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Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Erreurs dans la photométrie à flamme occasionnées par l'adsorption pendant la filtration. M. O'SULLIVAN. p. 259–260

Dans la détermination par la photométrie à flamme du potassium et du sodium dans les jus et mélasses des quatre sucreries betteravières irlandaises, des erreurs se sont produit par suite de l'adsorption des cations par le papier à filtrer. On discute des moyens de l'élimination de l'erreur.

* * *

Compression de la bagasse dans le moulin à canne. J. YOUNGER. p. 260–262

L'auteur discute la mécanique, les causes et les effets de la compression de la bagasse pendant son passage entre les cylindres supérieure et inferieures d'un moulin à canne.

* * *

La raffination de sucre. Remarques sur les procédés individuels. 4-ème partie. F. M. CHAPMAN. p. 263–268

Dans la seconde section de cet article l'auteur discute les caractéristiques de sirop de mélange et son chauffage, et ensuite le travail d'essoreuses centrifuges et les types de machines, continues et discontinues, employées.

* * *

La marche d'une cristallisation normale à l'égard à l'effet de la teneur en non-sucres, substances colorées et cristaux. 2-ème partie. S. ZAGRODZKI. p. 268–270

Dans la seconde partie de cet article, l'auteur compare les résultats d'une cristallisation théoriquc et expérimentale pour les solutions sucrées pures, impures et colorées. Ensuite il considère mathématiquement le procédé de cristallisation dans un appareil à cuire.

Fehler bei der Flammenphotometrie als Folge der Adsorption während der Filtration. M. O'SULLIVAN. S. 259–260

Bei der flammenphotometrischen Bestimmung von Kalium und Natron in Rübensaften und- Melassen der vier irlandischen Zuckerfabriken, haben sich Fehler als Folge der Kation-Adsorption auf dem Filterpapier ereignet. Einige Methoden für die Beseitigung des Fehlers werden besprochen.

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Die Komprimierung von Bagasse in der Zuckerrohrmühle. J. YOUNGER. S. 260–262

Die Mechanik, Ursachen und Wirkungen der Kompression von Bagasse, als sie zwischen den Ober- und Unter-walzen fliesst, werden diskutiert.

* * *

Zuckerraffination—Anmerkungen über Einzelverfahren. Teil 4. Die Affination. F. M. CHAPMAN. S. 263–268

In der zweiten Sektion dieses Aufsatzes bespricht der Verfasser die Charakteristik von Maischsirup und seine Hitzung; danach folgt eine Diskussion von Schleuderarbeit und der verschiedenen Arten kontinuierlicher und diskontinuierlicher Maschinen, die man anwendet.

* * *

Der Verlauf einer nornal geführten Kristallisation mit Berücksichtigung des Einflusses des Gehalts an Nichtzuckern, Farbstoffen und der Kristallmenge. Teil 2. S. ZAGRODZKI. S. 268–270

Im zweiten Teil vergleicht man die Ergebnisse von theoretischer und experimenteller Kristallisation miteinander für reine, unreine und gefärbte Zuckerlösungen. Das Kristallisationsverfahren in einem Kochapparat wird mathematisch untersucht.

Errores en fotometría a llama causado por adsorción mientras la filtración. M. O'SULLIVAN. *Pág.* 259–260

En la determinación por fotometría a llama de potasio y sodio en jugos y melazas remolacheras de las cuatro azucareras irlandesas, errores han ocurrido como resulta de adsorción de cationes sobre el papel de filtro. Se discuten medidas para eliminar el error.

* * *

Compresión de bagazo en el molino de caña. J. YOUNGER. *Pág.* 260–262

Se discuten el mecánico, las causas y los efectos de compresión de bagazo cuando pasa entre las mazas superior y inferiores de un molino de caña.

* * *

Refinación de azúcar—Notas sobre procesos unitarios. Parte IV. Afinación. F. M. CHAPMAN. *Pág.* 263–268

En la segunda sección de este artículo, el autor considera varias características de meladura de mezclado y su calefacción, y también discute la operación de centrífugas y los tipos de máquina continua y no-continua que se usan.

* * *

La cursa de cristalización normal con respeto al efecto de no-azúcar, material colorante y contenido de cristales. Parte II. S. ZAGRODZKI. *Pág.* 268–270

En esta segunda parte las resultas de cristalización teórica y experimental de soluciones puros, impuros y colorados se comparan, y el proceso de cristalización en un tacho se considera matemáticamente.

THE

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Notes & Comments

International Sugar Agreement prospects.

The discussions held in Geneva between Dr. RAUL PREBISCH, Secretary-General of UNCTAD, and representatives of ten major exporters were completed on the 16th July. In addition to Australia, Brazil, Cuba, Czechoslovakia, India, Malagasy, Mexico, Poland, South Africa and Taiwan, representatives of the EEC and USSR were also present. Sufficient progress was made to warrant the calling of another full-scale Conference on the 23rd September and Dr. PREBISCH stated that "there was a reasonable expectation that the quota proposals he put forward would be accepted by the Governments concerned".

Some, details of these proposals became known towards the end of July: basic export tonnages scheduled for the major exporting countries for 1969 amounted to 7,546,000 metric tons, raw value, while Dr. PREBISCH recommended that these should be cut by 10% in order to raise world market prices in line with the proposed price objective in the range of 3·25–5·25 cents per pound. This would bring initial quotas for this group to 6,791,000 tons, while 132,000 tons, not subject to adjustment, was earmarked for a group of small exporters to the world market.

