination of lead, copper, zinc and tin, the procedure for copper using tartrate medium. The method for lead, however, requires the high sensitivity of the cathode-ray polarograph.

An advantage of the polarographic method compared with the colorimetric determination of these metals lies in removing the difficulty of comparing visually colours produced by metal complexes at very low concentrations. Details are given below of polarographic methods, suitable for the routine determination of lead and copper in sugar products, which have been developed in this laboratory. A Tinsley Mark 19 instrument was used throughout the work. Lead is determined in 1% nitric acid solution following a dithizone extraction of the residue from dry ashing, while copper is determined in a base electrolyte of tartaric acid after dry ashing of the sample.

Although GORSUCH[3] has pointed out the losses which may occur with dry ashing above 500°C, the recovery experiments proved both methods to be reliable and reproducible.

LEAD DETERMINATION

*Reagents**

(*i*) ammonia (s.g. 0·880).

(*ii*) 5% potassium cyanide solution in distilled or deionized water.

(*iii*) 0·1% diphenylthiocarbazone (dithizone) solution in chloroform.

(*iv*) 0·002% dithizone solution in chloroform, prepared daily from a stock of reagent (iii).

(*v*) 25% w/v ammonium citrate solution in distilled or deionized water prepared by dissolving 250 g ammonium citrate in about 750 ml of water containing 20 ml of reagent (i) and making up to 1 litre; this solution is extracted with reagent (iii) until free of metals. This state is indicated by the green colour persisting in the chloroform layer. Dithizone remaining in the aqueous phase is then removed by extraction with successive small quantities of chloroform until the citrate solution is colourless, when the solution is filtered.

(*vi*) hydrochloric acid (s.g. 1·16).

(*vii*) sulphuric acid (s.g. 1·84).

(*viii*) 1% nitric acid prepared by diluting 1 ml of concentrated nitric acid to 100 ml with distilled or deionized water.

Preparation of solution

It has been found that lead present in sugar products is in a form which can produce complexes with dithizone which may be extracted with chloroform; however, with low-grade products such as affination syrup and molasses, the time required for the emulsion to separate into its component aqueous and chloroform phases is long. Consequently such materials are preferably ashed. Nevertheless, when the level of lead in low-grade products is high and it is desirable to know this amount quickly it is possible to obtain a close approximation to the true content by treating the sample, diluted to about 50% solids, in the same way as a refined liquor, removing the chloroform phase as it separates for isolation of the lead.

Wet ashing is too lengthy an operation to be considered for routine analysis as carried out in many trace element laboratories and, although some perchloric acid oxidations were included in the investigation, most of the analyses involved dry ashing. This is effected by treating 10 grams of the sample with about 2 ml of reagent (vii) in a silica crucible and gently heating over a Bunsen burner until the initial reaction has subsided. The crucible is then placed in a muffle furnace, the temperature of which should not exceed 500°C, and left overnight or until the ash has been decarbonized.

The residual ash is treated with 1 or 2 ml of reagent (vi) and enough distilled or deionized water added dropwise to fluidize and dissolve the mixture by swirling and gentle warming. When solution is complete, the contents of the crucible are transferred to a 100 ml separating funnel with about 20 ml of distilled or deionized water.

For refined sugars and other high-grade materials the solution is prepared by dissolving 10 grams of the sample in distilled or deionized water, adding 1 ml of reagent (vi) and then washing into a 100 ml separating funnel to a total volume of about 25 ml.

Isolation of lead

The lead solution is treated with 1 ml of reagent (v) for refined products or 5–10 ml for low-grade products and the pH adjusted to about 9 by the addition of 20–25 drops (about 1½ ml) of reagent (i). If a precipitate is formed at this stage the volume of reagent (v) should be increased until precipitation is prevented. In order to form complexes with other interfering metals (Fe, Cu, Zn, Cd), 1 ml of reagent (ii) is added and the mixture shaken after which 5–10 ml of reagent (iv) is added and the separating funnel shaken

[1] *Analyst*, 1947, **72**, 423.
[2] *J. Pol. Soc.*, 1961, 1.
[3] *Analyst*, 1959, **84**, 135.
* All reagents should be lead-free, and of A.R. (Analytical Reagent) grade purity.

vigorously. Excess dithizone is indicated by the appearance of a purple, blue or green colour in the lower chloroform layer. If this phase is red further extractions with 5 ml aliquots of reagent (iv) are necessary until all the lead has been removed from the ammoniacal solution.

The combined chloroform extracts are now transferred to another 100 ml separating funnel and 5 ml of reagent (viii) added. On shaking, the lead is removed to the acid aqueous phase as indicated by the reappearance of the original green colour of the chloroform layer. If this green colour is not obtained the chloroform should be extracted with further 1 ml aliquots of reagent (viii) until the original colour of the chloroform phase is restored. The latter is discarded and the combined acid extracts run into a test tube calibrated at 10 ml. After making up to the mark with reagent (viii) the solution is deoxygenated with nitrogen and a polarogram run on the resulting solution. A reproducible step occurs at —0·62 volts against a quiescent mercury pool anode. The step height is proportional to the concentration of lead, 0·03μA being equivalent to 1 p.p.m.

The polarographic wave form may be improved by substituting the 1% nitric acid (reagent viii) by a nitric acid-gelatine mixture such that the nitric acid concentration remains at 1% and the gelatine concentration is 0·05%. The acid should be warmed gently to facilitate solution of the gelatine.

Results

To check the precision of the method a number of recovery tests were carried out by adding known amounts of lead to samples of sugar materials before ashing. The results from dry ashing of affination syrup and final molasses are shown in Table I together with those obtained by straight extraction from white and soft brown sugars. The original lead content was determined using the polarographic method.

Table I

Sample	*Original Pb (p.p.m.)*	*Pb added (p.p.m.)*	*Total Pb found (p.p.m.)*	*Pb recovered (p.p.m.)*	*% recovery*
White sugar	0·0	0·20	0·20	0·20	100
		0·50	0·48	0·48	96
		1·00	1·00	1·00	100
Soft brown sugar	0·0	0·30	0·29	0·29	97
		0·50	0·51	0·51	102
		0·90	0·89	0·89	99
Affination syrup	0·4	0·20	0·59	0·19	95
		0·50	0·91	0·51	102
		0·80	1·18	0·78	98
	1·2	0·20	1·39	0·19	95
		0·50	1·71	0·51	102
		0·80	2·00	0·80	100
Molasses	3·5	0·50	4·00	0·50	100
		0·80	4·28	0·78	98
		1·00	4·47	0·97	97
		2·00	5·48	1·98	99
	3·8	3·00	6·65	2·85	95

Recoveries from samples oxidized with perchloric acid/sulphuric acid are shown in Table II.

Table II

Sample	*Original Pb (p.p.m.)*	*Pb added (p.p.m.)*	*Total Pb found (p.p.m.)*	*Pb recovered (p.p.m.)*	*% recovery*
Affination syrup	0·4	0·5	0·91	0·51	102
		0·75	1·10	0·70	93
		1·00	1·40	1·00	100
Molasses	2·6	0·30	2·90	0·30	100
		0·50	3·12	0·52	104
		1·00	3·60	1·00	100

Under the conditions described, i.e. 10 grams of original sample and 10 ml final volume, lead can be determined accurately down to 0·2 p.p.m., which is adequate for most purposes. By proportionately increasing the amount of the original sample or reducing the final volume of solution it is possible to estimate the lead at levels lower than 0·2 p.p.m. if required.

Copper Determination

Polarograms of copper in an alkaline tartrate base electrolyte show two waves representing the reduction of the complex but below about pH 6 the doublet wave disappears and only a single wave is observed.

† *Reagents*

(*i*) sulphuric acid (s.g. 1·84).

(*ii*) nitric acid (s.g. 1·42).

(*iii*) 1M tartaric acid solution, prepared by dissolving 15·01 g of solid tartaric acid in distilled or deionized water and making up to 100 ml.

(*iv*) tartaric acid/nitric acid mixture, prepared by adding 1 ml of reagent (ii) to 10 ml reagent (iii) in a 100 ml flask and making up to volume with distilled or deionized water. This solution is 1% with respect to nitric acid and 0·1 molar with respect to tartaric acid.

Preparation of solution

A 10-gram portion of the sample is dry-ashed as described for determination of lead. When the ash has been decarbonized the silica crucible is removed from the muffle furnace and allowed to cool. The residue is treated with 5 ml of reagent (iv) and warmed to ensure solution of the copper from the ash. The solution, plus washings with reagent (iv) is transferred to a graduated test tube and made up to 10 ml with reagent (iv).

Although any insoluble material remaining at this stage will not influence the polarogram it may be considered desirable to remove it to facilitate subse-

† All reagents should be copper-free and of A.R. grade purity

quent cleaning of the mercury. Removal of any residue is simply effected by centrifuging and decanting the supernatant solution. The latter is polarographed after deoxygenating.

The height of the wave is proportional to the concentration of copper in solution, 0·11 μA being equivalent to 1 p.p.m. The half wave potential of the copper tartrate complex varies with pH but under the conditions described above the Cu wave occurs at —0·33 volts against a quiescent mercury pool anode. The use of gelatine as a suppressor should be avoided since it may influence the height of the wave although its effect is more marked in alkaline tartrate medium[1]. Iron present in the materials tested does not affect the copper wave.

Results

The reliability of the method was proved by a number of recovery tests, the results of which are shown below in Table III. The original copper contents were determined by the polarographic method.

Table III

Sample	*Original Cu (p.p.m.)*	*Cu added (p.p.m.)*	*Total Cu found (p.p.m.)*	*Cu recovered (p.p.m.)*	*% recovery*
Soft brown	2·5	2·5	5·1	2·6	104
		5·0	7·5	5·0	100
		10·0	12·6	10·1	101
Affination syrup	2·5	1·0	3·4	0·9	90
		5·0	7·5	5·0	100
Cane molasses	6·8	5·0	11·7	4·9	98
		10·0	16·6	9·8	98

The use of polarography for the determination of trace impurities in sugar products is capable of further development and it is hoped that eventually techniques will be worked out for measuring several elements in the same solution.

SUMMARY

Details are given of polarographic methods suitable for the routine determination of lead and copper in sugar products.

ACKNOWLEDGMENTS

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Sugar Refining - Notes on Unit Processes

Part III. Mud Filtration

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

(1) *Introduction*

LIQUOR filtration separates about 1% solids from suspension. The aim is maximum rate of flow at maximum Brix, and this leads logically to a system where liquor running period = non-effective time. (To avoid putting too much liquor into sludge runnings, the filters *must* be well drained.) Good sluicing also is vital and on no account must the filter leaves be bridged with cake.

Conversely, in mud pressing the aim is to separate about 1% suspended solids from 2–3% liquor solids. To this end one wants a cake with the minimum of voids from which sweet water must be flushed with fresh water or with air or with both. Structurally, one of the best tools is a plate and frame press in which:

(*a*) the frames should be filled and the cake compacted by continuous pumping; the more chalk admitted the less voids and residual sugar will be left.

(*b*) residual sugar should be displaced by cross washing and blowing, or by blowing, soaking and blowing, and

(*c*) finally, the cake is discharged by removing the walls of the chambers.

(*a*) and (*b*) apply with equal force to any mud filter, be it leaf or candle, but because the cake must be held in place, the filter itself must be a special purpose unit. No dual-purpose filter can be more than a compromise between conflicting objectives, a truth which has been demonstrated many times.

(2) *Mud quality*

When a leaf filter is sluiced, the 67°Bx liquor accompanying the cake ultimately is diluted 6–8 times and reappears as sweet water of 13–10°Bx. Its pH has dropped and its ash content on solids has risen. Also it involves recirculations. So, the very first thing in recycling a liquor filter is to *drain well.* Plaistow for many years has set the timers so that during the first few seconds, sluice water goes into "return liquor".

The next requirement is to improve the quality of the mud, and for this it is essential to see and handle the cake in order to gauge the addition of lime or kieselguhr, or to raise the temperature of filtration.

The importance of mud quality is shown below.

Table I

Mud Pressing	*Very Bad*	*Bad*	*Fair*	*Good*
Washing time (min)	58	47	62	16
Wash Water (cu.ft.)	280	220	170	130
Sugar in washed cake %	2·1	1·3	0·9	0·5
Mud frames	not full	nearly full	full	full

[1] MEITES: *J. Amer. Chem. Soc.*, 1949, **71**, 3269.

(3) *Mud filtrability improvement*

In 1956 it was reported by the British Sugar Corporation that recycling of settled mud to carbonatation tanks greatly improved settling rates and also filtrability of cake. Recycling of mud apparently conglomerates the aggregates and stabilizes the process (but the thought of filtering mud twice is unattractive). Quoted figures for particle sizes were:

Batch carbonatation precipitate	3 – 4 microns
Continuous carbonatation precipitate	8 – 30 microns
Kelham Dorr clarifier mud	20 – 27 microns

The improvement may be connected with the observation that the electrical charge on $CaCO_3$ particles appears to be positive, while that on proteins appears to be negative.

Mr. GEORGE CONNOR of Tate & Lyle Ltd. experimented with reliming and regassing of sluicings, using various lime additions and various retention times. On a disc at 15 in vacuum, however, recarbonatated sludge did not filter any better than untreated sludge, all effluent was cloudy and cakes cracked.

It has been reported that aragonite compares favourably with the most active filter aids.

(4) *Factors influencing filtration and washing of filter cakes*

A paper of this title by Mr. G. THOMAS of Dorr-Oliver Inc. deals with the operation of a rotary vacuum filter, but the reasoning has general application. The algebra simply restates the relative importance of pressure, viscosity and particle size, but it is brought out that in cake formation, the weight of cake formed in unit time is proportional to $\sqrt{\text{cake resistance}}$ and $\sqrt{\text{filtrate viscosity}}$, and also that the weight of cake varies as $\sqrt{\text{cake formation time}}$, so that if the speed of rotation of the drum (or leaf) is doubled, output increases not by 100%, but by only 41%. Similarly, doubling the concentration of mud should give about a 40% increase in output, which may be exceeded because high concentration can also decrease the specific resistance of the cake.

The paper also shows that, if the resistance of the filter itself is small, the cake should wash at about *half* the average filtration rate. If wash water removed the original liquor by displacement, recovery would be proportional to amount of wash. Actually only part of the liquor is displaced; the remainder is diffused. A curve of washing of wax crystals to remove oil shows straight line displacement up to about 65% of oil in cake. If this applied also to carbonatation cakes, residual sugar in wet cake would be about 1·4% but in practice it is found to be 0·5%.

(5) *Sweetening-off the cake*

The basic factors governing sweetening-off are:

(*a*) quantity of liquid in final cake, and

(*b*) Brix of liquid in final cake.

In most carbonatation refineries, dry cake solids are about 1% on melt. In a plate-and-frame press the cake is "dried" largely by exclusion, i.e. residual sweet water is displaced by chalk filling the voids.

Press cake which appears to be solid and dry then contains 40–50% liquid, so that residual sugar must vary directly with the Brix of the sweet water left in the voids. It follows, when using a leaf press for mud, that it is best to follow the sequence:

(i) build a cake to bridge the leaves,

(ii) blow the cake with air to drive residual sweet water out of the cake and also from the body of the filter,

(iii) wash the cake and blow again,

(iv) open the filter, swinging the bottom more than 90°, and spring the leaves one by one to let the cake drop from the inverted-vee (this is possible only in a Sweetland), and

finally sluice the leaves and recycle.

(6) *Effect of dryness of cake and Brix of mud*

This is demonstrated in Table II.

Table II

Solids in cake %	*Cake solids % melt*	*Brix of liquor in cake*	*Sugar left in S.W. in cake*	*Sugar left in dry cake*
40	1	15	0·25	19
	1	12	0·18	15
	1	9	0·135	12
	1	6	0·09	8
50	1	15	0·15	13
50	1	12	0·12	11
50	1	9	0·09	8
50	1	6	0·06	6

If cake is "blown" before washing, one can do better.

(7) *Mud filter designs*

Mud pressing removes 1% solid cake from 8–20% sweet water. A major objective must always be to limit the amount of liquor getting into the mud system (via sluicings).

In terms of performance, the best mud filter is a plate-and-frame press equipped for cross washing. Its construction is ideal for its duty, but it requires considerable labour, is heavy on cloth, leaky and hazardous, and is not suitable for North American conditions.

Drum filters of various types are general in beet plants, and are used by a few refineries. The maximum pressure differential is 7–8 p.s.i., and in consequence cake resistance must be low, mud slurry must be dense, and the cost of adding filter aid can be high. In addition, drum filters are bulky, and expensive in first cost and in maintenance.

(8) *Plate and frame presses*

The curse of plate-and-frame presses is length of joint. Doubling the dimensions of a plate halves the length of joint per sq.ft. Johnson presses 48 in square were long used in Australian refineries, and were installed for mud at Plaistow. They were of limited success.

There have been reports on chain-linked chamber plate presses used for cement, and mechanized presses are in use both in Europe and in America.

Bad cleaning and blocked ports may crack plates, creating a hazard when the press is opened. Great Western Sugar Co. and others have met this difficulty by filling the centre of the plates with brass coil springs of 1 in dia. at 1·4-in centres.

Two refineries, each melting 280,000 lb/hr, have batteries, one of seven 650 sq.ft. presses (total area 4550 sq.ft.) and the other of four 1550 presses (total area 6200 sq.ft.). The second refinery, however, aims to work only two shifts at the station.

Table III compares wash used in small and large Johnson presses in 1957—

Table III

Johnson press area, sq.ft.	580	1535
Average wash, cu.ft.	67	198
Wash, cu.ft./sq.ft. area	0·115	0·129
Wash "thickness", inches	1·4	1·55
Frame thickness, inches	1·5	1·63
Ratio frame/wash "thickness"	1·07	1·05

For practical purposes, good cakes can be washed with one cake volume = say 2·5 voids volumes of water.