Re-exports of sugar from Czechoslovakia, Hungary, Poland and other East European countries, resulting from their imports of Cuban sugar under trade agreements, were to be limited to 1,650,000 tons, while a special hardship reserve of 25,000 tons was set aside for allocation to developing countries. The total of permitted exports for 1969, should an Agreement come into force, would thus be limited initially to 8,598,000 tons which is in line with indicated outlets.

According to press reports, basic quotas for major exporters included in the total were: Australia 1,100,000 tons, Brazil 500,000 tons, Cuba 2,150,000 tons, Czechoslovakia 270,000 tons, EEC 300,000 tons, India 250,000 tons, Poland 370,000 tons, South Africa 625,000 tons and Taiwan 630,000 tons.

Australian officials would not commit themselves on the proposals, saying that the quotas could not be considered on their own because they would have to be related to price increases which would result from reduced exports; another influence would be the amount of sugar permitted to be stored, and by whom. Brazil considers the 10% cut as realistic and would agree so far as her share is concerned. The South African Sugar Association is studying the proposals before making any comment.

But sharp reactions have come from EEC countries. Italy considered that agreement would be difficult in view of the French attitude to quotas, Holland that the 300,000-ton quota for the EEC was unacceptable, and France that it was unrealistic. France is the major producer in the EEC and, over the past several years, has restricted production in order to avoid expensive subsidies. As part of the overall economic policy within the Community, a new common price of about $17 per ton was agreed in 1967, payable as long as production totals less than 105% of consumption. For the next 20% of production, a price of $10 per ton is payable. The price of $17 per ton is well above and $10 is below the former French price, so that, by producing approximately 117% of consumption (105% at $17, 12% at $10), the average price would be the same as formerly. This would permit France to produce an exportable surplus of 1·2 million tons, and the EEC was demanding that it be permitted to export this amount but without the obligation to do so as a quota.

The Community may therefore stay outside the agreement if its demands are not met, leaving it free to join at a later date if such a move is favourable. If this were to happen, the presence of a large quantity of high-quality white sugar available outside quotas would undoubtedly make it difficult for the price aims to be realized, in the opinion of C. Czarnikow Ltd.[1]. However, many customary outlets to ISA members would be blocked by Agreement regulations, in particular some 60,000 tons of sugar from the French West Indies currently forming their US quota, and disposal of their 1·2 million tons would present problems for the EEC. It is to be hoped, therefore, that a formula will be found whereby the EEC can play its full part in a new Agreement which can both raise the prosperity of the sugar industry in general and, in the spirit of UNCTAD, increase market possibilities for the developing countries rather than reduce them, to the benefit of developed countries.

[1] *Sugar Review*, 1968, (876), 139.

World sugar balance.

F. O. Licht K.G. recently published estimates of world sugar movements in the three years up to August 1968[1]. They were close to the figures given earlier, the final stock figure at August 1968 being only 40,000 tons higher than that estimated in April.

	(September-August)		
	1967/68*	1966/67†	1965/66
	(metric tons, raw value)		
Production	66,937,253	65,818,228	63,272,209
Imports	22,001,402	21,147,762	20,952,360
Initial stocks	18,517,522	18,650,042	18,225,517
	107,456,177	105,616,032	102,450,086
Final stocks	17,404,331	18,517,522	18,650,042
Deliveries	90,051,846	87,098,510	83,800,044
Exports	21,878,802	21,437,116	20,873,833
Consumption	68,173,044	65,661,394	62,926,211
Production increase or decrease	+1,119,025 (1·70%)	+2,546,019 (4·02%)	−3,855,760 (5·74%)
Consumption increase	+2,511,650 (3·83%)	+2,735,183 (4·35%)	+2,862,999 (4·75%)

* Estimated
† Preliminary

Consumption for 1967/68 is indicated as only 3·83% higher than the year before. C. Czarnikow Ltd. comments[2]: "This level must be considered fully satisfactory, particularly when it is remembered that the lower production in India in 1967/68 led to a dramatic fall in the domestic consumption of statistical sugar in that country. . . . Weather conditions in India have improved, while the policies adopted by the Government of India have led to a marked expansion in the production of sugar, and our friends are indicating that consumption will show a corresponding growth. There seems little reason to anticipate much change in the general pattern of the offtake of sugar elsewhere in the world during 1968/69 and we would expect to see an increase in consumption in the region of 3·8–4·0% during the year. On the other hand it would appear unlikely that production will rise by the 2·5–2·6 million tons which this would represent and a further reduction in stocks would appear to be indicated."

* * *

US sugar supply quota, 1968.

The US domestic price of sugar has been high for some time, in spite of the increases reported last month[3]. A further increase had been expected but had been delayed by consultations between the USDA and the authorities in the Philippines where, it had been suggested, the producers would have difficulty in meeting their basic quota.

In the event, an increase of 100,000 tons to 10,900,000 short tons, raw value, was announced by the Department on the 19th July (the third within a month) while shortfalls totalling 71,253 tons were announced at the same time (the 47,667-tons share of the increase in the domestic beet sugar areas quota, 5726 tons in Panama and 17,860 tons in Thailand). The Philippines has not accepted any share of the prorations or increased quota, and it is understood that an early start will be made to the next crop to ensure filling of the 1968 quota. The changes in quota and new quotas appear elsewhere in this issue.

* * *

Hawaiian Sugar Producers' Association 1967 Report.

Production of the third largest crop in Hawaii's history and a cane area greater than at any time in the past 25 years belie predictions of Hawaiian sugar being a dying industry. Poorer than normal juice quality, due to lower radiation and frequent rains during the spring and summer, drought in some localities during 1966, and borer and rat damage prevented the 1967 crop from equalling or exceeding the 1966 record. A "total research" concept developed by Dr. R. L. Cushing and the staff of the Experiment Station has resulted in a consistent rise in yields, and improved operations. Major projects include the first full-scale dry cane cleaner, with a capacity of up to 125 tons of cane per hour, which has been built at Laupahoehoe; a new harvester to cut, elevate, chop and deliver cane to a buggy without it touching the ground; use of digital computers to control factory operations; development of a steady-state mathematical model for a sugar factory; fully automatic sprinkler and surface irrigation systems; rat and borer control; and sugar quality investigations.

A 43-day strike at the Crockett refinery of California & Hawaiian Sugar Company prevented a record year in terms of melt and refined sugar deliveries since they were ahead of the record 1966 figures when the strike started and prospects were good. Mediation brought about an end to the stoppage after six weeks but the settlement has increased operating costs significantly; cost reduction efforts are consequently to be intensified and capital improvements aimed at cost reduction will be accelerated.

* * *

USSR sugar expansion hopes[4].

The USSR is hoping to produce ten million tons of sugar from its own beet crop in 1968/69, an increase of 1,500,000 tons over the 1967/68 production, according to a Reuter report from Moscow. The estimate was made by Vasily Zotov, Minister of the Food Industry, on the basis of early crop prospects. It apparently did not take into account the possibility of drought or frost damage late in the season. The increase is planned in spite of a reduction of 300,000 hectares in the area sown. Observers in Moscow believe Soviet agronomists are hoping to reap the benefits of new, higher-yielding beets that were to be sown this year.

[1] *International Sugar Rpt.*, 1968, **100**, (20), 1-5.
[2] *Sugar Review*, 1968, (877), 143.
[3] *I.S.J.*, 1968, **70**, 276, 256.
[4] *The Times*, 18th June 1968.

Errors in flame photometry caused by adsorption during filtration

By MARY O'SULLIVAN,
(Research & Development Department, The Irish Sugar Co. Ltd., Carlow, Ireland)

Introduction

POTASSIUM and sodium in raw juice, thick juice and molasses have been calculated from conductivity readings since 1952 in the Irish Sugar Co. Control Laboratories. The calculations involve the use of an empirical table for raw juice and of formulae for thick juice and molasses[1]. In the 1967/68 campaign it was decided to change to the more direct method of flame photometry.

The campaign averages are given in Table I. They are corrected for the effect of de-liming by ion exchange.

Table I

Milligram atoms % polarization

Factory	*Raw juice plus Na from deliming* K	Na	Total	*Thick juice* K	Na	Total
1	28·9	4·8	33·7	29·2	4·2	33·4
2	28·2	6·7	34·9	27·9	7·8	35·7
3	28·1	4·5	32·6	24·2	6·6	30·8
4	33·2	8·1	41·3	26·8	9·0	35·8

Factory 1 does not have a de-liming plant and the K and Na in raw and thick juices compare very closely. The other factories use a deliming resin, and the raw juice Na values have therefore been increased by an amount equivalent to the Ca removed. Some substitution of K by Na is also observed when using a freshly regenerated resin and the daily composites of hourly samples will contain a proportion of juice in which this substitution has occurred. This exchange of K and Na should not affect the totals and, in fact, they agree quite well for Factory 2 and fairly well for Factory 3. In Factory 4 however the total K + Na in thick juice is much lower than the total for raw juice and the discrepancy would have been still greater had not the cause of the error been discovered about three-quarters through the campaign.

Samples were exchanged between the factories and this department, and the EEL photometer from Factory 4 was compared with the EEL and Beckman DU instruments used in these laboratories; these investigations did not reveal the source of error, however. It was subsequently noted that at Factory 4 a filter paper was in use which was different from that used in the other laboratories and which was unexpectedly found to adsorb K, Na (and Ca) readily from dilute solutions.

References to contamination of solutions from filter paper ash occur in the literature[2,3]. Some workers[2] prefer to use glass filters or to centrifuge to avoid contamination by ash or paper fibres. To avoid such contamination, the factory control laboratories were instructed to use "ashless" paper. One particular very well-known brand was used in all the laboratories except that of Factory 4 where a different, but almost equally well known, brand of "ashless" paper happened to be stocked.

No references appear to occur in the literature on the possibility of paper adsorbing cations. It is of interest to note that the error was noticed in the first instance because of the difference in the results found for raw and thick juices. If the error had affected both equally it might have passed unnoticed. In the experiments to be described the paper which adsorbs cations is coded as *B*; the other as *A*.

Experimental Part

(1) A diluted thick juice from Factory 4 gave a reading of 7·5 p.p.m. K unfiltered and the same reading after filtering through paper *B* and discarding 200 ml of filtrate. When only about 30 ml were discarded the reading was only 4·9 p.p.m.

(2) Raw and thick juices from Factory 3 were diluted in proportions of 8 and 2 g, respectively, to 100 ml. Aliquots were further diluted 20 times and one analysed without filtration, and others after filtration through papers *A* and *B*. These 3 treatments are referred to as *X*, *A* and *B*. Another aliquot was filtered through paper *B* and then diluted 20 times without filtration. This treatment is referred to as *Y*. In all cases only about 30 ml of filtrate was discarded. The K and Na contents are recorded in Table II.

Table II

Treatment	*X*	*Y*	*A*	*B*
Raw K	5·9	5·8	5·9	5·2
Thick K	4·9	4·8	4·8	3·4
Raw Na	0·36	0·38	0·38	0·52
Thick Na	1·78	1·74	1·78	1·28

Treatment *B* is the only one which causes serious error. It involves filtration through paper *B* of very dilute solutions.

(3) Three raw juices were treated as in *A* and *B* above, and the results recorded in Table III.