It is reported that the time required to displace sugar from cake is about 3 min, and work in 1943 suggested that it is easy to wash excessively, e.g.

Wash water flow rate (c.f.m.)	*Time to wash (min)*	*Total wash (cu.ft.)*	*Residual sugar in mud %*	*Remarks*
1·2	33	40	0·3%	Intermediate points plotted on a log/log plot lie in a straight line
3·1	30	92	0·2%	

Moisture in press cake can vary between 41 and 46% while a typical analysis is $CaCO_3$ 78%, $CaSO_4$ 7%, Fe and Si 1%, other substances 14% on dry matter.

(9) *Alternatives to plate and frame presses for carbonatation mud*

Suchar filters.—Savannah (melt 180,000 lb/hr) have used 3 × 900 sq.ft. Suchar filters for 14 years. Results are poor, sweetening-off is ineffective and expensive in water. It is concluded that the filter is unsuitable for mud (though excellent for liquor).

Vacuum drum filters.—When filtering sluicings at 85°C the maximum vacuum obtainable is about 12 in, i.e. the effective differential pressure is about 6 p.s.i. compared with a pressure filter at 50–70 p.s.i. The resistance of refinery carbonatation mud is high and to build good cakes requires high pressure. Drum filters would seem to be unsuitable tools, and this view is supported by experience with a Davey Paxman drum filter, when no useful results were reported owing to the nature of the chalk and the impervious thin cakes which could not be removed from the drum. The cloth rapidly blinded.

No success was reported either with an "EimcoBelt" filter; the clarity of effluent was unsatisfactory, and the cost of thickening sludge was too high.

Trials on the Eimco filter showed that cloths rapidly blinded, and effluent was cloudy. Various grades of cloth were tried, and acid washing did not cure blinding.

String filter.—Cloths rapidly blinded, but the cake would filter well after addition of 2–3% filter-aid and rate of flow was then 6·4 cu.ft. per sq.ft. per hour.

Eimco Burwell filter.—This has double frames but cannot be cross-washed. The author in 1954 thought it suitable only for free-filtering muds.

"Fasflo" filter.—It has been reported that the filtration rate (1–1·1 cu.ft./sq.ft./hr) with this filter approached that of a plate and frame press; the filtrate was clear, and sweetening-off required about as much water as a plate-and-frame press. Cake cannot fall off the leaf, but it is difficult to avoid bridging of cake and wrecking of the sluicing gear. Cake *must* be discharged wet, and sluicing gear is not robust. Cloth renewal was difficult.

Funda and Schenk filters.—These are horizontal leaf filters in which the sweetened-off cake is discharged by spinning. They are expensive (£20–£55 per sq.ft. of filter surface) and because of differential hydrostatic head, may produce excessive sweet water by overwashing the bottom leaves. Ideally they should be "blown".

(10) *Sweetland presses*

A Sweetland leaf filter for mud is a "special" and to use a deep-bottomed liquor Sweetland is to invite trouble with both evaporation and sugar loss. Both Sugarland and Vancouver refineries use suitable Sweetland filters and have a reasonable operation using kieselguhr. Success depends on getting a hard cake which cannot slough off and can be blown and washed. Such a cake *must* be discharged dry by hand labour. If sugar loss and evaporation are prime targets, a tight-bodied pressure filter may be the best alternative to a plate-and-frame press.

Vancouver refinery filters mud on three small Sweetlands, cotton covered, using kieselguhr. Feed is at 20°Brix, and washings 10–0°Brix. Sugar in cake is 0·3–0·5%. Filter cycle is 100 min: running 25 min, blow-back 12 min, wash 45 min (at 8 g.p.m.) and dump 5 min. Wash is 58 cu.ft., i.e. 1·6–2·0 cu.ft. per cu.ft. of cake, or 4–5 void volumes. Leaf changes are about 6 per annum.

Mr. J. O. SMITH in 1949/50 reported that 15–25 p.s.i. gave cakes which were full but soft, sliding easily from the leaves. At 55–70 p.s.i., cakes were very hard. Washing was extravagant because the filter lacked the refinements of tight shell, 'I' leaves, screen plate, etc. One cannot hope to sluice a Sweetland mud press.

Cake can be formed evenly by circulating body feed (from the far end) at 8 c.f.m.

(11) *Calculated capacity of a shallow-bottomed Sweetland filter*

Observations, combined with basic data obtained by Mr. F. C. BURGESS, lead the author to conclude that a 500 sq.ft. Sweetland with leaves at 4-in centres might, when using 0·5% CaO on melt, deal with mud from 800,000 lb (350 long tons) of raw sugar.

Considerations of efficient sweetening-off show that the filter must be a "special". The shell must hug the leaves, there must be a feed distributor, and the leaves should be of "I"-pattern.

Superficially, if the barrelled filter is "blown", and sweetened-off by 3 × 35 cu.ft. slugs with "dwells", the final sugar in cake will be below 1% and washings production will be small (1·2 cu.ft. per cu.ft. of mud).

Mud *must* be discharged dry by vibration, or by air lancing. The best configuration for the shell opening is not yet apparent.

(12) *Conclusion on Mud Pressing*

The most promising alternatives to plate-and-frame presses seem to be (*a*) special Sweetlands, or (*b*) special candle filters, air-purged. However, progress is eternal, and the author might be proven wrong next week.

(13) *Disposal of press mud by mixing with ashes*

Plaistow produces 12,000 tons of ashes per annum and 10,000 tons of press cake. If they were mixed at the boiler dumper bars, the heat in the ash would evaporate the water in the press cake. It is reported that an Australian refinery does so mix.

Correspondence

To the Editor,

The International Sugar Journal.

Dear Sir,

The Direct Polarimetric Determination of Sucrose in the Presence of Glucose and Fructose by Addition of Borax.

In April 1967 there appeared in *The International Sugar Journal* an article by Jose Fernández Bertrán, J. Marinello and A. Lloreda Casado from the University of Oriente, Cuba.

It is claimed in this article:

(a) that the addition of borax does not produce an optically inactive complex with glucose and fructose,

(b) that sucrose forms complexes with borax, and

(c) that the polarimetric determination of sucrose in the presence of glucose and fructose by the addition of borax does not constitute an exact analytical method.

With reference to point (a), it is known that when the borax-glucose and borax-fructose ratios are large, the optical activity of the complex is nullified.

For the proportions that we have recommended in our analytical technique[1], the optical activity of the boron-glucose and boron-fructose complexes do not become zero separately, but the combination of their values, of opposite sign, becomes zero or practically so[1,2].

Referring to point (b), in our first paper[3], referred to by FERNÁNDEZ & BERTRÁN *et al.*, we pointed out that there was a small decrease in the optical activity of pure sucrose without seeking to determine the cause. At present the formation of a boron-sucrose complex is not proven.

It is known that complex ions of boron-sugars are charged electrically and so can migrate to the anode or cathode. Experiments made by D. GROSS[4] of the Tate and Lyle Research Laboratories, working on an electrogram of incompletely hydrolysed sucrose solution at pH 9·2 with 0·05 M sodium borate and applied 6 in from the cathode end, showed that the glucose and fructose spots moved 240 mm from the departure line, while the sucrose spot remained practically upon the start line. If a boron-sucrose complex were formed, it should be displaced towards the anode.

Referring to point (c), FERNÁNDEZ BERTRÁN *et al.* declare that they refer to our first paper[3] entitled "Determination of Sucrose in the *Impure Products* of the Cane Sugar Manufacturing Process by the Action of Boron Salts". They, however, worked with *pure sugar solutions* and no values obtained with impure sugar products are included in their paper[5].

It is well known that impurities such as bases, acids, salts, lead clarificants, amino compounds and foreign optically active substances, exert changes on the optical rotation of sugars[6].

Then, we believe it is a hasty conclusion to qualify the exactness of a method for impure sugars solutions on the bases of figures obtained from pure ones.

[1] J. LÓPEZ HERNÁNDEZ: Paper presented to 12th Congress of the International Society of Sugar Cane Technologists, 1965, in press.

[2] TICHÁ and FRIML: *Listy Cukr.*, 1963, **79**, 57–63; *I.S.J.*, 1963, **65**, 308.

[3] J. LÓPEZ HERNÁNDEZ: *I.S.J.*, 1963, **65**, 46–48, 72–63, 107–109.

[4] *Nature*, 1954, **173**, 487.

[5] *I.S.J.*, 1967, **69**, 107–111.

[6] BROWN and ZERBAN: "Sugar Analysis", 3rd Edition (Wiley, New York). 1955, pp. 275–283, 321, 417.

Our method is different from that of CLERGET, which is exact for pure sugar solutions but for highly impure products, such as cane molasses, has proved to be inexact, so that some sugar countries have now replaced it by chemical methods.

Our method is presented on the basis of giving to the cane sugar industry a simple and rapid method which, while not being 100% exact, is more exact than the actual pol or direct sucrose as measured at present.

Many technologists have tested the method, the latest being D. ADAM and R. P. JENNINGS[7] who, working on impure products and with larger amounts of borax than we have recommended*, found the following figures:

Direct pol	*Pol using Borax*	*Clerget Sucrose*
Mill Molasses		
30·40	34·9	34·94
33·40	35·3	35·26
35·40	36·3	36·13
34·80	37·4	37·49
36·80	39·1	38·94
39·20	39·5	39·62
Invert Syrups		
26·20	38·80	38·74
25·25	37·60	37·68
21·20	35·00	35·14
20·95	34·80	34·81
20·55	34·60	34·61
19·10	33·60	33·51
19·40	33·00	32·77
18·20	31·80	31·76
16·60	30·40	30·44
16·20	30·60	30·34
13·10	27·80	27·86
—18·80	4·40	4·30

A statistical analysis of these figures made by us shows correlation coefficients for mill molasses between Direct Pol and Clerget Sucrose of $r = 0{\cdot}90505$ and between Pol using Borax and Clerget Sucrose of $r = 0{\cdot}9984$. For invert syrup, the correlation coefficient between Pol using Borax and Clerget Sucrose is 0·99894, practically the ideal $r = 1{\cdot}0000$.

The basis of our method is that in every case the amount of borax recommended is added to 13 g sucrose, 0·5 g glucose and 0·5 g fructose, or close to these figures. It was demonstrated[1,2] that, under these conditions, the combination of the optical rotations of the boron-glucose and boron-fructose complexes is zero.

This was demonstrated even for pure sugar solutions: ADAM & JENNINGS[7] in their Table II show that for 13 g sucrose in 100 ml, pol = 49·95 without borax, while for 13 g sucrose, 0·5 g glucose and 0·5 g fructose with 25 ml of 2% borax solution in 100 ml, the pol = 50·00.

Unfortunately, FERNÁNDEZ BERTRÁN *et al.*, working on pure products have not made this experiment but, if we look at Table XIV in their paper[5] we can see that the addition of the polarimetric value for 13 g sucrose and 0·5 g glucose plus 13 g sucrose and 0·5 g fructose, is 49·33 without borax and 49·81 with borax. In Table IV of the same paper, for 13 g sucrose in 100 ml without borax, the pol = 49·90.

Yours faithfully,

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Tucumán, Argentina.

[7] 40*th Congr. S. African Sugar Tech. Assoc.*, 1966, 206–213.

* For mill molasses in Argentina we found the same value by adding 25 ml of a 2% borax solution or 50 ml of a 4% borax solution.

Studies on pH in Sugar Manufacture

Part I. The effect of temperature on pH

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Introduction

IN cane sugar manufacture control of hydrogen ion concentration has a profound influence on sugar losses in process, particularly in the production of direct consumption white sugar from cane, employing sulphitation. The aim of correct pH control is to maintain both sucrose and reducing sugars intact, and to avoid conditions under which these sugars undergo decomposition. A thorough knowledge of the effects of pH conditions on the composition of sugar house products in various stages of the process is essential, and the present work deals with some aspects of pH control in both raw and direct consumption white sugar processes under Indian conditions.

The pH of cane juices and sugar-house products varies with temperature and very often the process control is based on pH values measured at room temperatures.

SPENGLER[1] and co-workers found striking changes in pH of beet juices with temperature, after carbonatation, and observed a drop of up to 1·5 on heating to 100°C. BACHLER[1] observed that inversion which occurs during evaporation of thin beet juices of safe pH value is due to the large fall in pH between room temperature and 96–98°C and that the true pH at the temperature of evaporation could be low enough to cause inversion. STADLER[1] in his study on inversion

[1] Principles of Sugar Technology, Vol. I. Ed. P. HONIG. (Elsevier, Amsterdam) 1953, p. 466.

rates concludes that only slight errors will result if inversion is estimated from measurement of pH at room temperature. According to HONIG[2] the temperature coefficient of pH, $\frac{d(pH)}{dT}$, is in most cases slightly negative for technical solutions in the sugar industry, and that it is of the magnitude of +0·002 to —0·02. For beet products in U.S.A. and European countries the temperature coefficient is negative for temperatures from 20°C to 85°C. He further states that for cane products $\frac{d(pH)}{dT}$ is negative for alkaline products and positive for pH range 5·8 to 7·0. GROSS[3] carried out studies with solutions of raw sugar from different countries, in the temperature range of 20°C and 80°C and, while with cane raws found coefficients of + 0·0016 to + 0·0041, with beet raws he obtained in most cases negative temperature coefficients. He also studied refinery liquors from this point of view. According to GROSS[4]: "there are strong indications of regularities particularly with respect to certain products of similar origin and process history." At the 12th Session of ICUMSA it was recommended that the pH/temperature relationship should be studied by collaborative tests on a wide variety of sugar products in widely varying geographical areas[5]. No data appear to have been published on the influence of temperature on pH under conditions obtaining in the Indian sugar industry.

The present work was carried out at Yeshwant S. S. Karkhana Ltd., a cooperative sugar factory where the process of sugar manufacture is as follows:

A. *Direct consumption white sugar of* 99·8% *pol:* Superphosphate extract is added to raw juice, to raise its P_2O_5 content by 100–150 mg/litre, and it is then heated and subjected to simultaneous liming and sulphitation in a continuous system at 70°C. The treated juice is heated to 100°C and sent to a "Rapi-Dorr" clarifier. The mud is filtered with an Oliver Campbell rotary vacuum filter. Syrup is sulphited to about 5·2 pH in an absorption tower.

A straight three-massecuite system is followed, wherein grain is made for *B* and *C*-strikes and well-washed *B*-sugar is used as seed for the *A*-boiling. Washed *C*-sugar is melted along with excess *B*-sugar. *C*-massecuites are double-cured while *A* and *B*-massecuites are single-cured in semi-automatic high gravity centrifugals. Sugar produced is superior to ISS 30 colour, the highest Indian colour standard.

B. *Raw Sugar of* 98·5% *to* 98·8% *pol:* Simple defecation is adopted with addition of superphosphate extract at raw juice stage. A straight three-massecuite system is followed as in white sugar manufacture and normally unwashed sugar from *A*-strikes is bagged, though sometimes when juice quality is favourable even sugar from *B*-strikes is bagged along with sugar from *A*-strikes.

Procedure

In order to study the influence of temperature on pH of juices, syrups, molasses and other technical sugar solutions the following methods were adopted:

(i) pH was measured with an A.C. meter (manufactured by Atomic Energy Establishment, Trombay) in conjunction with a glass calomel electrode system.

(ii) The pH meter was frequently standardized at different temperatures at which pH measurements of various solutions were made, using a phosphate buffer solution, of 6·85 pH, the pH/temperature relationship of which is known.

(iii) Distilled water was used for dilutions or preparing solutions.

(iv) The pH of all molasses was determined after 1:1 dilution, while in the case of sugars 60°Bx solutions were prepared.

The following materials were examined from the point of view of studying temperature-pH relationships.

(i) Mixed juice,
(ii) Clear juice,
(iii) Syrups,
(iv) *A*-Heavy molasses,
(v) *B*-Heavy molasses,
(vi) *C*-Light molasses,
(vii) Raw and white sugars,
(viii) Final molasses, and
(ix) Pure sucrose solutions.

These products from both raw sugar and white sugar processes (ii to viii) were analysed for pH at different temperatures.

Results

The elevated temperatures to which these juices, molasses and sugar solutions are subjected, either during heating or boiling operations, were kept in view during these studies. The results are presented in Tables I and II. Table I deals with changes of pH with temperature, in the case of raw juice, pure sucrose and white sugar solutions as well as other sugar-house products from white sugar manufacture by the double sulphitation process.

Table II gives data on variations in pH at different temperatures of technical sugar solutions from raw sugar manufacture.

In these tables are given

(i) pH values at different temperatures.
(ii) Change of pH per unit change of temperature.
(iii) Difference in pH values obtained at room temperature and temperature of operation.

It will be observed from the data in Table I that:

(1) The pH of all the products studied was lowered on heating.

(2) Clear juice from sulphitation process exhibits a drop of 0·35 to 0·50 pH when heated from 30° to 90°C. This is significant for two reasons: (a) the temperature at which clear juice remains in the clarifier is 90°C to

[2] Principles of Sugar Technology, Vol. III. (Elsevier, Amsterdam). 1963, pp. 121–122.
[3] *Proc. 11th Session ICUMSA*, 1954, 83–84.
[4] *Proc. 13th Session ICUMSA*, 1962, 54.
[5] *Proc. 12th Session ICUMSA*, 1958, 66.