Table III

Treatment	*Potassium* *A*	*B*	*Sodium* *A*	*B*
Raw juice I	6·6	5·8	0·64	0·55
" " II	7·0	6·0	0·55	0·50
" " III	7·4	6·5	0·64	0·55

The same juices were brought to pH 9·0 with N/10 Na_2CO_3 before treatment. The results (for K only) are given in Table IV. The falls in results in both *A* and *B* from Table III to Table IV may be attributed to the further dilution.

Table IV

(Potassium)

Treatment (pH 9·0)	*A*	*B*
Raw juice I	6·2	5·3
" " II	6·6	6·1
" " III	7·0	6·0

[1] *I.S.J.*, 1955, **57**, 219.
[2] BURRIEL-MARTÍ and RAMÍREZ MUNOZ: "Flame Photometry" (Elsevier, Amsterdam) 1957, p. 226.
[3] HERMANN: *Zeitsch. Zuckerind.*, 1967, **92**, 640.

(4) A solution of NaCl containing about 6 or 7 p.p.m. Na was filtered through both papers and tested. Results were 6·6 through *A* and 5·3 through *B*.

(b) A solution of KCl containing about 7·5 p.p.m. of K was applied in lots of 20 ml to a *B* paper and the filtrates analysed for K (Table V).

Table V

Unfiltered	7·4 p.p.m.	Fraction 5	6·9 p.p.m.
Fraction 1	3·3 „	„ 6	7·1 „
„ 2	5·6 „	„ 7	7·3 „
„ 3	6·5 „	„ 8	7·3 „
„ 4	6·7 „	„ 9	7·4 „

(6) An approximately 10 p.p.m. solution of Ca was similarly treated and the Ca determined by EDTA (Table VI).

Table VI

Unfiltered	10·4	Fraction 3	10·4
Fraction 1	5·0	„ 4	10·4
„ 2	7·7	„ 5	10·4

(7) A solution was prepared containing about 8 p.p.m. each of K, Na, and Ca. Five 20-ml portions were filtered, each through a fresh *B* grade paper (in order to provide sufficient composite for an EDTA titration of Ca). The results were:—

	K	*Na*	*Ca*
Original	8·2	8·3	8·0
Filtered	8·2	8·3	6·2

Conclusion

The error due to adsorption is, as might be expected, greater with more dilute solutions and may be minimized by diluting in two stages and filtering only at the first stage. It varies of course with the amount discarded from the filtrate before taking the portion for testing and may be eliminated by passing through and discarding about 200 ml of final filtrate so as to saturate the paper with adsorbed cations. It is simpler to use a suitable grade of paper which does not adsorb cations. Experiment 7 shows that calcium is preferentially adsorbed (and presumably magnesium also) when it is present in about the same concentration as K or Na. Raw juice normally contains much Mg and thick juice little or none. The thick juice in Factory 4 also had very little Ca whereas raw juice may easily contain about 0·5 p.p.m. after dilution for testing, as well as about 1·0 p.p.m. of Mg. This may explain why the error is greater when analysing thick juice. The pH does not, according to experiment 3, affect the potassium estimation. A few experiments (not described) with molasses indicated errors similar to those found with raw juice, i.e. less than with thick juice. The composition of molasses ash is identical with that of thick juice, but the ratio of sugar to ash is much smaller than in thick juice. This may affect the results, but this aspect has not been investigated.

Compression of bagasse in the sugar cane mill

By J. YOUNGER, B.Sc., A.M.I.Mech E.

THE loose mat of bagasse as it approaches a mill on an intermediate carrier apron, consists of a mixture of juice, fibre and air. As it is gripped by the rollers, the initial compression offers virtually no resistance because the air and juice can escape freely. As the grip becomes tighter, internal pressures are built up which force the juice out at high velocity. The incoming bagasse as it nears the point of greatest compression will offer obstruction to the free escape of the juice and air, some of which will be trapped.

Fig. 1 shows the feed as it passes between two mill rollers; the area of maximum compression is shown between A and B which lie on an arc subtended by an angle of 12°. This arc multiplied by the length of the roller corresponds closely in area to the 0·1 *LD* suggested by HUGOT[1]. In the section A—C, immediately preceding A—B, the pressure has started to build up and approximately 10% of the total resistance to compression will be found in this region, the balance of 90% lying between A and B.

In Table I are set out conventional mill sizes, with commonly used bearings and hydraulic loadings. It is interesting to note that the specific pressures between the top and side rollers are very nearly the same in all the conventional mill sizes chosen. The mean is 150 kg/sq.cm. and Table 18 in HUGOT's book[2] indicates that one could expect a compression of 0·0876 to result from a pressure of this order. To take an example, if the opening between the rollers was 1 inch, and the specific resultant hydraulic pressure[3] between them was 150 kg/sq.cm., the thickness of the feed would be 11·4 inches.

If the vertical C—C′ is selected so that its length would give a compression of 0·20 when supplied with a feed 11·4 inches thick, and the distance between C—C′ and A—A′ divided into equally spaced ordinates, each ordinate represents a corresponding compression, and the appropriate pressures may be obtained from HUGOT's Table 18. In the example given above, the mean pressure in the region A—C is 20 kg/sq.cm.

[1] "Handbook of Cane Sugar Engineering" (Elsevier, Amsterdam) 1960, p. 112.
[2] *ibid.*, p. 118.
[3] *ibid.*, p. 116.

Table I. Specific pressures between top and side rollers in conventional three-roller mills when both side rollers do equal work. It is assumed that the apex angle between feed, top and bagasse rollers is 76°.

Mill size (in)	*Journal size (in)*	*Hydraulic load per bearing (tons)*	*Load between top and side rollers (tons)*	*90% of load (tons)*	*Length of chord, 12° angle (in)*	*Pressure area (sq.in.)*	*Specific pressure (tons/sq.in.)*	*Load in tons/inch of roller*
24 × 48	12 × 15½	100	127	114·3	2·506	120	0·954	4·17
27 × 54	13½ × 17	125	158·7	142·8	2·82	152	0·939	4·63
28 × 56	14 × 18	138	175	157·5	2·922	169	0·934	4·93
30 × 60	15 × 20	155	197	177·3	3·132	188	0·944	5·17
33 × 66	16 × 21	184	234	210·6	3·441	227·8	0·927	5·58
36 × 72	18 × 22	220	280	252	3·76	270·5	0·933	6·1
38 × 78	19 × 24	250	318	286·2	3·97	309·5	0·928	6·4
40 × 84	20 × 27	300	381	342·9	4·17	350	0·970	7·14
42 × 84	20 × 28	306	388·5	349·6	4·39	368·5	0·947	7·28
44 × 84	21 × 28	325	413	371·7	4·6	386	0·962	7·74
					Average specific pressure		0·9438 = 150 kg/sq.cm.	

In Table I it has been assumed that both rollers are doing equal work, a condition which does not often obtain in practice. The effect of the rise and fall of the top roller is shown in Table II and is measured by the percentage of total work done by the feed roller. It will be seen that when all the work is left to the bagasse roller, the specific pressure between the top and bagasse rollers is doubled to 300 kg/sq.m. (1·92 tons/sq.in.) from which one would expect a compression of 0·0783 instead of 0·0876.

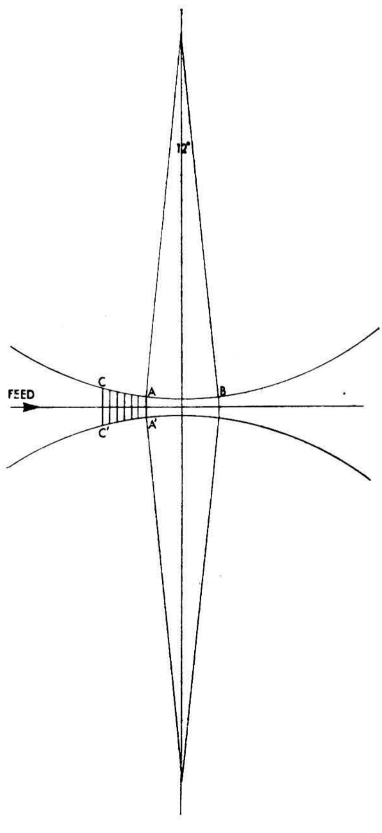

Fig. 1

Table II

% of Total Work done by feed Roller	*% of Total Work done by Bagasse Roller*	*S.R.H.P. between top and feed rollers* kg/sq.cm.	(tons/sq.in.)	*S.R.H.P. between top and bagasse rollers* kg/sq.cm.	(tons/sq.in.)
50	50	150	(0·962)	150	(0·962)
40	60	120	(0·770)	180	(1·154)
30	70	90	(0·577)	210	(1·347)
20	80	60	(0·385)	240	(1·539)
10	90	30	(0·192)	270	(1·772)
0	100	0	(0)	300	(1·924)

It is generally accepted that multiple squeezes of lesser intensity are more effective than single squeezes of greater intensity; it therefore seems logical that both rollers should be made to do their fair share of the total work. In practice, however, it is not possible to arrange for both the feed and bagasse rollers always to do equal work since allowance must be made for variations in the feed which may cause the top roller to rise. Clearly, if the two rollers of a conventional mill are doing equal work and the top roller rises further, then the ratio of the openings will change and a condition will arise where the feed roller will do a greater proportion of the total work than the bagasse roller. In such a case the resultant horizontal component of the reaction on the top bearing will act on the discharge side and this could lead to choking. Probably the ideal running condition would exist when the feed roller does 35–40% of the total work.

When considering the relative proportions of the total work done by the feed and bagasse rollers, it should not be thought that these give any indication of the relative settings of the two side rollers. The great quantity of juice carried by the feed entering between the top and feed rollers should be largely absent from the feed entering between the top and bagasse rollers. In a well set mill, the feed roller will extract more of the sucrose in the bagasse fed into it than will the bagasse roller. This is because the great quantity of fluid escaping at high velocity from the high-pressure zone will carry with it the contents of ruptured cells. Of course, the higher specific pressure at the discharge side will rupture more cells, but there is much less fluid to act at a vehicle to carry the contents away.

After passing through the maximum compression zone between the top and feed rollers, the air trapped in the bagasse mat will re-expand and this helps to re-expand the mat of bagasse fibre. This ability to re-expand will be greater than the available space between the top roller and the trashplate will allow. Consequently the bagasse mat will remain under compression and will exert pressure on the surface of the trashplate and the top roller.

The degree of this compression will depend on the thickness of the feed entering the mill and on the clearance between the top roller and the trashplate. It will probably lie between 0·20 and 0·30 which from HUGOT's Table 18 corresponds to a pressure lying between 4 and 10 kg/sq.cm. (57 and 142 p.s.i.). Thus the friction between the bagasse mat and the stationary trashplate surface will act like a brake on the top roller. If the slope of the trashplate is neglected and the pressure assumed to be even over the surface, the total force will be dependent on the area, and the power required to overcome the friction (assuming there is no slip between the top roller and the bagasse mat) will be: h.p. $= \frac{2\pi RN\mu AP}{33{,}000}$, where R is the radius of the roller in feet, N is the roller speed in r.p.m., μ is the coefficient of friction, A is the area of the trashplate, and P is the mean specific pressure. If $2\pi RN$ = surface speed is taken as 50 feet/min, $\mu = 0{\cdot}30$ and the area $A = 1$ sq.ft, then the formula reduces to

h.p. $= 0{\cdot}0655P$, where P is expressed in p.s.i., or
h.p. $= 0{\cdot}93P$, where P is expressed in kg/sq.cm.