Table I. Change of pH with temperature in white sugar manufacture

	pH at different temperatures							*Change of pH per °C rise in temperature*	*Change of pH from room temp. to operating temperature*	*Remarks*
	30°C	40°C	50°C	60°C	70°C	80°C	90°C			
Mixed juice	5·1	—	5·0	—	5·00	—	—	—0·0025	—0·10	
	5·20	—	—	—	5·00	—	—	—0·0050	—0·20	
	5·05	—	—	—	4·95	—	—	—0·0025	—0·10	
	5·40	—	—	—	5·30	—	—	—0·0025	—0·10	
Clear juice	6·9	—	—	—	6·60	—	6·55	—0·0058	—0·35	1966-67 season
	6·70	—	—	—	—	—	6·30	—0·0067	—0·40	,,
	6·95	—	6·70	—	6·60	—	6·50	—0·0075	—0·45	,,
	7·00	6·90	6·80	6·65	6·60	6·60	6·50	—0·0083	—0·50	1965-66 season
	6·90	6·90	6·80	6·70	6·60	6·50	6·40	—0·0083	—0·50	,,
Sulphured syrup	5·20	—	5·15	—	5·05	—	—	—0·0037	—0·15	1966-67 season
	4·85	—	—	—	4·75	—	—	—0·0025	—0·10	,,
	5·45	—	—	—	5·20	—	—	—0·0062	—0·25	1965-66 season
	5·35	—	5·30	—	5·20	—	—	—0·0037	—0·15	1966-67 season
A-Heavy molasses	5·60	—	5·50	—	5·45	—	—	—0·0037	—0·15	1966-67 season
	5·55	—	—	—	5·45	—	—	—0·0025	—0·10	,,
	5·70	—	—	—	5·50	—	—	—0·0050	—0·20	1965-66 season
	5·85	—	5·80	—	5·70	—	—	—0·0037	—0·15	1966-67 season
B-Heavy molasses	5·75	—	—	—	5·55	—	—	—0·0050	—0·20	
	5·65	—	—	—	5·50	—	—	—0·0037	—0·15	
	5·95	—	5·90	—	5·70	—	—	—0·0062	—0·25	
C-Light molasses	5·40	—	—	—	5·25	—	—	—0·0037	—0·15	
	5·50	—	—	—	5·35	—	—	—0·0037	—0·15	
	5·35	—	—	—	5·15	—	—	—0·0050	—0·20	
Final molasses	5·40	—	5·35	—	5·30	—	—	—0·0025	—	1966-67 season
	4·90	4·80	4·80	4·75	—	—	—	—0·0050	—	1965-66 season
White sugar	6·2	—	6·05	—	6·00	—	—	—0·0050	—0·20	1966-67 season
	6·45	—	6·35	—	6·25	—	—	—0·0050	—0·20	,,
	6·30	—	6·20	—	6·15	—	—	—0·0037	—0·15	,,
	6·20	—	6·15	—	6·10	—	—	—0·0025	—0·10	,,
	5·70	—	5·55	—	5·40	—	—	—0·0075	—0·30	1965-66 season
	5·80	5·70	5·65	5·50	—	—	—	—0·0100	—	,,
Limed and sulphured juice	7·35	—	7·10	—	7·05	—	—	—	—0·30	
	7·60	—	—	—	7·00	—	—	—	—0·60	
Pure sucrose solution	6·60	—	6·45	—	6·20	—	—	—0·0100	—	
	6·60	—	6·40	—	6·20	—	—	—0·0100	—	
Melt	6·30	—	—	—	6·00	—	—	—0·0075	—0·30	
	6·45	—	—	—	6·10	—	—	—0·0083	—0·35	
	6·15	—	6·05	—	5·80	—	—	—0·0083	—0·35	

95°C, and (b) the actual temperature of boiling in the 1st evaporator body is invariably higher (100°—110°C) with a consequent drop in pH of about 0·5.

(3) In the case of sulphured syrup and molasses from white sugar manufacture the drop in pH from room temperature to the temperature of operation in pans is in the neighbourhood of 0·10 to 0·25. Control of syrup sulphitation has to take into account this drop in pH.

(4) White sugar solutions show a drop in pH varying from 0·10 to 0·30 (0·10–0·20 in most cases) for a rise from room temperature (30°C) to 70°C.

(5) In white sugar manufacture pH changes resulting from rise in temperature are generally smaller (about —0·0025–0·0062/°C) for low pH products such as syrup and molasses but greater (about 0·0075/°C) for higher pH products such as clear juice and melt.

(6) Mixed juice pH falls only by about 0·1 for a temperature rise from 30°C to 70°C.

(7) The pH of 60°Bx sucrose solution drops by 0·40 on heating from 30°C to 70°C.

From Table II it will be seen that:

(1) The pH change in clear juice from the defecation process ranges from 0·45 to 0·70 for a rise in temperature from 30°C to 90°C.

(2) In syrup from the raw sugar process the fall in pH on heating from 30°C to 70°C (which represents the temperature of boiling in pans) varies from 0·45 to 0·55.

(3) The heavy and light molasses boiled in the raw sugar process show drops of 0·2 to 0·4 pH when heated from 30°C to 70°C. In final and *C*-light molasses (which also contains some final molasses) the drop in pH is 0·15 to 0·25, i.e. lower than in the case of other molasses.

(4) Solutions of raw sugars of different pH values, produced during different periods, show pH drops varying from 0·10 to 0·55 for rise in temperature from 30° to 70°C.

(5) With limed juices, the pH drop on heating from 30°C to 70°C is very high, viz. 0·65 and more.

Table II. Change of pH with temperature in raw sugar manufacture

Material	pH at different temperatures							Change of pH per °C rise in temp.	Change of pH from room temp. to operating temp.	Remarks
	30°C	40°C	50°C	60°C	70°C	80°C	90°C			
Clear juice	6·90	6·90	6·80	6·70	6·60	6·5	6·45	—0·0075	—0·45	1965-66 season
	7·40	7·20	7·05	7·05	6·90	—	6·70	—0·0116	—0·70	1966-67 season
	7·20	—	—	—	6·80	—	6·65	—0·0091	—0·55	,,
	7·35	7·20	7·05	—	6·80	—	6·70	—0·0109	—0·65	,,
	7·15	—	7·00	—	6·75	—	6·65	—0·0083	—0·50	,,
Syrup	7·00	—	6·80	—	6·55	—	—	—0·0110	—0·45	,,
	7·05	—	6·70	—	6·55	—	—	—0·0125	—0·50	,,
	6·80	—	6·45	—	6·30	—	—	—0·0125	—0·50	,,
	7·40	—	7·00	—	6·85	—	—	—0·0138	—0·55	,,
A-Heavy molasses	6·70	—	6·55	—	6·35	—	—	—0·0087	—0·35	,,
	6·60	—	6·30	—	6·25	—	—	—0·0087	—0·35	,,
B-heavy molasses	6·40	—	6·15	—	6·0	—	—	—0·0100	—0·40	,,
	6·45	—	6·20	—	6·15	—	—	—0·0075	—0·30	,,
C-Light molasses	5·85	—	5·70	—	5·60	—	—	—0·0062	—0·25	,,
	5·85	—	5·70	—	5·65	—	—	—0·0050	—0·20	,,
Final molasses	5·55	—	—	—	5·35	—	—	—0·0050	—0·20	,,
	5·65	—	5·60	—	5·50	—	—	—0·0037	—0·15	,,
Raw sugar	6·95	—	6·60	—	6·40	—	—	—0·0138	—0·55	,,
	6·95	—	6·75	—	6·60	—	—	—0·0087	—0·35	,,
	6·85	—	6·65	—	6·55	—	—	—0·0075	—0·30	,,
	5·50	—	5·45	—	5·40	—	—	—0·0025	—0·10	1965-66 season*
	5·75	—	5·65	—	5·60	—	—	—0·0037	—0·15	,, *
Limed juice	8·00	—	7·60	—	7·35	—	—	—0·0162	—0·65	1966-67 season
	8·50	—	8·15	—	7·70	—	—	—0·0200	—0·80	,,
	7·45	—	7·10	—	6·80	—	—	—0·0160	—0·65	,,

* analysed after one year.

(6) In the raw sugar process the temperature coefficients are high in syrup and clear juice, and decrease progressively from syrup to final molasses, i.e. from high to low pH products. The values vary from 0·0138 for syrup to 0·0037 for final molasses in the sugar-house products of the 1966/67 season.

In general, pH changes for the same rise of temperatures vary widely with similar products in different periods, as a result of variations in the cane composition. The pH drop is higher in technical sugar solutions from the raw sugar process than those from white sugar manufacture for the same amount of heating. The sugar-house products which are of lower pH show smaller falls in pH on heating than those which have higher pH.

In the case of raw juice, limed juice and limed and sulphured juice, the temperature rise might change the original composition and the pH-temperature relationship for these products does not have the same significance as in the case of other products studied. Knowledge of this relationship for clear juice and syrup is of vital importance from the point of view of process control and practical working.

Discussion

Since the pH temperature relationship is not linear, the temperature coefficient giving change of pH per unit change in temperature will not be of practical significance in process control. What is really important is the variation in pH value from room temperature to the temperature of operation in the factory. It is this difference in pH values which has to be taken into consideration in process control since we are primarily concerned with pH conditions of technical sugar solutions at elevated temperatures obtaining in process. Sucrose is highly sensitive to acidic conditions at high temperature and pH conditions considered safe at room temperature might become acidic at the elevated temperatures prevailing in the boiling house. In most of the cases studied, including technical sugar solutions, variation of pH with temperature is a reversible change and when original conditions are restored the pH returns to its original value.

The dissociation constant of water changes with temperature; the pK for water at 22°C is 14 and at 100°C it is 12·37. Thus even pure sucrose solution, when heated, will show a higher H^+ ion concentration owing to increase in the dissociation of water. In addition, the salts present in technical sugar solutions influence markedly their pH-temperature relationship, since the dissociation constants of these salts also change with temperature. Solutions of salts of strong bases and weak acids are reported to have negative temperature coefficients of pH, and cane juices mostly are found to contain salts of weak acids. In cane juices and technical sugar solutions water serves as solvent for sucrose and salts. The combined effect of water and weak acid salts is to bring down the pH whenever these technical sugar solutions are heated. However cane juice composition shows wide variations in different periods and regions. It is therefore not possible to predict exactly the change in pH with temperature for sugar cane products. The data presented indicate certain regularities and trends in respect of sugar-house products from the two processes

Sugar cane agriculture

Fungicidal treatment of cane setts prior to planting. J. A. MARIOTTI. *Rev. Agronomica Noroeste Argentino*, 1966, **5**, (1–2), 133–154.—Results are recorded of treatment with 12 different fungicides at different times of the year at Tucumán. Mercurial compounds gave the best results.

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Varietal resistance of sugar cane to leaf scald disease in British Guiana, 1964. S. BISESSAR. *Min. of Agric., Guyana, Sugar Bull.*, 1966, (33), 57–61.—In this Bulletin, the 33rd Annual Report of the British Guiana Sugar Experiment Station, results are given of recent screening tests of new varieties of sugar cane against leaf scald (caused by the bacterium *Xanthomonas albilineans*). Varieties are classified under six headings ranging from very susceptible to resistant. Some varieties proved resistant in one area but susceptible in another, suggesting the possibility of different races of the pathogen being in existence in the country. So far positive evidence of this has not been found.

* * *

Start of major changes in harvesting cane? G. S. BARTLETT. *S. African Sugar J.*, 1966, **50**, 1029–1031. Trials of new methods (for Natal) of cutting and harvesting cane, with a view to reducing the amount of hand labour employed, are described. The Queensland method of hand cutting and stacking, using the Queensland long-handled and curved-bladed knife, combined with mechanical loading, are proving successful. The system operates with burned cane only and cane which is not seriously lodged.

* * *

Managing irrigation during the rains. G. TURCK. *S. African Sugar J.*, 1966, **50**, 1041–1043.—In Natal irrigation control during the dry winter months, when cane is not growing vigorously, is a simple matter but in the summer, when the cane's demand for water becomes much greater, efficient control of available water becomes more complex. The article is to assist growers with good summer irrigation management. It explains how to avoid unnecessary operations which are wasteful in terms of equipment, pumping and labour.

* * *

The harvest of freeze-damaged cane. L. L. LAUDEN. *Sugar Bull.*, 1966, **45**, 68.—Thanks to suitable weather during harvest the harvesting of freeze-damaged cane in Louisiana was proving satisfactory, about 65% of the crop having been dealt with at the time of writing (November 1966). A plea is made to growers not to deliver poorly topped or stale cane to the mill.

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The sugar cane seedling programme at the U.S. Sugarcane Field Station, Houma, La., 1957–1965. R. D. BREAUX and P. H. DUNCKELMAN. *Sugar Bull.*, 1966, **45**, 70–72.—It is pointed out that the breeding programme was greatly expanded in 1957 owing to increased seed production resulting from improved breeding techniques and indoor crossing facilities. As a period of about 10 years is needed to test a sugar cane seedling fully before it can be released, the benefits of the expanded breeding programme are only now being felt. Advanced tests indicate that improved, new commercial varieties will soon appear. Greater emphasis is now being placed on resistance to mosaic disease.

* * *

Chemical weed control on Taiwan. S. Y. PENG. *Sugar y Azúcar*, 1966, **61**, (12), 26–31.—The increased use of herbicides in sugar cane fields in Taiwan in recent years is described, more than 50% of the crop being now herbicide-treated. The difficulties that have to be faced are described such as the varied climatic and edaphic conditions, preponderance of small scale cultivators and the practice of interplanting sugar cane with other crops. Results of recent experimental work with various herbicides are outlined. A list is given of 30 common weeds in sugar cane in Taiwan, arranged in order of importance. Nutgrass (*Cyperus rotundus*) heads the list.

Studies on pH in Sugar Manufacture—*continued*

studied so far. It is clear that the changes are not uniform in different periods and in different products. A practical solution to this problem is to carry out frequent pH measurements of the juices and syrups at the processing temperatures and use the data for technical control of the process.

Acknowledgement

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Summary

Experiments on the pH-temperature relationships of juices and sugar house products in raw and white sugar manufacture have shown that the pH values of these products are lowered on heating. The fall in pH of sugar-house products at various stages in processing from room temperature to working temperature is discussed on the basis of data collected.

The use of "Simazine" along with 2,4-D as weedicide in sugar cane fields. K. KAR, V. S. NEGI and R. P. SINGH. *Proc. 34th Conv. Sugar Tech. Assoc. India.*, 1966, 1–6.—Application of "Simazine" at 2·2 kg/hectare was notably more effective than at 1·1 kg/hectare. If its high cost could be reduced it could be profitably used. Unchecked growth of weeds reduced cane yield by 34%. Trash mulching kept most weeds suppressed.

* * *

Rôle of different factors in cane cultivation. K. KAR and A. NATH. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 7–18.—Sugar cane cultivation and production in Uttar Pradesh is discussed at some length, with special emphasis on the subject of sugar cane varieties at present cultivated, manuring, diseases and pests. What is regarded as the proportionate importance of different factors in improving cane yield in the State is given in a diagram (manuring 30%, irrigation 20%, improved varieties 9%, pest control 9%, disease control 9%, interculture 8%, timely planting 7%, rotation 5%, and germination 3%).

* * *

On the problem of the low standard of manuring in northern India. G. N. MISRA. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 19–23.—In Uttar Pradesh the average yield of sugar cane is 400–450 maunds per acre (15–16½ tons/acre) yet progressive growers have touched a level of 2600 mds per acre (95 tons/acre). The major controlling factors are considered to be manuring, notably nitrogen, and irrigation. Reluctance of growers to utilize available resources of manuring and irrigation is regarded as responsible to some extent for the low standards. The economics of nitrogen manuring at different levels under prevailing conditions are discussed.

* * *

Elongation of cane in relation to soil moisture during the formative phase. S. SINGH and L. SINGH. *Proc. 34th Conv. Sugar Tech. Assoc., India*, 1966, 25–31. It is pointed out that little work has been done in India on the subject of soil moisture in relation to cane growth. Experimental work on the subject in other countries is discussed. Two cane varieties grown under deficient and normal irrigation were studied, soil moisture being recorded at 9 in and 18 in. The two varieties behaved differently. Reduced stalk elongation at the formative phase due to inadequate soil moisture could not be made up later with adequate moisture supply.

* * *

Response of sugar cane to different levels of manuring and irrigation under the two methods of planting cane. G. N. MISRA, J. D. SINGH and V. N. SINGH. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 33–39. Results are discussed of trials extending over four seasons carried out at the Regional Research Station, Varanasi, Uttar Pradesh, the two methods of planting being the trench and the flat method. Different levels of nitrogen and irrigation were employed. There was little response to higher levels of nitrogen and watering under the trench system. This system also gave better germination but fewer tillers. There was no marked difference in the two methods of planting in regard to number of millable stalks and total yield.

* * *

Hormones and sugar cane. U. S. SINGH. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 73–88.—Three separate papers are presented—(III) Respiratory response of sugar cane setts to indole-3-acetic acid treatment, (VI) Effect of indole-3-acetic acid on the rate of moisture loss from the setts after soaking, and (VII) The response of metabolic water uptake and germination efficiency of seed setts to indole-3-acetic acid treatment and the mutual relationship of the two processes.

* * *

Comparative efficiency of different insecticides against army worm, *Pseudaletia (Cirphis) unipuncta*. H. SINGH, B. SINGH and Y. PRASAD. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 119–122.—Although not normally a serious pest of sugar cane in Uttar Pradesh this army worm has caused damage in the Terai region, eating the leaves of young cane leaving only the midribs. Some methods of control previously used are outlined. In the experiments discussed it was found the pest could be effectively controlled by spraying with "Telodrin", "Endrin" or gamma BHC at 0·31 kg active ingredient, diluted in 375 litres of water, per hectare. Dusting with 10% BHC and 5% "Aldrin" dusts at 25 kg and 12·5 kg per hectare were effective but slightly less so.