The variation in power consumption with compression ratio, assuming constant roller speed, is illustrated in Fig. 2. The h.p. required will, of course, vary directly with surface speed and trashplate area for any given compression ratio and the latter will vary with the thickness of the feed when the mill is operating at constant roller speed, i.e. the thicker the feed, the greater will be the compression ratio and the more h.p. will be required to overcome friction.

It is true that a thicker feed may cause the top roller to rise and will thus increase the clearance above the trashplate, but the proportionate increase in the discharge opening is much greater than that of the trashplate clearance. To take an example, if a mill has an opening of $\frac{1}{4}$-inch between the top and bagasse rollers and, say, $2\frac{3}{4}$ inches above the trashplate, and the feed causes the top roller to rise $\frac{1}{8}$ inch, the discharge opening has increased by about 50% but the trashplate clearance is raised by only 4·5%. There will be a steep increase in the power consumption due to trashplate friction.

This argument has been based on the figures for bagasse compression quoted by HUGOT from experiments made by NOËL DEERR. Nevertheless it is

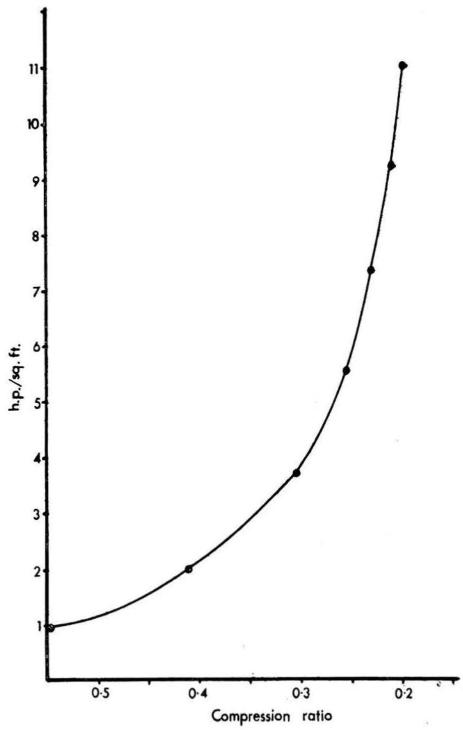

Fig. 2

doubtful whether these results can be directly applied to the compression of bagasse in a mill. JENKINS[1] has shown[1] that the compression achieved in a mill is some 25% less than that obtained in a static test with the same specific pressure.

In DEERR's experiments the elastic response of the compressed bagasse after the release of pressure was not recorded. The juice, fibre particles and solid residues are by themselves almost incompressible; it is only the air which can be perceptibly compressed and which will re-expand. Air is, of course, present inside the pith of the cane, but the bulk of the air present lies between the loosely-packed chopped fibre on the intermediate carrier aprons.

At each pressing some of the air is expelled and some is compressed and re-expands. In successive pressings the quantity of air present will be reduced, and also the bagasse particles will have been reduced in size and will be more closely packed together. The thickness of the blanket therefore becomes less after each pressing. There is a case for conducting a series of experiments on the same lines as those of NOËL DEERR but taking samples after each successive mill in a tandem. The results, adjusted by a factor such as that suggested by JENKINS, might enable one to predict the movements of a top roller in response to feed variations.

[1] *Proc. 9th Congr. I.S.S.C.T.*, 1956, (2), 154–166.

Sugar refining - Notes on unit processes Part IV. Affination

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

(*continued from p.* 237)

MINGLING SYRUP

Mingling syrup inevitably will saturate itself at the temperature of the magma and there is no advantage in having it below saturation, when it will promptly dissolve the sharp edges of the crystals. In Table V are saturation Brix values for mingling syrup at a range of temperatures determined by C. H. ALLEN in 1956.

Table V

Temperature	*Cane*	*Beet*
38°C	70·6°Bx	69·4°Bx
43°C	71·6°Bx	70·5°Bx
48°C	72·7°Bx	71·7°Bx
53°C	73·7°Bx	72·8°Bx

In the days of hand washing, leaking hoses were generally parked in pockets in the monitor casings and under-saturation of mingling syrup was a serious problem. In 1936 preconcentration of mingling syrup at Plaistow Wharf reduced the quantity of 1st crop massecuite by 38%. It is evident that the cost of undersaturated minging syrup can be high so that attention to water leaks can be proportionately profitable. Wash water valves still leave a lot to be desired, and Inland Sugar Company changed over to Jamesbury ball valves; these, fitted with elastomer seal rings, have given good service.

Work in Australia showed that the Brix of mingling syrup was one of the factors which had a large effect on the efficiency of affination. At Plaistow Wharf, laboratory trials showed that purging with mingling syrup at 74°Bx with no subsequent wash gave the results shown in Table VI.

Table VI

Raw sugar	*Temperature of magma* (°C)	*Sugar yield* (%)	*Ash removal* (%)
Cuban, 0·61% ash	30	101·4	58
	40	98·0	58
	50	96·8	58
	60	95·4	61
Beet, 0·39%	30	100·9	48
	40	98·7	48
	50	96·0	48
	60	94·3	48

These figures indicate that working at temperatures above the saturation temperature of the syrup simply results in loss of yield without any compensating gain in ash removal.

Mingling syrup purity

Work in Australia showed that the yield of washed sugar decreased by about 2% for each 5° reduction in purity of mingling syrup, this decrease obviously being the result of heavier wash. Carried to an extreme, mingling with exhausted molasses would produce 3rd crop sugar and this would require a tremendous wash to up-grade it to melter standard. On the other hand, mingling with a solution of raw sugar shows almost no advantage compared with a 90 purity syrup; this is to be expected, however, since the purging efficiency (syrup eliminated % syrup in massecuite) is 75–80% for low-grade massecuites but about 90% for high-grade massecuites. In both cases, residual mother syrup may be eliminated only by displacement with "clairce" made by washing.

Mingling syrup volume

The weight of 1 cu.ft. of crystal sugar is 56 lb, but since the specific gravity of sucrose is 1·58 the volume of 56 lb of crystals is only 0·57 cu.ft. and the voids therefore occupy 0·43 cu.ft. The characteristics of magmas prepared by filling various proportions of this void space with syrup are given in Table VII. The syrup, saturated at 43°C, is of 72°Bx and weighs 85 lb per cu.ft.

Table VII

% of voids filled	*Volume of syrup* (*cu.ft.*)	*Volume of crystals* (*cu.ft.*)	*Brix of magma*	*Density* (*lb/cu.ft.*) *syrup*	*crystals*	*magma*
100	0·43	0·57	88·4	36·5	56	92·5
90	0·39	0·57	89·0	32·8	56	88·8
80	0·34	0·57	89·8	29·2	56	85·2
70	0·30	0·57	90·5	25·6	56	81·6
60	0·26	0·57	91·4	21·9	56	77·9
50	0·22	0·57	92·7	18·3	56	74·3

It may be seen that to obtain a heavy and literally "stiff" magma it is necessary to underfill the voids. This increases considerably the internal friction of the magma and thereby (1) increases the power consumption of the mingler and the agitator in the feed trough, (2) abrades the molasses film, and (3) abrades the crystals, making dust. The combined effects of (2) and (3) can only be conjectures, but the author believes the disadvantages offset the advantages in using stiff magma. There is a fractionally lower power consumption by the centrifugal motor, since with stiff magma there is a smaller weight of syrup to be accelerated.

The author in 1949 investigated the weight of mingling syrup required for various sizes of raw sugar. It was concluded that the dosing gear for the mingler should be capable of variation by ± 5%.

A figure commonly quoted in Australia was 19 cu.ft. of syrup per long ton of raw sugar; for syrup of 72°Bx (85 lb/cu.ft) this corresponds to 72 parts of syrup to 100 parts of sugar by weight, and a water content of about 11½%.

Heating of mingling syrup

Trials have indicated that the optimum magma temperature for the avoidance of inversion in affination is 43°C. Such a temperature can be obtained (a) indirectly, by overheating the mingling syrup, or (b) directly, by heating of the magma using e.g. Stevens coils. In very cold climates, such as those of

Eastern Canada and New England, where raw sugar can become very lumpy, there is perhaps a case for direct heating of the magma, but in temperate conditions the author believes that the higher capital and operating costs cannot be justified and that it is better to heat only the syrup.

Indirect heating

An arrangement for indirect heating is included in the idealized affination station illustrated in Fig. 1. The syrup storage tank 16 below the centrifugals should be mechanically agitated to minimize troubles with settling of stray grain and residence time should normally be 5 min during the week, increasing to 15 min at start-up after the week-end. The mingling syrup supply tank 21 is level-controlled and fed by a valve close to the rising main. The emergency supply valve 27 is similarly situated, the purpose being to avoid pockets which can accumulate grain ahead of the valves. Diaphragm valves have been known to block with grain upstream of the bridge.

The circulating syrup pump 23 should have a capacity of 200% of maximum demand, when the only effect of variation in demand will be to alter slightly the terminal temperature difference between vapour and syrup. Successful operation of the film heater 25 depends on good coverage and protection of the tubes from heavy incrustation. A plate heater is probably a better tool than the film heater 25 but it is a more expensive heating surface and the higher heat transfer rate is obtained at the cost of more pressure drop and a higher power demand. It is possible that the reason for non-scaling of plate heaters is that the high working pressure avoids the decomposition of calcium bicarbonate, as in pressurized water heaters; if this is the case it might be feasible to maintain a partial pressure of CO_2 in the body of heater 25.

In Tables VIII and IX are calculated the heat requirements of raw sugar and the temperature of the mingling syrup which is necessary if it is to be the sole source of heat. It is supposed that the mingling syrup is of 72°Bx, i.e. saturated at 43°C, and that the specific heats of raw sugar and syrup are 0·3 and 0·65, respectively.

Mechanically and thermally, therefore, it seems advantageous to fill the voids and use up to 38 lb mingling syrup per 56 lb raw sugar, equivalent to 68 lb syrup per 100 lb of raw sugar.

Types of heater

The principal types of heater are: (a) cross-flow or up-flow heaters in which the tubes are flooded, (b) film heaters, the most convenient being down-flow, and (c) plate heaters of the A.P.V., De Laval or Rosenblad types.

(a) *Cross-flow heaters* have horizontal tubes which bow and are difficult to clean. *Up-flow heaters* are simple but the proximity factor is unfavourable, the heat transfer rate is poor (10–15 B.Th.U./sq.ft./hr/°F) and the tubes tend to be neglected and become blocked. Any tubular heater should, if the flow of syrup stops, exhaust itself to a vacuum main.

(b) *Film heaters.* Blowing air up the tube or blocking the centre increases the heat transfer rate to 40–50 B.Th.U./sq.ft./hr/°F. This value was also found at Liverpool on a sprayed calandria.

(c) *Plate heaters* provide very much higher heat transfer rates. W. S. GIGGARD in 1961 found that increasing the pressure difference on the syrup inlet side from 30 to 50 p.s.i. raised the heat transfer rate from 91 to 110–111 B.Th.U./sq.ft./hr/°F.