* * *

The pink borer, *Sesamia inferens*, and its relative incidence on sorghum and sugar cane in Nizamsagar tract. B. H. K. RAO and A. S. RAO. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 123–126.—In this part of India sorghum and sugar cane are important crops, the latter being either eksali (12-months crop) or adsali (16–18-months crop). Observations on the life history of the pest, its host plants and on population counts are given. It was found the pest attacked young shoots of cane then moved to sorghum and then back to the later cane crop. Cane areas adjoining sorghum were found to have a relatively higher population of pink borer.

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The activity of *Chilotraea infuscatellus* in relation to meteorological conditions. B. H. K. RAO. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 127–129.—Early shoot borers, *Sesamia inferens* and *Chilotraea infuscatellus*, are major cane pests in Andhra Pradesh. Their populations were studied over a number of years in relation to weather conditions. The highest populations of *Chilotraea* were recorded in years of high maximum temperature and low relative humidity.

* * *

Results of manurial experiments on sugar cane conducted in the alluvial soils of the Simbhaoli sugar cane factory zone, Meerut, U.P. K. S. MATHUR, D. S. SAXENA and M. SINGH. *Proc. 34th Conv. Sugar Tech.*

Assoc. India, 1966, 131–136.—The response of different sugar cane soils to N and P fertilizers is discussed, from trials carried out over a number of years. Figures are given for what are regarded as optimum N and P requirements over the customary basal manuring with farmyard manure.

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On the response of sugar cane to sanai (sunn hemp) green manuring. S. P. MISHRA. *Proc. 34th Conv. Sugar Tech. Assoc. India*, 1966, 251–253.—Field trials are reported in which the beneficial effects of green manuring with sunn hemp (*Crotalaria juncea*) on sugar cane, with and without sulphate of ammonia, are demonstrated. The optimum dose of sulphate of ammonia (196 kg/hectare) gave a yield of 62·8 metric tons without green manure and 69·73 tons with green manure. It was concluded that green manuring on the prevailing light soils was economically advantageous.

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Power driven trailer. ANON. *Australian Sugar J.*, 1966, **58**, 463.—A new power-driven trailer is described, of interest to cane growers with problems of hauling cane from fields under wet conditions. It is suitable for attachment to any tractor. Its vital feature is the drive box, a New South Wales invention (incorporated under licence). This drive box will not permit the trailer to overrun the tractor and power reaches the trailer wheels "only when these wheels commence to resist their rolling action or when the tractor drive wheels slip." Power is available for forward and reverse travel and trailer tyres do not have to match the tyre size of the tractor. The main frame of the trailer has been so constructed that it acts as rails for the loaded cane trucks.

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Underground water re-charge trial. ANON. *Australian Sugar J.*, 1966, **58**, 467.—Trials in artificially recharging underground watersheds in the Bundaberg districts used for cane irrigation, by piping water from a river, are described. The water was run into shallow trenches on sandy soil, one of which absorbed water at the rate of a million gallons a day.

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Studies on the optimum number of replications in sugar cane field trials. I. Varietal trials. J. S. CHEN. *J. Agric. Assoc. China*, 1965, **50**, 27–36; through *Plant Breeding Abs.*, 1967, **37**, (1), 124.—Based on varietal trial data collected from three localities in Taiwan, the optimum number of replications is derived from (1) ordinary and (2) saline or sandy soils.

* * *

Sugar cane resistance to top borer. ANON. *Indian Farming*, 1966, **16**, (3), 36; through *Plant Breeding Abs.*, 1967, **37**, (1), 126.—The varieties Co 1234 and Co 1235 were resistant to *Chilotraea infuscatella*; Co 1340 and Co 1259 were tolerant and Co 1186 and Co 647 had poor resistance to the pest. It was observed that the higher the lignification of the midrib the greater was the resistance.

Studies on the germination of sugar cane: effect of depletion and conservation of moisture in setts. R. R. PANJE, P. S. GILL and M. P. MOTIWALE. *Indian J. Agric. Sci.*, 1966, **36**, 161–172.—Experiments carried out to ascertain the effect of various degrees of depletion and conservation of moisture in cane setts are reported. Moisture depletion from setts slowed down and reduced germination, the effect varying unevenly with the degree of desiccation. Moisture in the seed sett itself seemed sufficient provided it was conserved. Conservation of moisture was efficient when setts were placed in a polyethylene bag. Speed of germination was primarily determined by the moisture content of the sett. Coating setts with a shellac emulsion (20%) or wax emulsion was favourable for increased and early, rapid germination (under the dry conditions of northern India). Seed canes with the leaf crown lost more moisture than those without the leaf crown.

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The origin of North Indian sugar canes. G. BREMER. *Genetica* (Hague), 1966, **37**, 345–363.—Reference is made to the monumental work of C. E. BARBER from 1910 to 1920 in studying and classifying the large group of North Indian canes, later referred to collectively as *Saccharum barberi*. He distinguished four groups, the chromosome numbers of which are discussed. It is considered that the North Indian sugar canes are hybrids between ancient indigenous sugar canes with a basic number of 17 chromosomes, and forms of *S. spontaneum* with $n = 40$, $n = 48$ and $n = 56$ respectively. It is also considered that differences found between different forms of Indian *Saccharum spontaneum* in respect to chromosome number, sugar content and mosaic resistance may be attributed to intercrossing with canes of the fertile *Saretha* group.

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Mechanization of sugar cane production in the Antilles. D. BASSEREAU. *Agronomie Trop.*, 1966, **21**, 1155–1161.—The writer shows how labour costs in sugar cane production in the West Indies have increased by 60% while the price received for cane has increased by only 10–13%. It is considered that the need for further mechanization in the region is urgent but there are many difficulties, especially with small growers. These are discussed.

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Cordyceps barnsii Thw., **a fungal parasite of the white grub in sugar cane.** D. HOCKING. *E. Af. Agric. For. J.*, 1966, **32**, (1), 75; through *Rev. Appl. Ent., Ser. A*, 1967, **55**, (1), 19.—In north eastern Tanganyika larvae of *Cochliotis melolonthoides* were found to be destroyed in large numbers by the fungus on an extensive sugar cane estate where this melolonthid was the principal pest. The grub population was not, however, being reduced to an economical level. The manner in which infection was disseminated was not discovered.

Sugar beet agriculture

A method of inducing autopolyploidy in sugar beets by seed treatment. H. SAVATSKY. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14**, 26–47.—An account is given of earlier work on the treatment of sugar beet plants with colchicine and of the successes and failures. In the experiments reported colchicine treatments were applied at various concentrations for varying periods, to dry, pre-germinated and germinated sugar beet seed. Germination of dry and pre-germinated seed was almost normal, that of germinated seed significantly decreased. The number of tetraploids obtained was highest with seed just starting to germinate. Treatment of dry, pre-germinated and germinated seed was effective, that of pre-germinated seed for 16 hours (overnight) being the most effective method.

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High temperature studies of sugar beet germination. R. M. HOOVER and J. R. GOODWIN. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14**, 61–66.—Sugar beet growers in California (Imperial Valley) experience poor germination with early sowings (August to mid-September). Experiments with various accepted germination promoters and inhibitors are reported. No treatment studied improved germination percentage at 45°C constant temperature. When the temperature was reduced to 43°C considerable germination took place. Varietal selection for heat-tolerant seed may be the only solution.

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Effect of growth regulators on yield and quality of sugar beets. K. SCHREIBER and A. C. FERGUSON. *J. Amer. Soc. Sugar Beet Tech.*, 1966, **14**, 67–74.—In Manitoba the growing season for sugar beet is short, 135 days on average, and sugar beets are often harvested immature. Results are given of experiments, over four years, to test the effects of various growth promoting substances. Gibberellic acid as a foliar spray constantly increased yield but decreased sugar content. Maleic hydrazide increased sugar content but decreased yield. Yields of sugar per acre were not materially affected by these substances used alone or in combination.

* * *

The limit of profitability when applying nitrogen fertilizer to sugar beet. H. KIEPE. *Zucker*, 1966, **19**, 631–634.—Results are given of nitrogen fertilizer trials carried out since 1961 with varying amounts of nitrogen in different areas of Germany. These varied from 120–200 kg/ha. In general, dressings as high as 200 kg/ha were regarded as uneconomical.

Monogerm sugar beet seed and its evolution. III. L. DECOUX. *Sucrerie Belge*, 1966, **86**, 133–189.—The great advance in the use of monogerm seed in Belgium in recent years is described. From 1961 to 1966 the area planted with monogerm seed has increased from 5 to 90% of the crop. During this period seed spacing increased on average from 3 to 8 cm. In Belgium monogerm seed with germination of 85–90% and monogermity of 85–90% is now available.

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Influence of increased supplies of phosphate and potassium on the yield of sugar beets. N. KNAUER. *Zucker*, 1967, **20**, 4–9.—Trials, mainly on light heathland soils, with increased supplies of P and K were carried out over several years. Increased supplies of phosphatic fertilizer of the order of 60 to 90 and 120 kg/ha resulted in increased root yield while leaf yield remained nearly unchanged. With manure only and no phosphate fertilizer, yield decreased considerably, less so on a more fertile brown earth soil. Increased K supplies on the heathland soils gave significantly increased yields.

* * *

Various types of sugar beet seed and their application in practice. E. BORNSCHEUER. *Zucker*, 1967, **20**, 45–47.—The advantages of monogerm seed in meeting the labour shortage problem are stressed, as are the merits of processed and pelleted seed.

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Is it possible to omit all hoeing work when cultivating sugar beet? A. VETTER and W. VÖLKER. *Zucker*, 1967, **20**, 93–98.—Results of trials indicated that all hoeing may be omitted if weed control is carried out by chemical means.

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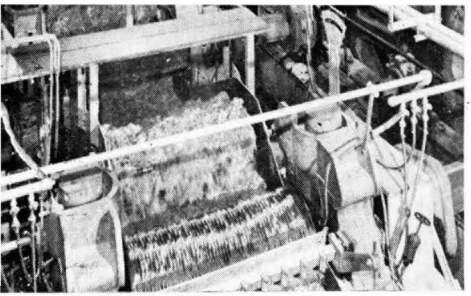
The uptake and adsorption of "Diquat" and "Paraquat" by tomato, sugar beet and cocksfoot. R. C. BRIAN. *Ann. Appl. Biol.*, 1967, **59**, (1), 91–99.—This paper deals with the adsorption and uptake characteristics of "Diquat" and "Paraquat" in various régimes of light and darkness. Experiments showed that uptake, although rapid in light, is increased by darkness and therefore takes place through the cuticle and not through stomata. Darkness for as little as 4 hours increased uptake almost twofold. "Diquat" and "Paraquat" are rapidly and strongly adsorbed both to leaf tissue and to extraneous matter on the leaf surface. Uptake in the field is so rapid that rain immediately after treatment has little adverse effect. The sugar beet used was the variety "Sutton's Improved".



Cane sugar manufacture

The sulphur problem in India. S. K. CHATTOADHYAY and S. G. GUPTE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 15–23.—A survey is made of the requirements of sulphur for various purposes and of sources which might be utilized to avoid having to import the element. A number of processes for the sugar industry, suggested for reduction of sulphur requirements, are briefly reviewed.

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A note on continuous sulphitation in our factory. G. K. LIMAYE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 29–31.—Troubles in clarification have been minimized by the use of a lime proportioning device and a continuous system of liming and sulphitation.

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Mill setting calculations. T. T. OOMMEN. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 32–38.—See *I.S.J.*, 1967, **69**, 244.

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Mill bearing lubrication. V. B. KHARKAR. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 39–41.—Energy loss in a mill bearing, and its measurement, are discussed, as are boundary lubrication and factors affecting mill lubrication. An example is given of pressure on an oil film in a bearing and the consumption of lubricant is discussed.

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Inclined headstocks, uniform grooving and their advantages. G. K. CHETTY. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 42–44.—The author's mill operates with a 12-roller mill tandem the first mill of which has deep grooving but the other three of which have the same grooving so that the rollers are interchangeable. The diameters of the nine rollers are in a decreasing order so that new rollers, as they gradually wear, can be moved so obtaining six times the wear they would give if all the rollers were identical. This non-uniformity is permitted by the inclined headstocks of the mill housings.

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A study of the sugar cane shredder for increased sucrose extraction and greater mill capacity. T. T. OOMMEN and V. C. BAHREE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 45–48.—Experience with installation of a Searby shredder at Shimoga factory where the tandem comprised a 2-roller crusher and four 3-roller mills, all of them old, is reported. Installation of the shredder raised crushing capacity from an average of 29 t.c.h. to 43 t.c.h. while reduced mill extraction was increased from 91·73 to 92·88 in spite of a reduction of imbibition % cane from 13·68 to 10·00%. The usefulness of the shredder in acting as a tramp iron detector is mentioned, and it is considered best to locate it between the crusher and the first mill; if this is not possible, the shredder should replace the crusher (which might be adapted for use as a mill), when initial preparation by cane knives and extra power for the shredder will become necessary. The shredder is not justified for addition to long tandems (18 rollers or more) but will soon repay its cost when added to short tandems of 9, 11 or 12 rollers.

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Studies on the production of white sugar without sulphur in sulphitation factories. D. P. KULKARNI. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 24–30.—See *I.S.J.*, 1967, **69**, 243.

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Use of "Instol" for better performance of low-grade stations in a sugar factory. S. C. GUPTA, N. A. RAMAIAH and J. P. BANSAL. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 49–59.—See *I.S.J.*, 1967, **69**, 273.

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A new prototype boiler and the method of treatment of boiler water practised at Sakthi. K. K. MENON and M. K. RAMKUMAR. *Proc. 21st Conv. Deccan Tech. Assoc. (India)*, 1966, (1), 60–63.—Two new prototype boilers have been supplied and installed at Sakthi Sugars Ltd. and are briefly described; they are narrow-tube units of 6500 sq.ft. h.s., including a 280 sq.ft. economizer, provided with horse-shoe furnaces and three banks of tuyères. Internal brick baffles are included to direct the hot gases into contact with the heating surface, and blow-down is continuous. Make-up water is taken from the river and conditioned by treatment with alum, settling and filtering the decanted water through sand filters, the plant having a capacity of 100,000 g.p.h. The main feed is condensate and is treated with Na_2SO_3 to take up dissolved oxygen, Na_2CO_3 to precipitate Ca salts, and Na_3PO_4 to reduce scale formation.

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A note on saving fuel in the khandsari process of sugar manufacture. S. K. D. AGARWAL and V. M. BHALWAR. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 64.—The combustion gases from the furnace supplying heat to the open pans in which khandsari sugar is boiled contain a great amount of

heat which is wasted. By arranging for raw juice to flow through evaporator tubes set across the chimney, its temperature is raised to 60–65°, so recovering some of the waste heat.

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Efficient use of fuel. H. S. DWARKANATH. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 86–92.—The advisability of using bagasse at as low a moisture content as possible is emphasized, and the various types of furnace hearth are reviewed. Recommendations are made to achieve high efficiency of oil burning where this is necessary, and combustion air control, waste heat recovery and instrumentation are discussed.

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Efficient steam utilization. H. S. DWARKANATH. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 93–107.—The importance is emphasized of ensuring that boiler efficiency is not nullified by inefficient utilization of steam. Attention should be paid to piping layout and design, to leaks and lagging, air venting and condensate removal. Other factors aiding steam economy include ensuring high heat transfer by good circulation, and operation at low temperatures.

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Efficient steam generation—some practical suggestions. N. B. LELE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 108–110.—It is suggested that training schemes and refresher courses for boiler engineers be started to give them the necessary knowledge for improving the performance of their boilers. It is also suggested that seminars be held among engineers concerned in their factories with the same types of boiler so that operating experience and the results of experiment can be shared with the object of improving performance.

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Power from process steam in a sugar factory. B. L. CHAKRADEO. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 111–112.—If steam is generated at 600 p.s.i. and 750°F T.T. it would be possible for a 1000 t.c.d. factory to supply 1500 kW to the national grid during the season. It is suggested that the factories located near the grid should examine the relative return for supplying this power and for excess bagasse supplied to paper factories to see if the former would not be more profitable.

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Steam economy in relation to pan boiling. D. P. KULKARNI. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 113–118.—Steam economy in the pan house depends on two types of consideration: on the plant and on its operation. Thus factors of the first type include the pan capacities, pan design, the use of vacuum crystallizers, circulation aids including mechanical circulators, and instrumentation. Factors of the second type include the boiling scheme used, use of water at the pans, strike Brix, molasses separation, wash water used, and adjustment of pan floor working to avoid steam load fluctuations.

Efficient use of fuel steam—our efforts and success. UGAR SUGAR WORKS LTD. STAFF. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 119–120. When first built in 1942, Ugar Sugar Works Ltd. used 43% bagasse on cane as fuel. In 1955/56 it was modernized, with a new high-pressure boiler with spreader stoker in place of a step-grate low pressure boiler, a 1300 kW steam turbo-set with electric drive to new high-speed centrifugals instead of the former low-speed water-driven machines. An economizer was fitted to the new boiler, all condensates are now collected and used as boiler feed, extensive lagging has been fitted and particular attention is paid to maintaining uniform crushing. The triple-effect evaporator has been replaced by a quintuple-effect, and vapour bleeding has been introduced for juice heating. The evaporator can now operate with 10 p.s.i. exhaust steam, permitting a higher syrup Brix, and the net effect is to reduce bagasse consumption to about 23·5% on cane.

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To improve the thermal efficiency. M. ANAND and D. B. SABNIS. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 121–125.—Details are given of the steps taken at Krishna Sahakari Sakhar Karkhana Ltd. to improve milling so as to produce bagasse of the minimum moisture content and maximum calorific value, to burn bagasse efficiently with minimum loss and maximum steam generation, and to achieve maximum economy in steam usage by installation of prime movers and process equipment for minimum steam consumption.

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Diffusion plants for cane sugar extraction—will these revolutionize existing mills? N. B. LELE, S. P. KELKAR and R. M. DUVEDI. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 126–129.—A brief account is given of the advantages and disadvantages of cane diffusion *vs.* milling and very short descriptions are given of the existing commercial diffuser designs.

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Sugar factory lubrication: an attempt at standardization. G. K. CHETTY. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 138–141.—See *I.S.J.*, 1967, **69**, 178.

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Principles underlying adoption of fuel and steam economy measures in sugar factories. S. K. GHOSH. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 142–146.—A heat balance for a sugar factory is drawn up and the individual items discussed with the emphasis on heat economy of each.

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A note on reversal of cane cutter knives and dirty top rollers. G. K. CHETTY. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (1), 187–192.—Worn rollers on the second mill of a tandem were resulting in chokes because all the mills were driven by the same engine at constant speed and no individual

variation was possible. The "dirty rop roller" technique[1] was adopted, whereupon feeding trouble stopped and maceration could be increased, with resultant higher extraction. The practice was extended to the 3rd and 4th mills, maceration being higher and pressure increased at the 4th mill. The reduced mill extraction was maintained constant in spite of an increase of 1·5% in the fibre % cane. When cane deliveries fell, the opportunity was taken of reversing the direction of the cane knives so that their direction became against that of the cane blanket on the carrier. Further and more controlled testing is to be carried out but it is concluded from the experiments made that operation of the knives in this way provides almost as good preparation as a shredder, at practically no investment cost, provided that the knife motor has adequate power.

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(The) Continuous centrifugal machine. V. P. YAWALE and V. B. MUDHALE. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 17–24.—Data on the Buckau Wolf horizontal continuous centrifugal are tabulated, with a description of its construction. Trials were carried out with it for single-curing and double-curing of *C*-massecuite and the results are tabulated with corresponding data for a batch-type machine working on the same products. The machine is found to have many advantages including high and uniform sugar quality and throughput, low power consumption, cleanliness and low maintenance and labour costs.

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Corrosion and pitting of boiler headers and tubes in the Phaltan Sugar Works Ltd. G. K. JOSHI and S. V. DESHMUKH. *Proc. 21st Conv. Deccan Sugar Tech. Assoc. (India)*, 1966, (2), 45–52.—Examination of metal and analysis of the water explained the sudden occurrence of honey-comb pitting in the boiler tubes and headers, and severe corrosion of newly-replaced nipples; they were due to elimination of a header tank between the clarifier and evaporator (in which air in the clarified juice had separated). The aerated juice has resulted in dissolved oxygen in the condensate used as boiler feed.

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Our condensers. C. G. M PERK. *S. African Sugar J.*, 1967, **51**, 65–71.—The various types of surface and jet condenser are surveyed and a brief historical review given of condenser development. The efficiency of a condenser is discussed. Calculations are made for comparison of water requirements of a counter-current and a parallel-flow condenser; the latter requires more in all cases, the amount (25–41%) depending on the water temperature (85–95°F). The air to be removed is also greater (152–90%) depending on the water temperature. Consequences of installing a parallel-flow condenser instead of a counter-current unit are discussed; the only credit item for the former is its lower cost. Combinations of parallel-flow condensers operated with water-jet air extractors, water-ring vacuum pumps and with reciprocating pumps are discussed, and a table presented of capacities, velocities and dimensions of counter-current condensers of capacities ranging from 10,000 to 60,000 lb vapour to be condensed per hour.

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Installation of (a) back-pressure turbo-generator of moderate capacity. K. C. CHIANG. *Taiwan Sugar*, 1966, **13**, (6), 24–28, 11.—Detailed instructions are given on the various stages in the installation of an impulse steam turbine.

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Chemical products feeder for the treatment of boiler feed water. O. A. ESPINOSA Y DE LA T. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (2), 86.—A device is illustrated by a diagram and its operation is explained. A container is connected by a gate valve to the feed water inlet, this gate valve being kept fully open while a ball valve in a water line entering the container is so adjusted that the water entering the container requires 8 hours to dissolve the solid contents and carry them into the boiler feed line. The container is filled every 8 hours with sufficient chemical for the next 8 hours' treatment. Each boiler requires a separate device.

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Considerations on the cane compression curve of Noël Deerr. E. F. GONZÁLEZ A. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (2), 91–92.—NOËL DEERR's compression data for cane are plotted in the form of graphs of the volume of fibre, juice and air during the compression, of the volume of fibre and air, and of the volume of juice expressed. It is seen that up to about 500 p.s.i. the mixture contains air which is compressed; from 500 p.s.i. onwards, however, the volume of fibre remains practically constant at a value corresponding to a fibre density of 141·35 lb/cu.ft., and in milling considerations it should be borne in mind that this will be the value of fibre density during milling where pressures are always greater than 500 p.s.i.

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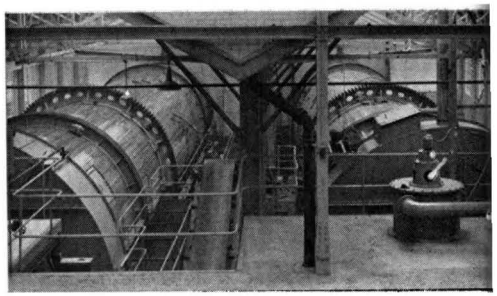
Cleaning of evaporators with soda and acid. Indexes for its control. R. P. PUERTAS. *Bol. Ofic. A.T.A.C.*, 1966, **21**, (3), 24–36.—An account is given of the electrochemical nature of corrosion of metals, tabulating the electrochemical series and briefly describing sacrificial anode protection. Certain chemical and physical properties of hydrochloric acid are discussed, as is the corrosive effect of caustic soda on various metals, a table of concentrations at various densities being appended. The nature of scale formed in the various bodies of an evaporator is tabulated and the various cleaning compounds reviewed: acidic, alkaline and detergent. Indexes for acid and alkaline usage—amounts which may be expected to be consumed—for various degrees of scaling are tabulated and discussed and some practical points in their use emphasized.

[1] CRAWFORD: *I.S.J.*, 1959, **61**, 307.

Beet sugar manufacture



Experience in the setting up of pulp drying plants at sugar factories. M. P. KHAZIN. *Sakhar. Prom.*, 1966, **40**, (12), 23–29.—After a brief mention of Soviet pulp presses, guidance is given on the conversion of solid fuel-fired dryers to gas- or oil-fired units. Results are given of tests carried out at one sugar factory where the unit now burns oil instead of solid fuel. At high thermal efficiency, the heat consumption per kg of moisture evaporated was 70–76% of the furnace input, while efficient insulation reduced the losses to 2·3–3·9% compared with 10–12% usually sustained in these units. The dry solids content of the pulp was increased from 15–16% to 89–93% during 25 min at an average daily throughput of 38 tons.

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Recent knowledge on processes using ion exchangers in some branches of the food industry. A. ZSIGMOND, E. GRYLLUS and E. MAGYAR. *Zucker*, 1966, **19**, 621–630, 655–661.—Ion exchange processes recently developed at the Hungarian Sugar Industry Research Institute are described (most of them have been patented). They cover a wide range, including: beet thin juice softening; sugar juice decolorization; glucose syrup purification; betaine extraction from molasses; and production of potassium and sodium carbonates from vinasse. Beet thin juice deliming tests with a 200-litre column gave an average lime removal efficiency of 94·5% at a resin capacity utilization of 59·8%. Low-grade product sugar solution of 45°Bx was passed through a "Wofatit EZ" granulated anion exchange resin which reduced the colour content by 50–70%. The effects of various factors were studied, including solution temperature, sugar and colour concentration and contact time. Betaine was extracted from beet by means of "Varion KS" strongly acid cation exchange resin in H^+ form. A recovery of 85–90% was obtained, compared with 30–40% by the normal alcohol extraction method. The scheme for potassium and sodium carbonate extraction from vinasse involves addition of alkali to precipitate out lime salts as calcium carbonate. After filtration, the alkaline solution is passed through a cation exchange resin in ammonium form, and the resultant vinasse, containing ammonia, used directly as substrate, or the ammonia liberated by adding lime and distilling. The cation exchanger charged with alkali ions is regenerated with ammonium carbonate to give a mixture of potassium, sodium and ammonium carbonates. (The ammonia is distilled off and together with the ammonia recovered in other stages is converted by CO_2 to ammonium carbonate and re-used for regeneration.) The mixture of K and Na carbonates is evaporated and subjected to fractional crystallization, giving a 80–85% recovery of the alkali contained in the vinasse solution in the form of 80–85% recovery of the alkali contained in the vinasse solution in the form of 80% and 60% potash crops. This recovery is approx. the same as obtained by fractional crystallization of the vinasse ash direct.

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The use of special steel and plastics at the Elsdorf sugar factory of Pfeifer & Langen. R. ZURHELLE. *Zucker*, 1966, **19**, 661–663.—Details are given of the pieces of equipment and components which, for various reasons, have been made of special steels and plastics.

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Liming juice before 2nd carbonatation. S. ZAGRODZKI and J. MAKOWSKI. *Gaz. Cukr.*, 1966, **74**, 261–265. Tests showed that adding 0·2% CaO (on raw juice) to 1st carbonatation juice before gassing reduced the lime salts content in thin juice by 10–20% and the colour content by 10–30%, the effect being more pronounced with very dark 1st carbonatation juice. The method is particularly recommended where low purity raw juice is being processed, the purification efficiency rising as the raw juice quality falls.

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Research on continuous DDS diffusion using isotopes. Investigation of movement of the solid phase. P. HOFFMANN, W. GAWLOWSKA, S. CIESLIK, A. POCZYNAJLO and S. GAWRYCH. *Gaz. Cukr.*, 1966, **74**, 265–268.—Thin rods of sodium glass containing ^{24}Na each of 3 mC activity were placed one on each side and towards the head of a DDS diffuser. The movement of cossettes was then observed by means of counters placed at regular intervals on each side of the diffuser. The tests were carried out at three different speeds of rotation of the screw and three different cossette lengths, each corresponding to a given speed. Diagrams and graphs indicate the highly complex paths followed by the cossettes.

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The central control station at Plattling—experiences from five campaigns. H. HAESELER. *Zucker*, 1967, **20**, 9–21.—Details are given, with numerous coloured illustrations, of the central control station of the Plattling white sugar factory of Süddeutsche Zucker A.G.[1] The factory started operations in 1961 with a

[1] *I.S.J.*, 1962, **64**, 272.

daily slice of 3000–3300 tons but a slice of 4500 tons of beet per day is now achieved without any modifications to the diffusion station, which consists of one Buckau-Wolf tower. The control station is located on a central floor 7 metres above ground level and is surrounded by all the main process stations; the room has glass walls and three control consoles, two much longer than the third. A "Zetfax" facsimile unit in the middle of the room accepts and reproduces in written form analytical data from the laboratory. Data concerning the pan and centrifugal stations are transmitted to the appropriate station. Local control panels, subordinate to the central panels, supervise the pan station, beet washing, the lime station, and the screen and despatch station; the last of these is also subordinate to the sugar loading station. Information is given on individual control systems, and the accuracy of control is exemplified by strip chart sections demonstrating the consistency of 1st and 2nd carbonatation juice pH. Total costs of the central control station are given as DM 3·33 million (approx. £303,000), including assembly, materials and total labour costs.

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Problems relating to the economy and purification of sugar factory waste waters. G. MANEA, T. INOCENTIU and R. COJOCARU. *Ind. Alimentara*, 1966, **17**, 38–42; through *S.I.A.*, 1966, **28**, Abs. 917.—The quantities and compositions of waste waters from nine Rumanian beet sugar factories are tabulated and the treatment methods used are described. The water consumptions per ton of beet are 4·2—8·4 cu.m. in factories with continuous diffusers and 12–19 cu.m. with diffusion batteries.

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Length of the production cycle at sugar factories. B. S. ZHALOV. *Sakhar. Prom.*, 1967, **41**, (1), 4–8.—Tabulated data for the 38 sugar factories in the Vinnitsa trust in the Soviet Union show the overall production times at each factory as well as the retention times at individual process stations and the size of the equipment at the individual stations, expressed in terms of weight of sucrose. The factories are grouped according to the type of filters used for 1st and 2nd carbonatation juice. The overall production cycles ranged from 7·7 to 14·4 hours. The data show that those factories with short production cycles have more efficient juice purification and yield more white sugar of lower colour content with lower undetermined losses than do factories with long cycles. The value of the survey is assessed and the procedure for compiling the data is described.

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Use of synthetic fibre filter cloths. V. A. ZAMBROVSKII. *Sakhar. Prom.*, 1967, **41**, (1), 18–21.—Results obtained at a number of Soviet sugar factories in filtration tests using filter cloths made of caprone and of a "Terylene"-type synthetic fibre are discussed. In general, the "Terylene"-type cloth proved superior to the caprone and cotton cloths[1]. The results are summarized in a table which recommends the "Terylene"-type cloth for bag filters (service life 108 days), vacuum filters (service life 86 days) and DGS-59 mud thickeners (service life 26 days), while a caprone-"Terylene" mixture is recommended for disc filters (service life 44 days). Caprone cloths are also recommended for use in bag filters and DGS-59 mud thickeners, in which their service life was 35 and 15 days, respectively. In bag filters, the "Terylene"-type cloths gave a higher filtration rate and a more transparent filtrate than did caprone or cotton cloths, while also requiring less frequent washing. Tests are being conducted on filter cloths treated with various organo-silicon compounds to overcome the problem of blinding.

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Real evaluation of the flume water problem. S. KOLACZOWSKI. *Gaz. Cukr.*, 1966, **74**, 285–291.—The problem of flume water treatment for recirculation purposes is discussed in connexion with the problem of beet mechanization. The author seeks to find a compromise between the costs to the factory of extra equipment to handle the flume water contaminated by mechanically-harvested beet, and the costs to the beet farmer of machines to handle and clean mechanically-harvested beet, it being decided that manual labour for beet lifting is too costly. Schemes for flume water recycling are discussed and various measures recommended.

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Conditions and trends of modernization of water and waste water economies in Polish sugar factories. K. SKALSKI. *Gaz. Cukr.*, 1966, **74**, 292–295.—The water usage and waste water production at Polish sugar factories is discussed generally in the light of increased beet processing and the fact that by 1980 the Polish sugar industry will suffer from a deficiency of fresh water. Methods of waste water treatment and utilization whereby the problem may be overcome are discussed.

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Return of press water to continuous diffusers. P. M. SILIN. *Gaz. Cukr.*, 1966, **74**, 304–305.—See *I.S.J.*, 1967, **69**, 148.

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Modern feed water treatment station. E. MALANOWSKI. *Gaz. Cukr.*, 1966, **74**, 305–308.—At the Serrae sugar factory in Greece, ferric chloride solution is added to raw water used as boiler feed to coagulate and settle out colloids. The water is then passed through sand filters and limed. This converts calcium and magnesium bicarbonates to their respective carbonates which are precipitated. Magnesium chloride and sulphate are converted to insoluble magnesium hydroxide, leaving the calcium salts in solution. The dissolved calcium is removed by gassing with CO_2 in a special mixer, any remaining being removed by passing the water through two "Wofatit F" cation exchangers in Na^+ form. The treated water has a hardness less than 0·1° and a pH of 7·5.

[1] See also *I.S.J.*, 1965, **67**, 119.

The control of microbial activity in raw juice extraction. I. VAVRA and Z. TOT. *Zeitsch. Zuckerind.*, 1967, **92**, 18–25.—For examination of the microbiological status of juice samples it was found best to dilute to approximately 5°Bx before incubation for 1–3 hours at 45°C. A pH fall of 0·5–1·0 units, considered quite usual when juice is not disinfected, is shown (by comparison with the pH of juices to which lactic acid had been added) to be equivalent to a loss of 0·2% sugar on beet. The fall in pH of beet press juice was found to be a satisfactory criterion for microbial activity. In attempts to devise techniques suitable for microbial control of diffusion in a works laboratory not provided with the facilities available in a microbiological laboratory, it was shown that cleaning of Erlenmeyer flasks by brushing and washing with a detergent, followed by rising with normal drinking water, was adequate since, although they are not made completely sterile, only slight changes in pH occurred after 5 and 12 hours' incubation in them of sterile juice. It is not necessary to place cotton plugs in the necks of the flasks, but merely to cover them with a washed beaker. In tests on disinfection of diffusers and press water with formalin, it was found that large doses added every 8–12 hours did not have the desired result since microbes accompanying the cossettes into the diffuser caused fresh infection two hours after formalin addition. It is thus better to add smaller amounts more frequently, while continuous addition of 0·010–0·015% formalin on weight of beet to a diffuser will completely inhibit bacterial activity. Press water can be effectively disinfected with 5 litres of formalin per hour or 10 litres every 2 hours, equivalent to 0·008% on beet.

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Lime-carbon dioxide purification in the sugar factory with some examples of variants. J. HENRY. *Sucr. Belge*, 1967, **86**, 221–239.—See *I.S.J.*, 1967, **69**, 212.

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Contributions to the improvement in clarification of juice from sugar plants. F. DOMSA *et al. Lucr. Inst. Cerc. Alim.*, 1964/65, **7**, 127–135; through *Abs. Rom. Tech. Lit.*, 1966, **2**, (4), Abs. 1016.—As a result of experiments made with a micro-installation at the Bucharest Food Research Institute on variations of clarification technique with juice obtained in a laboratory continuous diffuser, it was concluded that the technological quality of the beet varied with the district of origin and that this was manifested in the physical and chemical characteristics of the first carbonatation juice. However, by modern techniques beet of different quality would give a 1st carbonatation juice having a filtration coefficient F_k between 1·5 and 4·5, ensuring ready separation of muds. Only from beet grown in the northern part of Rumania and stored for not more than 60 days is it possible to obtain a juice of sedimentation coefficient S_k over 3, suitable for decanting and giving a mud filterable through a vacuum filter. Based on their researches, the authors recommend the utilizing of continuously-operating "concentrating strainers" for mud separation from 1st carbonatation juice, with vacuum filters for filtration and sweetening-off of the muds.

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Development of sugar centrifugal drives in the Siemens Group. H. F. ALTMANN. *Zucker*, 1967, **20**, 59–68. A review is presented of centrifugal drive development by Siemens, starting with the development of the dynamo principle of WERNER VON SIEMENS expounded 100 years ago. It is pointed out that while pole-changing A.C. motors have been developed to a point where only minor improvements may be effected, thyristor-fed D.C. motors offer advantages over the A.C. motor which could be of major importance as centrifugal drives. Since the D.C. motor is a variable-speed motor with adjustable torque, the speed being adjustable at any time, a centrifugal provided with this type of motor is suitable for all massecuites and sugar qualities. The article is illustrated with numerous photographs and some diagrams.

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Composition and examination of boiler flue gases. H. ANDERS. *Zucker*, 1967, **20**, 68–70.—Measures whereby it is possible to obtain a solid-fuel boiler flue gas containing minimum CO and maximum CO_2 are discussed and methods of analysing flue gas (using the Orsat analyser or similar equipment, or an electric flue gas analyser) are described.

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Investigation of continuous defecation and carbonatation at Plovdiv. A. H. MLADENOV and T. SIRÀKOV. *Nauch. Trud. Vissh. Inst. Hranit. Vkus. Prom. Plovdiv*, 1964, **11**, 197–202; through *S.I.A.*, 1966, **28**, Abs. 955. Tests of continuous juice purification at a Bulgarian beet sugar factory are reported, using a Kartashov predefecation system, a Nogachevskii main defecator with propeller stirrer, and continuous carbonatation without automatic control.

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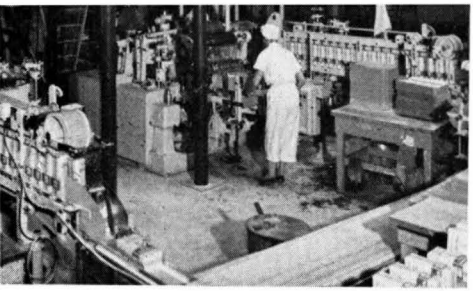
Crystallization of high purity massecuites. I. N. AKINDINOV and V. G. KALASHNIKOVA. *Trudy Krasnodar. Nauch. Issled. Inst. Pishch. Prom.*, 1965, **2**, 39–45; through *S.I.A.*, 1966, **28**, Abs. 965.—A modified 2-massecuite system was investigated, suitable for treating low-purity beet syrups. The 2nd (low-grade) massecuite is boiled at a purity of 81·5–83·4 to a crystal content of 40–46·7%. Subsequent crystallization is carried out for an extended period (e.g. 26 hr) during which portions of the massecuite are subjected to "preliminary centrifugalling" to remove the excess crystal, e.g. after 6, 12 and 18 hours. Further details of the preliminary centrifugalling are not given. In laboratory crystallization tests, the final molasses purity was lowered to within 0·2–2·3 units of normal purity. Numerical results of the tests are given, together with a table of the non-sugar concentrations in massecuites of 80–83·8 purity and 90–94·8°Bx.



Sugar refining

Clarifier studies at C & H. L. A. ZEMANEK and C. E. KEAN. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 123–138.—A detailed account is given of the difficulties encountered when a mixture of Jacobs and Bulkley-Dunton flotation clarifiers, assembled for experimental purposes over the years since 1946 and totalling 7500 g.p.h. capacity, was replaced by a single Sveen-Pederson unit. The latter was expected to allow easy application of experience collected with the other units as it was of similar design but had individual features thought to permit better control. In the event, the system in operation had to be changed basically and it was ten months before performance became satisfactory. Treatment of scum is discussed; precoat Oliver filtration had a number of disadvantages, as had the use of desludging centrifuges; however, successful results could be achieved using a Mirrlees Watson "Poly-Cell" clarifier or Sweetland filters. Polish filtration of clarifier effluent would require almost as many Sweetland filters as the clarifier eliminates, so making its installation unattractive; however, provided the effluent is of good clarity, filtration before the char columns might not be necessary.

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A comparison of carbonatation and phosphatation-flotation in C.S.R. refineries. W. A. BENNETT, E. W. P. CUNNEEN and A. M. HERTZBERG. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 162–171.—Comparison of the phosphatation-flotation system used for washed sugar liquor clarification in four refineries of the Colonial Sugar Refining Co. Ltd.[1] with the carbonatation system used at two other C.S.R. refineries shows that the former method removes less ash and causes 0·01% inversion (on total solids in melt), while it removes an average of only 30% of the colour in melter liquor compared with 55% removal by carbonatation. Char requirements in phosphatation refineries are 30–35% on melt compared with 17–20% on melt in carbonatation refineries. Probably because phosphatation removes little or no sulphate, the bone char has proved to be less effective as a pH buffer, with the result that the liquor running period has to be stopped early because the pH falls to the minimum safety level. A decrease in the liquor flow rate over the char was caused by an excessive suspended solids contents in phosphatation liquor; these were found to be cane "fibre" and other organic matter of plant origin. Treatment of the liquor in a centrifugal separator reduced the fall in flow rate, while filtration permitted almost constant flow rates with an increase of about 30% in throughput compared with the unfiltered liquor. Filtration also reduced fluctuations in the cistern sweetening-off times. For adequate filtration, 0·15–0·20% kieselguhr is required and the filtering area should be about the same as for carbonatation, thereby removing the cost advantage of phosphatation over carbonatation. The suspended solids were also found to have an adverse effect on decolorization by bone char. While the difference between the concentrations of polyvalent anions and polyvalent cations (EPA)[2] was greater in phosphatation liquors than in carbonatation liquors, the effect of this difference in the EPA on char requirements has not yet been established. While the bacterial counts in phosphatation liquor were greater than in the carbonatation liquor, both liquors had low and similar counts after char treatment.

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Continuous in-line Brix measurement and control. J. J. QUINTERO. *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 181–187.—The Fischer & Porter in-line Brix measurement system determines the Brix by comparing the weight of a column of the sugar liquor or syrup with that of a column of water at the same temperature. The sugar solution is passed through a vertical measuring chamber into which purge water, heated by a heat exchanger inside the chamber to the same temperature as the solution, is also fed at a flow rate maintained by a purge meter with a constant differential pressure regulator, which is pre-set to supply the water at a pressure slightly above the head pressure in the chamber. The Brix transmitter sends an output signal, proportional to the pressure differential exerted by the solution over the water column, to a recording controller. An accuracy of up to $\pm$ 0·5°Bx or better is claimed to be possible over a narrow Brix range, provided reasonable tolerances are maintained. Possible uses illustrated include measurement of the Brix of syrup leaving the last evaporator effect and the control of dilution water supply to a melter. A chart demonstrates the maintenance of Brix over long periods at 55°Bx with an accuracy of $\pm$ 0·25°Bx which at one period fell to $\pm$ 0·75°Bx when additional quantities of sugar were fed from another source. Use of a more sophisticated system as described would, it is claimed, give even greater accuracy.

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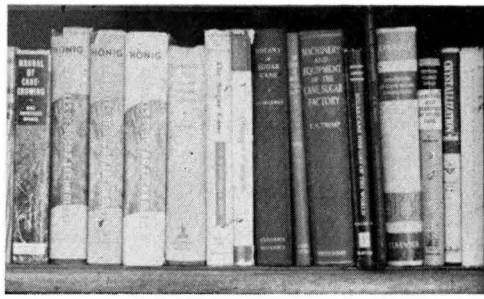
[1] *I.S.J.*, 1963, **65**, 208.
[2] *ibid.*, **65**, 239.

New books



Guyana. 34 pp.; 6 × 8 in. (Barclays Bank D.C.O., 54 Lombard St., London E.C.3, England.) 1967.

In this well-produced booklet on Guyana, some five pages are devoted to the sugar industry. The general outlines of the industry are accompanied by a table showing the sugar production in the years 1955–66, and the level of sugar exports, which are given as 279,141 tons (valued at £10,105,424) out of a total production of 288,869 tons. It is pointed out that over 96% of the sugar comes from 11 large and 2 small estates, served by 11 factories, slightly under 80% being produced by Bookers Sugar Estates Ltd. The Demerara Co. Ltd. estates produce nearly 20%, while the remainder is produced from cane bought from small farmers. Despite the fact that the country is ideal in some ways for cane growing, it has difficulties not apparent in other countries, or not to the same extent. Since there are two dry and two wet seasons, the year's crop must be harvested in two separate milling seasons. However, the intervals between the seasons are too short for easy maintenance of the machinery. Moreover, although the heavy rainfall and high water table permit good cane growth, the sucrose content is lower than in drier and better-drained countries, so that about 10½ tons of cane are needed per ton of sugar. Other aspects of the country's economy are dealt with in a clear and concise manner.

* * *

Sugar price movements in world and U.S. domestic markets. (C. Czarnikow Ltd., Plantation House, Mincing Lane, London E.C.3.) 1967.

This is an annual record which takes the form of a graph, measuring approx. 22 × 30 inches, showing the world price of sugar (including the London Daily Price and the New York No. 4 and No. 8 Contract Spot Prices), the U.S. Domestic Market Price (including the New York No. 6 and No. 7 Contract Spot Prices) and the Commonwealth Negotiated Price. The chart covers the period from January 1959 to December 1966 and notes, at appropriate places, those factors which had significant effects on the prices at particular periods. The ordinates are cents/lb and £/ton. An inset panel gives a graph of the average world values during the period 1928–1966. It is interesting to note how the graph is divided into three quite distinct sections, with prices fluctuating only relatively slightly in the range £20–30 per ton during the period January 1959–December 1961, followed by the gradual rise during 1962 and the phenomenal leap to over £100 per ton in 1963. After this the prices fell just as abruptly throughout 1964, and since then have continued a downward trend, picking up only slightly this year. As the reader may gather, the chart, produced by one of the world's leading sugar brokers, presents a very clear picture of sugar price movements.

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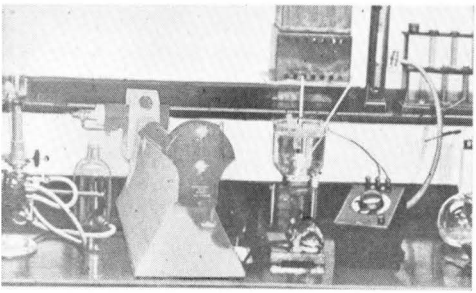
Advances in carbohydrate chemistry. Vol. 21. M. L. WOLFROM and R. S. TIPSON. 572 pp.; 6 × 9 in. (Academic Press Inc., 111 Fifth Avenue, New York, N.Y., 10003 U.S.A.; Academic Press Inc. (London) Ltd., Berkeley Square House, Berkeley Square, London W.1.) 1966. Price: 156s 0d.

To celebrate the 21st anniversary of "Advances" the present volume contains a 38-page review of the contributions of EMIL FISCHER to carbohydrate chemistry by one of his students, Professor KARL FREUDENBERG. It is stated that FISCHER's entry into the field of sugar was a result of his finding that phenylhydrazine forms readily isolable, characteristic compounds with the sugars. As with the other carbohydrate groups, he made a fundamental and thorough study of sugars, finding connexions between different kinds of sugars and discovering new sugars, using phenylhydrazine again and again, but also developing other methods. His use of the stereochemistry of the sugars to develop the theory of VAN'T HOFF and LE BEL on the spatial arrangement of atoms led to unanticipated consequences, and by studying the sugars, amino acids and proteins, he established experimental evidence of the manner in which natural compounds of high molecular weight are built up.

Among the other monographs in this volume is one on the application of mass spectrometry to the structural analysis of carbohydrate derivatives (written by KOCHETKOV & CHIZHOV); the glycofuranosides (J. W. GREEN); deoxy sugars (S. HANESSIAN); complexes of alkali metals and alkaline-earth metals with carbohydrates (J. A. RENDLEMAN); synthetic cardenolides (W. W. ZORBACH & K. V. BHAT); the teichoic acids (A. R. ARCHIBALD & J. BADDILEY); the effects of plant-growth substances on carbohydrate systems (H. W. HILTON); and chemical synthesis of polysaccharides (I. J. GOLDSTEIN & T. L. HULLAR).



Laboratory methods & Chemical reports

Studies on the keeping quality of Indian plantation white sugars. Part I. Colouring matter developed in sugar crystals during storage. N. A. RAMAIAH and B. I. NEMADE. *Sharkara*, 1965, **7**, 140–147.—The nature of colouring matter which was produced in plantation white sugars during storage was examined using spectrophotometry in the u.v. and visible spectra and by paper chromatography. The colouring matter was identified as caramel, produced by the same reactions as at high temperatures but at very much slower rate during storage.

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Rapid volumetric method for determining calcium and magnesium in limestone. M. ROCHE. *Sucr. Franç.*, 1967, **108**, 2–3.—The method proposed for use where only Ca and Mg are required is as follows: 1 g of the powdered sample is treated with a little water and the minimum possible amount of HCl. The product is boiled for a minute to eliminate CO_2, transferred to a 200 cc flask and made up to volume after cooling. The insoluble material (silica) is separated by decanting. A 10 cc aliquot of the supernatant is treated with a little water, a few drops of triethanolamine and a few cc of N NaOH. It is then treated with 0·01M disodium EDTA solution, using calceine* as indicator. A second aliquot is titrated using Eriochrome as indicator; the first titre corresponds to the $CaCO_3$ content and the second to the $CaCO_3 + MgCO_3$.

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Isolation of 1-ketose and nystose by chromatography on a cation exchange resin. R. M. MCCREADY and J. C. GOODWIN. *J. Chromatog.*, 1966, **22**, 195–197; through *S.I.A.*, 1966, **28**, Abs. 899.—A 20-g sample of sucrose was incubated with 10 g of Takadiastase in water at 20°C for 24 hr and 25 ml of the resulting oligosaccharide mixture (10% solids) added to a 4·5 × 122-cm column of 200–400 mesh "Dowex 50W X 4" resin (4% cross-linkage with divinylbenzene in the K^+ form). This was eluted with 0·2% potassium benzoate at 0·5 ml/min, and samples from the 200 fractions collected were analysed by paper chromatography. The fractions containing 1-kestose and nystose were combined separately. Potassium benzoate was removed from these fractions by ion exchange with 1 g of 50–100 mesh "Dowex 50W X 8" resin in the H^+ form and 2 g of 60–80 mesh "Permutit A" resin in the OH^- form. Three runs yielded 1·2 g of 1-kestose syrup and 1·3 g of tetrasaccharide syrup. Fine white crystals of 1-kestose were obtained by seeding and crystallization in anhydrous methanol, followed by recrystallization in water and anhydrous methanol [m.p. 198–200°C, $(\alpha)_D^{25}$ +28·4°, R_g 0·187]. Nystose crystallized as elongated plates from the tetrasaccharide syrup in anhydrous methanol [m.p. 130–133°C, $(\alpha)_D^{25}$ +9·7°, R_g 0·104].

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Crystallization of supercooled sucrose melts. A. V. ZUBCHENKO. *Khlebopekar. Konditer. Prom.*, 1965, **9**, (11), 19–20; through *S.I.A.*, 1966, **28**, Abs. 907. Pure sucrose (melting point 188°C) was melted at 195°C and transferred to a constant temperature in the range 90–130°C. The number of crystal nuclei appearing in unit time was measured with a microscope. Owing to the presence of decomposition products, it is not possible to determine whether sucrose normally passes into the glassy or the crystalline state on cooling.

* * *

Dependence of rate of formation of crystal nuclei in molten sucrose on temperature. A. V. ZUBCHENKO. *Khlebopekar. Konditer. Prom.*, 1966, **10**, (2), 12–14; through *S.I.A.*, 1966, **28**, Abs. 908.—Measurements of crystal formation rates in supercooled sucrose melts (cf. preceding abstract) are analysed by the fluctuation theory in order to determine the physical parameters of solidification. An increase in the nucleation rate to a maximum with decreasing temperature, followed by a decreased rate at lower temperatures, is in accordance with the theory. The temperature for maximum nucleation is about 110°C. The activation energy of nucleation, 23 kcal/mole, is similar to that for mannitol (22·58). The work of formation of a 3-dimensional nucleus is $2·1 \times 10^7$ (units not stated); from this, the surface tension at the crystal-melt interface is calculated to be 15·6 ergs/sq.cm., which is similar to that for other organic compounds.

* * *

Catalytic inversion of sucrose with "Amberlyst 15". Y. MURAKAMI and O. MORI. *J. Chem. Soc. Japan, Ind. Chem. Sec.*, 1966, **69**, 588; through *S.I.A.*, 1966, **28**, Abs. 911.—Inversion rates were measured at 50°, 70° and 90° in the presence of 65–200 mesh particles of a macroreticular cation exchange resin. The reaction rates were independent of particle size within this range, indicating an absence of diffusional retardation. The activation energy was the same as in homogeneous solution, but the reaction rates were much slower. It is concluded that H^+ ions are

* bis [bis – (carboxymethyl) – aminomethyl] – 2′,7′ – fluoresceine (Merck).

packed too closely on the resin surface, relative to the size of a sucrose molecule; less than one-tenth of the H^+ ions present are effective in catalysis.

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Investigations of filter-aid behaviour. D. N. SUTHERLAND and P. HIDI. *Trans. Inst. Chem. Eng.*, 1966, **44**, T122–T127; through *S.I.A.*, 1966, **28**, Abs. 914.—By considering the filter cake as a series of septa, in each of which the particles of impurities partially block the pores without changing the cake volume, it is shown that $\log (r_b/r_a) = 0{\cdot}4343kl\rho_a(1-\epsilon_a)c/a\epsilon_a$, where r_a, r_b are specific cake resistances of filter cake and partially blocked filter cake, respectively, l is the diameter of filter aid particles, ρ_a is the particle density of the filter aid, ϵ_a is porosity of the filter aid, c is the concentration of impurities, and a is the concentration of filter aid. The filtration rate f and r_a, r_b were measured for 60% sugar solutions in which a was 0·25–3·0 g/100 g of solids in solution, and c was varied over a wide range by using C-sugar/sucrose mixtures containing 0–85% of the former. With either "Celite 505" or asbestos filter aid, a graph of $\log_{10} r_b$ against c/a was a straight line, in agreement with the theory. If the slope of this line $= G$, it is shown that $a_{opt} = Gc/0{\cdot}4343$, where a_{opt} is the optimum filter aid concentration, i.e. that giving maximum filtration rate. It is also shown that $\sqrt{a_{opt}} = 0{\cdot}607f$; filtration rates measured in the presence of "Celite 505" at six values of c showed good agreement with this equation.

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Determination of grain size distribution, number of particles and the surface of sugar aggregates by means of sieve and sedimentation analysis. H. SCHIWEK. *Zucker*, 1967, **20**, 33–44.—While sieve analyses can be presented in graph form with normal coordinates, whereby the fractions retained by each screen size are added together to give a "total retention" curve, the latter can be presented in linear form on probability paper, or preferably by a "grain lattice" representing the ROSIN-RAMMLER-BENNETT (RRB) function. The RRB "grain lattice" is the graphic representation of an empirical approximation formula derived from coal grinding tests[1]. The formula was given the following form by BENNETT[2]: $R = 100\ e^{-(d/d')^n}$, where R = % crystals retained of grain size greater than grain diameter d, e is the base of natural logarithms, d' is the grain size index[3] (the mean grain size), and n is the uniformity index[3]. It has been found that the RRB distribution is the best form in which to represent the grain size distribution of sugar aggregates. A graph of aggregate surface area in sq.m./kg *vs.* d' has been constructed from recalculated values obtained by other authors, and gives values which differ somewhat from those obtained by WERNER[4]. The construction of an RRB "grain lattice" is explained. The abscissae give the sieved grain size, drawn on a log scale, while the ordinates give the crystal retention (R) drawn on a scale of log log $100/R$. A sieve analysis produces a linear plot the slope of which is equal to n and is easily determined by drawing a parallel from a focus point in the lattice towards an external scale which is calibrated in values of n from 0·92 to 3·0. Methods described for determination of the grain size distribution in finely milled sugar include techniques using the ODEN sedimentation balance and the ANDREASON pipette method. Full details are given of the procedures. Plotting of the values obtained for powdered sugar according to the RRB distribution method showed that there was wide divergency between the grain size distribution in different powdered sugars. The effect of various factors in milling of these sugars is discussed, of which only two have any practical significance: peripheral velocity and surface area of the feed material. The number of particles in slurry sugar used for seeding was also determined by various methods which are described, and recommendations are made whereby it is possible to obtain approximately the same defined number of particles per unit weight.

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The rôle of water in molasses formation. N. P. SILINA. *Sakhar. Prom.*, 1967, **41**, (1), 16–18.—Reference is made to the work of KHVALKOVSKII[5] on the effects of various non-sugars on molasses viscosity. It is pointed out that in an attempt to calculate the amount of water necessary to add to each of the non-sugars studied in order to obtain a standard molasses, the quantity of water in the molasses after non-sugar addition was considered but not the change in dry solids content brought about by the addition. In the present article an equation is developed which takes the dilution into account, and the quantities of water per g of added non-sugar required to give a molasses having a viscosity of 4·4 newtons/sec/sq.m. as calculated with KHVALKOVSKII's equation and the proposed equation are compared. It is shown that in contrast to KHVALKOVSKII's findings, calcium and magnesium salts do not require less water than sodium salts but require more than potassium salts. Carbonates, acetates and chlorides, having a considerable effect on sucrose solubility, require large quantities of water, whereas nitrates cause a considerable reduction in sucrose solubility and solution viscosity and therefore only require a small quantity of water.

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Ion exclusion equilibria in the system sucrose-potassium chloride-water-"Dowex 50W X 4". General correlation of ion exclusion data. W. MEYER, R. S. OLSEN and S. L. KALWANI. *Ind. Eng. Chem., Process Design & Dev.*, 1967, **6**, (1), 55–62.—The effect of temperature and sugar and salt concentration on equilibria in the system sucrose-KCl-water-"Dowex 50W X4" at sucrose concentrations of 0–60% by weight and

[1] ROSIN, RAMMLER & SPERLING: *Wärme*, 1933, **56**, 783.
[2] *J. Inst. Fuel*, 1936, **10**, 22.
[3] PUFFE: *Erzbergbau Metallhuttenwes.*, 1948, **1**, 97.
[4] *I.S.J.*, 1963, **65**, 339.
[5] *ibid.*, 1966, **68**, 277.

KCl concentrations of 0, 1, 3 and 6% by weight has been measured. For 60% sucrose and 0% KCl, increasing temperature increased the amount of sucrose sorbed. From 60° to 90°C the increase was 4·3 mg of sucrose per dry gram of K^+ resin per °C. Equilibrium measurements at 90°C showed that the amount of sucrose sorbed decreased with increasing KCl concentration; at fixed solution KCl concentration the increasing solution sucrose concentration increased the amount of salt sorbed by the resin. The average distribution ratio of sugar to salt in the resin and the solution was 2·32 for solutions containing 1% KCl by weight; it decreased to 1·65 for concentrations of 3% and 6% KCl by weight. These results show that sucrose can be separated from the salt by successive batch or continuous counter-current columnar treatment. The sucrose sorption data were correlated by the *n*-form of the BET multimolecular adsorption equation[1]. This equation was applied to the correlation of other ion exclusion data and found to be generally applicable to systems where the sorbed solute shows a limited solubility in the solvent phase.

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Reverse osmosis separation and concentration of sucrose in aqueous solutions using porous cellulose acetate membranes. S. SOURIRAJAN. *Ind. Eng. Chem., Process Design Dev.*, 1967, **61**, (1), 154–160.—The effects of operating pressure and feed concentration on solute separation and product rate for the system sucrose-water were studied, and the data correlated by empirical equations. Some parameters of process design are illustrated from the point of view of developing this separation process as a practical batchwise concentration technique. The variation of product rate as a function of feed concentration was studied at the operating pressure of 1500 p.s.i.g. using three typical films capable of giving more than 99% solute separation in the entire feed concentration range 0·1–1·4M. Performance of films was also studied in a month-long continuous test run. On the basis of the experimental results, it is estimated that the porous cellulose acetate membranes of the type employed may be expected to have actual processing capacities of 20 to 30 gallons of feed solution per day per square foot of film area at an operating pressure of 1500 p.s.i.g. for concentrating aqueous sucrose solutions from 3·3 to 32·4% by weight. A few experiments were conducted using natural maple sap containing 3·76% equivalent sucrose; increase in solute concentration up to 34·6% with reasonable processing capacities for the membrance and essentially 100% solute recovery were obtained.

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Mechanics of the Maillard reaction. II. J. JEŽO. *Listy Cukr.*, 1966, **82**, 300–302.—After extraction of 4(5)-methyl imidazole and pyrazine from molasses solutions a number of low-molecular imidazole and pyrazine derivatives, *inter alia*, were found in the residual solutions, although they occurred in small quantities. Details are given of the isolation methods used and of the chemical composition and physical properties of the fractions isolated.

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Ion exchange membranes in the sugar industry. I. Test methods. K. ČÍŽ and V. ČEJKOVÁ. *Listy Cukr.*, 1966, **82**, 302–307.—Cation and anion exchange membranes from East Germany (manufactured by VEB Farbenfabrik Wolfen) and from the Soviet Union (unspecified) were tested as were Permutit "Permaplex C 10" cation and "Permaplex A 10" anion exchange membranes. Their thickness, tensile strength, specific area (sq.m./kg), weight when wet and dry, dry solids content, exchange capacity and swelling capacity were determined and the results tabulated. In further tests the current density on the membrane and the permeability were determined with (i) KCl and water, and (ii) sucrose and water and the results expressed in graph form, showing the relationship between (i) the conductivity of the KCl solution and time, and (ii) concentration of the sucrose solution and time, with free diffusion of water through the membrane in both cases. The effect of sugar solution concentration on migration through the Wolfen membranes was studied with 0–80°Bx sugar solutions and KCl, $CaCl_2$ and $FeCl_3$ as electrolytes. The results are expressed in graph form.

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New photoelectric polarimeters. ANON. *Sugar y Azúcar*, 1967, **62**, (1), 34–35.—Photographs and descriptions are given of the Schmidt & Haensch "Saccharomat I" and "Saccharomat II" automatic saccharimeters[2].

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Technique of preparing an artificial low-grade massecuite. I. N. AKINDINOV. *Trudy Krasnodar. Nauch.-Issled. Inst. Pishch. Prom.*, 1965, **2**, 36–38; through *S.I.A.*, 1966, **28**, Abs. 967.—The method of preparing an artificial massecuite, for analytical or research purposes, from saturated molasses and sugar is described. The saturation coefficient is first determined as a function of non-sugar concentration. Any given inter-crystalline syrup composition can then be produced by dilution or concentration and/or dissolution of sugar. However, a low-purity massecuite can only be produced from a molasses of lower purity.

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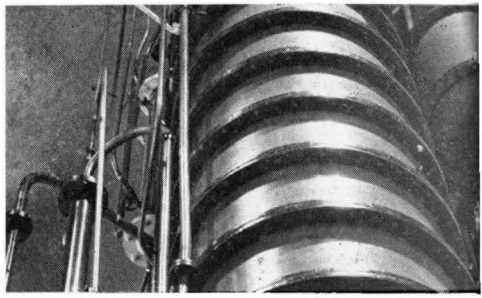
Influence of an ultrasonic field on the course of hydrolysis of aqueous sugar and dextrin solutions. B. ZAPIÓR and A. LITYŃSKA. *Zeszyty Nauk. Univ. Jagiell.*, 1965, (10), 151–157; through *S.I.A.*, 1966, **28**, Abs. 1014. Treatment of sucrose solution at various pH values with ultrasound at 800 k.-herz resulted in a small increase in the rate of inversion.

[1] BRUNAUER *et al.*: *J. Amer. Chem. Soc.*, 1938, **60**, 309.
[2] *I.S.J.*, 1963, **65**, 58.

By-products



Bagasse briquettes solve storage problems, spur new industry. B. PULIDO R. *Sugarland*, 1966, **3**, (7), 22. See *I.S.J.*, 1965, **67**, 123.

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Effect of inoculation of lactic bacteria on the quality of beet pulp. L. VOKOUNOVÁ and B. HYLMAR. *Listy Cukr.*, 1966, **82**, 282–285.—Beet pulp was inoculated with lactic bacteria culture immediately after leaving the diffuser and stored for 151 days. The loss in weight and dry solids was 1·89% and 0·03%, respectively, in pulp (i) inoculated with a given amount of culture, and was 3·07% and 0·07%, respectively, in pulp (ii) inoculated with twice the amount of culture as pulp (i). These results compare with weight and dry solids losses of 7·31% and 0·26%, respectively, in the control. The acetic, butyric and lactic acid contents after storage were: 36·6%, 23·1% and 40·3%, respectively, in the control; 45·1%, 4·4% and 50·5%, respectively, in pulp (i); and 50·5%, 7·0% and 43·5%, respectively, in pulp (ii). An important rôle in the quality of the pulp was played by the type of silo and the treatment during storage.

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Manufacture of anhydrous ethyl alcohol as a fuel from sugar cane. J. A. LÓPEZ H. *La Ind. Azuc.*, 1966, **72**, 271.—This summary of a report prepared at the Tucumán Agricultural Experiment Station quotes the recommendation of using sugar cane for manufacture of fuel alcohol instead of allowing it to be wasted. Burnt cane especially should be used and the juice from the milled cane sent direct to the distilleries for fermentation and the bagasse for use as fuel. Alternatively, by obtaining only a single crop of *A*-sugar—the major part of sugar recovery from the syrup—the *A*-molasses can be used for fermentation to alcohol. In this way one ton of cane would yield 52 kg of sugar (instead of the 65 obtained with three strikes) plus 35 litres of alcohol. The cane milled in Tucumán in 1965 would not be sufficient to produce the sugar quantity planned for 1966 and the alcohol produced would only be 6·5% of the petroleum fuel used, although it can be used up to 10% as an additive. Thus, by adoption of the scheme it would not be necessary to reduce cane production.

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Research on beet pulp ammoniation. Amino acid content of dried and ammoniated beet pulp. K. GLOGOWSKI and E. CZAPLICKI. *Gaz. Cukr.*, 1966, **74**, 269–271.—Ammoniated beet pulp contained the same amounts of various amino acids as did normal dried pulp, the only major difference lying in the higher arginine and histidine contents in the ammoniated pulp. On the other hand, pulp ammoniated under 4 atm pressure at 110°C for 1½ hr to a total N content of 4·3% (as opposed to 3% in the case of the normal ammoniated pulp) contained more histidine, phenyl alanine, *iso*-leucine, leucine, methionine and valine, while it contained less arginine and lysine and contained approx. the same amount of threonine as did the other pulps.

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Calculation of the economics of enriching (beet) pulp with inorganic nitrogen (ureation, ammoniation and lactation). J. KISIELNICKI. *Gaz. Cukr.*, 1966, **74**, 272–274.—The results of this study showed that while ureation and ammoniation are both economically sound, the former is the more economical process. Treatment with lactic bacteria was the dearest of the three methods.

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Quality improvement of bagasse particle board with low resin content. H. C. HUANG. *Taiwan Sugar*, 1966, **13**, (5), 23–25, 29.—See *I.S.J.*, 1967, **69**, 25.

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Clarification of molasses with a high lime salts content. N. V. GOROKHOVA and E. I. OZHEGOVA. *Khlepobekar. Konditer. Prom.*, 1965, **9**, (12), 17–19; through *S.I.A.*, 1966, **28**, Abs. 868.—Beet molasses containing more than 1% of lime salts cause blockage in centrifugal separators following the usual 1:1 dilution with cold water. Tests showed that dilution in a proportion of 1:3 dissolved a large part of the sludge and resulted in normal separator operation. The clarified molasses gave a slightly higher yield of yeast (of normal quality) than when 1:1 dilution was used. Decantation of molasses solution leads to losses of yield. Tests with normal molasses showed that 1:1 dilution gave maximum sludge separation; acidification of the solution to pH 5·0 gave a further increase in separated sludge (by 1–19%).

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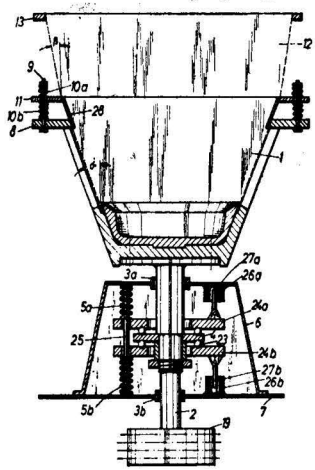
The distillery as part of a sugar factory. N. D. KARNICK. *Indian Sugar*, 1966, **16**, 529–534.—The deterioration of molasses in storage and costs of transport are reasons why alcohol production should be carried out at the sugar factory rather than at a separate distillery some way away. In addition the distillery could use surplus factory steam, electric power would be available from the factory and the distillery could be supervised and operated by the factory staff instead of having a separate staff.

Patents

UNITED STATES

Continuous centrifugal. W. SIEPE and H. SCHMIDT, *assrs.* HEIN, LEHMANN & CO. A.G., of Düsseldorf, Germany. **3,256,993.** 17th October 1963; 21st June 1966.

The under-driven shaft 2 of the continuous centrifugal is flanged to the lower frustro-conical sieve drum 1. The shaft is supported by bearings 3a, 3b and also carries a flange 4 which is connected by axial bearings 23 and clamping rings 24a, 24b with a series of springs 5a, 5b which are mounted on pins 25 and which serve as a support for the flange 4 relatively to the base plate 7 and the casing 6 surrounding this part of the drive. The springs 5a, 5b maintain the flange 4 and thus the drum assembly at a pre-determined height and also allow an oscillating movement in the direction of the axis of shaft 2 under the action of electromagnets 26a, 26b, carried by the casing 6 and base plate 7, which alternately attract the armatures 27a, 27b attached to the clamping rings 24a, 24b.



Mounted above drum 1 is another drum 12 having a different angle (β) to the vertical and connected to drum 1 (angle α) by flanges 8, 11, linked by pins 9 but separated by springs 10a, 10b, so that they may oscillate relative to each other. A transfer ring 28 is provided. Massecuite supplied to the rotating centrifugal ascends the screen fitted to drum 1 in a thin layer and is transferred to drum 12 where the smaller angle to the vertical reduces the forces causing the onward passage of the crystals. Thus a thicker layer forms and this is caused to move onward by the oscillation of the drums arising from activation of the electromagnets.

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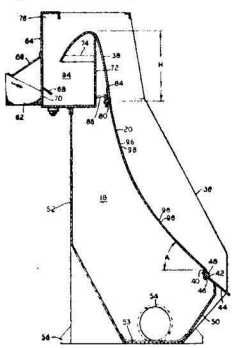
Screen with open conduit feed. G. KALJO, P. L. STAVENGER and J. C. ELSKEN, *assrs.* DORR-OLIVER INC., of Stamford, Conn., U.S.A. **3,259,244.** 31st January 1963; 5th July 1966.

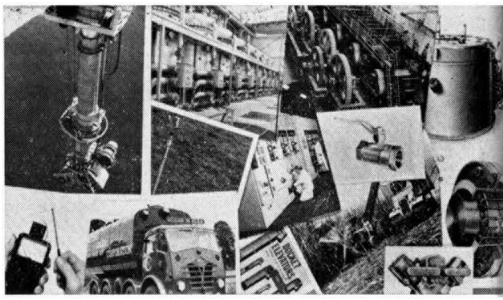
Feeds to screens of the type illustrated can be rectangular or can have sharp-edged weirs; in the former case, when the flow is small the opening must be restricted to maintain an adequate pressure head and this can lead to choking of the small opening. With a sharp-edged weir, high flow rates can result in the overflow adopting a trajectory such that tangential impingement on the screen must be produced by means of a constraining plate and this also can lead to clogging.



To prevent this the weir 38 on the screen 20 is of parabolic section and is supported by braces 74, 86 from the vertical wall 72 of the feed box. Raw juice from the mills is admitted to the feed box 94 through port 62 and evenly distributed along the length of the screen by baffle 68. It overflows the weir 38 and moves tangentially over the screen 20 which is formed from wedge bars 98 separated by spaces 96. Juice flows through these spaces into receiving chamber 18 from which it is collected through pipe 54 and so goes to process, while bagasse fibre passes over the surface of the screen deck and is collected and returned to the mills.

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).

Trade notices



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

Automatic polarimeter. Hilger & Watts Ltd., 98 St. Pancras Way, Camden Rd., London N.W.1, England.

Details are announced in catalogue CH 441 of the new M560 automatic polarimeter. Designed to meet the exacting requirements of the Australian National Standards Association for cane sugar, it has a measuring range of —120° to +120° I.S.S. using a 200-mm tube. It can use tubes up to 400 mm long and can measure more than 150 samples per hr with a maximum time of 45 sec per sample, of which less than 50 ml is required. Digital read-out and printing is provided, a decoder system providing readings as 5-digit illuminated numbers. A direct reading to 0·01° I.S.S. is obtainable. While the basic model uses monochromatic light at 5461 Å from a mercury-vapour lamp and a filter, an alternative instrument is available for use with sodium yellow light. Another version gives a direct reading of sugar concentration for the French standard weight. The instrument uses a bi-quartz oscillating plate modulator inserted with the sample tube between the polarizing and analysing Lippich prisms. An EMI photomultiplier type 9660 is used as detector, the signal produced being sent to a servo-motor which rotates the analysing prism to the balance point. Power supply is 200–250 V A.C. at 50 c/s, 600 VA single-phase. A printer can be fitted as an optional extra; this can be used automatically at the end of each measuring sequence, or for recording selected measurements only. Inter-locks built into the electronic equipment ensure that no read-out can be printed until the measurement is complete, and the print-out must be finished before the analyser will rotate for a new measurement. Solid-state circuits are used, and plug-in cards permit rapid and easy replacement of faulty units.

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Dust-free conveying of dry materials. Constantin (Engineers) Ltd., Radnor House, 1272 London Rd., Norbury, London S.W.16, England.

Dry pulverized and granular materials can be readily conveyed over long distances with a Fuller "Aero-pump", of which two types are available: one with a fluidizing base for handling pulverized materials, and the other with a conical base and swirl jets for materials which cannot be fluidized. The unit is especially suitable for conveying highly abrasive materials and materials sensitive to heat, since there are no moving parts in contact with the material. Automatic control of the operational cycle is through a control cabinet containing pressure switches which regulate the sequence of operation of filling, vent and discharge valves. For continuous conveying, two "Aeropumps" combined with one control panel are required. The unit is incorporated in complete pneumatic conveying systems designed and marketed by Constantin (Engineers) Ltd.

PUBLICATIONS RECEIVED

HODAG "CB-6" SUGAR ADDITIVE. Hodag Chemical Corporation, 7247 North Central Park Avenue, Skokie, Ill., 60076 U.S.A.

An 8-page report, entitled "Recent advances in the use of Hodag 'CB-6' in pan boiling" gives information on the uses of this chemical (α-methyl glucoside ester) for reduction of surface tension, increase of fluidity and other effects contributing to a shorter pan cycle. It improves massecuite handling and purging and gives greater crystal uniformity, purity and better sugar colour. The booklet discusses tests carried out in refineries and raw sugar factories in the U.S.A., Mexico and Trinidad, with the aid of graphs, charts and illustrations.

* * *

VALVES AND STEAM TRAPS. Midland Industries Ltd., Heath Town Works, Deans Rd., Wolverhampton, England.

Literature is available describing various types of MIL steam traps, reducing valves, temperature and flow control valves, non-return valves, strainers, air vents and eliminators, a signal control unit for use with control valves, and other valves and pieces of temperature control equipment.

* * *

SIDE-ENTERING MIXERS. Mitchell Craig Pumps Ltd., Glenburn Rd., College Milton, East Kilbride, Glasgow, Scotland.

A 12-page brochure, No. S.E.1, is available covering a range of gear- and belt-driven mixers from ½ to 40 h.p. It gives details of seal replacement, dimensions and mixer mounting.

* * *

AUTOMATIC PALLETIZING MACHINES. Carl Drohmann G.m.b.H., 7 Stuttgart-Bad Canstatt, P.O. Box 360, Germany.

A recently introduced leaflet carries information on Drohmann automatic palletizing machines, which can handle bundles, cases, drums, etc. for pallet sizes of 1200 × 800 mm (48 × 31½ in) and 1200 × 1000 mm (48 × 40 in.). The operating speed is up to 50 containers per min. The unit uses a numerically-controlled palletizing programme, and special designs are available for shipping sacks and polyethylene bundles.

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CONTINUOUS CENTRIFUGALS. Dorr-Oliver Inc., Stamford, Conn., U.S.A.

Bulletin SILV-1 gives details of Silver continuous centrifugals for crystallizer, *A* and *B*, and remelt refinery sugars. Typical results from Hawaii and Puerto Rico are given for commercial raw sugar and for *C*-massecuite, respectively, the data being compared with those for batch machines in each case. A brief explanation of centrifugal operation is also given.

International Society of Sugar Cane Technologists

13th CONGRESS, 1968

A BROCHURE on the 13th Congress of the I.S.S.C.T., to be held in Taiwan during the 2nd–16th March 1968, is being printed and should soon be available to intending participants from their local Regional Vice-Chairmen[1]. A package plan to cover the expenses of those attending the Congress has been worked out; the cost depends on whether the delegate attends the first part of the Congress from the 2nd to the 10th March, which includes visits to cane plantations, sugar factories, bagasse utilization plants, the Tainan Sugar Experiment Station, etc., as well as beauty spots and tourist attractions on the island.

The second part of the Congress, from the 11th to the 16th March, will be in Taipei, and will include the various symposia and meetings for presentation of papers. A special sight-seeing tour programme for ladies has been arranged for the 11th–16th March. The cost for the second part only will be U.S. $280 for occupancy of single rooms, $250 each for rooms shared with another delegate or $450 for a couple; for both parts of the Congress the cost will be $450 for single rooms, $400 each for shared rooms, or $750 for couples. The package plan includes transportation and first-class hotel accommodation during the Congress but excludes dinner on the five nights of 11th–15th March to permit delegates to make private arrangements.

The Congress will include six symposia on "Yield increase of sugar cane" (Moderator: Dr. I. E. STOKES), "Factory automation" (Moderator: R. H. HUGHES), "Sugar industry diversification" (Moderator: C. W. DAVIS), "Education and sugar industry progress" (Moderator: D. T. LOUPE), "Sugar quality" (Moderator: Dr. J. H. PAYNE), and "Cane diffusion" (Moderator to be named later). As announced previously[2], a new section on agricultural engineering has been formed (Chairman: N. J. KING) and papers will be presented to this section as well as to the agronomy, breeding, entomology, pathology, engineering, processing and by-products sections.

Application forms can be obtained from the Regional Vice-Chairmen or from Dr. H. S. WU, Taiwan Sugar Corporation, P.O. Box 35, Taipei, Taiwan. They should be completed and returned with the package plan cost or a minimum deposit of U.S. $50 which will be returnable at the request of the sender before the 2nd March 1968 in the event of his having to cancel the trip.

Delegates who choose to do so may participate in a post-Congress tour of the Philippines, organized by the Society's Vice-General Chairman, C. R. FLORCRUZ, and the Regional Vice-Chairman, C. B. RAYMOND. Delegates will fly to Manila on the 17th March and will visit Tarlac sugar mill, distillery and refinery (factory delegates) or Tarlac Development Corporation (field delegates), returning to Manila on the 19th. The estimated expenses in the Philippines are $60, exclusive of the air travel from Taiwan. Further details will be available from Dr. WU or Mr. RAYMOND.

Brevities

British Sugar Corporation Ltd. Research Laboratories.—As of the 15th August 1967 the British Sugar Corporation Ltd. Research Laboratories have moved from Nottingham to new premises at Norwich. Their new address is: British Sugar Corporation Ltd. Research Laboratories, Colney Lane, Colney, Norwich, NOR 70F, and their telephone number Norwich 52576–8.

* * *

Italian sugar strike[3].—The start of the sugar campaign in the northern and central districts of Italy was delayed for a month by a dispute between sugar workers and sugar factory owners over the renewal of a labour contract. The sugar factories did not accept any sugar beets as long as the contract was unsigned and sugar beet growers were becoming increasingly concerned as the delay in lifting and delivery caused some deterioration in the sugar content of the beets. After the contract was signed, the beet crop was estimated at 13 million tons.

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Puerto Rico mill closures[4].—The Sugar Producers' Association in Puerto Rico has announced that Central Cayey as well as Central San Vicente will close down before 1968. There are also rumours that another mill may join these two. In 1960 there were thirty-two mills in operation compared with ten fewer this year.

U.S. sugar cane crop record forecast[5].—Based on the condition of the sugar cane crop on 1st July, the Crop Reporting Board of the U.S. Department of Agriculture expects that production of cane for sugar and seed will total 25·1 million short tons, 3% more than in 1966, 12% above average, and slightly more than the record 1964 crop of 25,053,000 tons. Mainland growers plan to harvest 513,000 acres compared with 509,000 acres last year, while in Hawaii the estimated area to be harvested is 110,000 acres, or 6000 acres less than in 1966. The yield per acre is expected to be slightly less than last year in both Florida and Hawaii but the higher yield expected in Louisiana (27·0 tons/acre *vs.* 22·8 in 1966) more than counteracts the falls of production expected in the other two areas.

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Ecuador sugar production, 1966[6].—Sugar production in Ecuador during the calendar year 1966 totalled 147,000 metric tons, white value, according to the authorities there. Output during the previous year amounted to 151,000 tons.

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[1] *I.S.J.*, 1967, **69**, 159.
[2] *ibid.*, 1966, **68**, 351.
[3] *Public Ledger*, 26th August 1967, 2nd September 1967.
[4] C. Czarnikow Ltd., *Sugar Review*, 1967, (831), 166.
[5] *Lamborn*, 1967, **45**, 115.
[6] C. Czarnikow Ltd., *Sugar Review*, 1967, (825), 142.

C. W. Murray Award

SINCE publication of details of the Award early in 1967, Fletcher and Stewart Ltd. have received a number of letters requesting that the date for submission of technical papers for the 1968 Award should be extended beyond 31st March 1968. It has therefore been agreed that this date should be altered to 30th June 1968 and all concerned have been informed.

It is hoped that those who previously considered that the time available was insufficient will now submit an essay for the 1968 Award.

Details regarding the preparation and submission of papers are available from Fletcher and Stewart Limited, Bucklersbury House, 83 Cannon Street, London, E.C.4, England.

Brevities

Morocco sugar expansion[1].—In addition to the previously announced new sugar factories to be built in Morocco[2], further projects have been announced including a raw sugar factory in Sidi Bennour, of 2000 tons beet/day capacity, and raw sugar factories in Zelouan and Berkane, each of 1500 tons beet/day capacity.

* * *

Egypt—U.S.S.R. trade agreement[3].—Under the terms of a trade agreement, the U.A.R. is to receive 30,000 tons of sugar from the U.S.S.R. during the six months from July 1967.

* * *

Trinidad sugar production 1967[4].—Sugar production in Trinidad reached 197,855 long tons during the 1967 season, compared with 210,394 tons produced in 1966 and 250,586 tons in 1965.

* * *

Puerto Rico sugar production, 1967[5].—Sugar production in Puerto Rico this season has now closed with a final figure of 808,119 short tons, basis 96°, as against 873,408 tons in 1966. The average sugar yield for the 1967 crop at 9·903% cane shows an increase on the previous season's figure of 9·228% cane.

* * *

New sugar factory for Ethiopia[6].—The International Finance Corporation will supply $9,000,000 to the Ethiopian firm H.V.A.-Metahara, to be part of the $22,500,000 cost of a sugar cane plantation and sugar mill. The factory is to start in 1969 and will have an initial production of 29,000 tons, increasing the following year to its full capacity of 47,000 tons of white sugar. The annual capacity may be increased to about 65,000 tons.

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Indonesia sugar production[7].—Indonesia's sugar production will rise by 15% to about 650,000 tons in 1967, estimates the Minister of Plantations. He told the Indonesian Parliament that domestic consumption would not exceed 500,000 tons.

* * *

Guatemala sugar exports[8].—Exports of sugar from Guatemala in 1966 totalled 52,269 metric tons, tel quel, all but 43 tons for El Salvador being sent to the U.S.A. In 1965 exports totalled 31,587 tons, of which 31,171 tons went to the U.S.A. while 2 tons went to El Salvador and 414 tons to Honduras.

* * *

Portuguese East Africa sugar development[9].—It is reported that well-known South African companies have been chosen to supply the various machinery and equipment necessary for the functioning of the new sugar mill at Dondo[10]. The factory will have an initial output of 40,000 tons in a yearly cycle of 22 weeks and this is expected to be increased to 60,000 tons in 1969 and produced at a relatively low price.

Belgium/Luxembourg sugar statistics[11]

	1966	1965	1964
	—— *metric tons, tel quel* ——		
Imports			
Congo (Brazzaville)	—	—	1,582
Congo (Kinshasa)	—	—	4,719
Cuba	982	5	—
France	9,022	3,130	9,864
Germany, East	1,100	—	11,401
Netherlands	3,763	15	2,102
Paraguay	—	—	2,097
Peru	836	—	—
Poland	11,866	—	16
U.S.S.R.	15,870	—	—
Others	—	3	5,045
	43,439	3,153	36,826
Exports			
Cambodia	—	—	2,015
Cameroon	1,326	1,783	120
Dahomey	1,024	1,373	75
France	2,444	2,418	282
French Pacific	225	2,743	375
Gambia	—	315	1,095
Germany, West	24,312	36,692	8,130
Greece	856	2,452	4,146
Guinea	—	3,000	1,500
Iran	7,503	7,292	16,627
Iraq	—	—	2,447
Italy	5,411	1,241	1,172
Ivory Coast	6,356	10,338	613
Mali	—	10,158	3,491
Mauritania	1,360	—	—
Morocco	7,390	7,307	16,279
Netherlands	3,877	4,635	3,848
Niger	1,317	800	—
Nigeria	807	50	965
Persian Gulf	106	1,541	3,235
Rwanda/Burundi	849	1,122	177
Saudi Arabia	250	357	7,510
Senegal	3,225	6,786	—
Switzerland	358	401	1,594
Togo	2,676	686	75
U.S.A.	134	1,695	7,920
Upper Volta	6,781	1,018	—
Others	1,605	2,705	4,450
	80,192	108,908	88,141

Iran sugar production[12].—According to the annual report of the Iranian Development Bank, the sugar beet crop in Iran during 1966/67 amounted to 2·27 million metric tons compared with 1·4 million tons in 1965/66. Sugar beet production is expected to increase to 4 million tons eventually. Sugar production during 1966/67 was also considerably higher than in the previous year, reaching 300,000 metric tons, white value, or 84% more than in 1965/66. Three private and two state-owned factories have started production and extensions in three state-owned and two privately-owned factories have been completed. Cane sugar production in the south of Iran amounted to 38,000 tons, white value, which was a similar production figure to that of 1965/66.

[1] *Zeitsch. Zuckerind.*, 1967, **92**, 380.
[2] *I.S.J.*, 1967, **69**, 128, 223.
[3] C. Czarnikow Ltd., *Sugar Review*, 1967, (824), 135.
[4] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (21), 13.
[5] C. Czarnikow Ltd., *Sugar Review*, 1967, (826), 146.
[6] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (21), 16.
[7] *Reuters Sugar Rpt.*, 13th July 1967.
[8] C. Czarnikow Ltd., *Sugar Review*, 1967, (827), 150.
[9] *Overseas Review* (Barclays D.C.O.), August 1967, p. 28.
[10] *I.S.J.*, 1967, **69**, 255.
[11] C. Czarnikow Ltd., *Sugar Review*, 1967, (820), 121.
[12] F. O. Licht, *International Sugar Rpt.*, 1967, **99**, (23), 17.