The Plaistow Wharf heater was a three-pass unit with 97, 87 and 64 plates per pass, giving a total heat exchange surface of 1160 sq.ft. At a water flow of 3700 lb/hr and temperatures of 85°C inflow and 75°C return, the heat flow was $2{\cdot}02 \times 10^6$ C.H.U. per hour. The vapour temperature used for water heating was 89°C and power supplied to the water pump was 18 kW.

The temperature of syrup feed to the heater was 53°C and final temperature was 71°C. Two measurements of power supplied to the syrup pump gave values of 42 and 22 kW.

Table VIII. Heat requirements

	(A) *High*	(B) *Low*	(C) *Average*
Temperature of raw sugar, °C	40	0	15
Total heat in 56 lb raw sugar (C.H.U.)	670	0	250
,, ,, ,, ,, ,, ,, ,, at 43°C	720	720	720
Total heat to be added (C.H.U.)	50	720	470

* 1 C.H.U. = 1·8 B.Th.U.

Table IX. Syrup temperatures

	(A)	(B)	(C)
Total heat required (C.H.U.)	50	720	470
Case (i) Voids 105% full, requiring 38 lb syrup per 56 lb raw sugar			
Heat to be given up per lb of syrup (C.H.U.)	1·3	18·9	12·4
Temperature of syrup needed to give up this heat on cooling to 43°C (°C)	46	72	62
Case (ii) Voids 80% full, requiring 29·2 lb syrup per 56 lb raw sugar			
Heat to be given up per lb of syrup (C.H.U.)	1·7	24·7	16·1
Temperature of syrup required (°C)	46	82	69
Case (iii) Voids 60% full, requiring 21·9 lb syrup per 56 lb raw sugar			
Heat to be given up per lb of syrup (C.H.U.)	2·3	33·0	21·5
Temperature of syrup required (°C)	47	94	77

The plate heater as a tool looks very good; the heat transfer rate is about 100 B.Th.U./sq.ft./hr/°F, and the heating surface does not scale and can be cleaned with a sponge. The objections to plate heaters are high cost, high pressure drops requiring high-head pumps with attendant troubles in power usage, and gland leaks.

Direct heating of magma

At one installation, Stevens coils were used to heat magma at the rate of 50,000 lb/hr. The coils had a total heating surface of 252 sq.ft. and tip speed was 90 f.p.m. The installed power of the coil drive was 11 kW but only 3·5 kW was used. A water flow of 37 c.f.m. gave a velocity within the coil of 13 f.p.s. and required 8·6 kW pump power. The water temperature was reduced from 80° to 76°C, while the magma temperature was raised from 36·5° to 43°C during a residence time of 25 min. As originally installed this Stevens coil gave uneven heating of magma and was later altered so that all magma was evenly heated.

Sugar loss

Sugar loss, over the years, not only caused much concern but had a strong influence on mingling syrup policy. Low temperature evaporation, followed by instantaneous reheating in a contact condenser, was justified in an attempt to reduce apparent inversion. There is ample evidence of sporadic inversion in the mingling syrup circuit, which can at any time be heavily infected by poor raw sugar or by wet floor sweepings.

At Breda refinery in Holland it was believed that more sugar loss was caused by fermentation than by inversion due to heat and in 1952 the mingling syrup was being heated to 75°C and the magma to 60°C.

The awkward question is how to maintain pH at 6·0–6·5 without adding too much alkali and thereby increasing molasses output. Obviously one should try to avoid developing acidity, and the best approach is to shorten the life of the mingling syrup. Mingling needs 3–5 minutes and there need be only 5–10 minutes supply (2–3 charges) in the feed trough. The pump supply tank can be kept nearly empty and the mingler supply tank need hold only 2–3 minutes' supply during the week. At week-ends the stock can be built up to 10 minutes' supply, when the tank must be fitted with alternative overflows at two levels.

The first crop (remelt) pan supply tank, which needs an agitator, should be kept empty. The pH of the mingling syrup should be watched; if it drops, the syrup should be limed or chlorited and samples, examined in the laboratory to check whether the trouble is due to bacteria.

It is not at present possible to say accurately how much sugar is lost in the affination process. The volume of raw magma is about 160% of raw sugar solids and, judging from the meagre data available, sucrose loss by inversion may be 0·1% raw sugar solids.

Centrifugal Work

The centrifugal is the main tool in affination, but it is important to realise what a centrifugal *cannot* do. Limitations of ploughing torque and damage to cloths generally make it impossible to reduce residual syrup (or wash) below 5–6% on crystal. In affination work, the last of the wash syrup has about half the impurity concentration of the mixed run-off so that residual wash syrup is equivalent to about 3% of the original mother syrup.

Residual syrup varies with surface area, as is shown in Figs. 3 and 4, with the degree of conglomeration, and, in extreme cases, with the purity of the run-off syrup.

Investigations in Australia during the 1920's showed that:

(i) the wash water should not be applied until the bulk of the mother syrup had left the sugar;

(ii) the whole of the wash water should be applied rapidly;

(iii) the spinning time after washing should be long enough to drain the sugar properly; and

(iv) the sugar should not be allowed to get too hard.

Qualification (iv) is perhaps obsolete; all modern centrifugals are discharged by plough.

The disadvantages of applying wash water too early was emphasized. A charge of 8 cu.ft. of magma might contain 3·5 cu.ft. of mother syrup and an adequate purge might then eliminate 3·3 cu.ft. of syrup so that a wash of 0·16 cu.ft. (producing 0·50 cu.ft. of clairce) would be available to displace the residual 0·2 cu.ft. of mother syrup. Too early application of wash water must result in the clairce mixing with a larger volume of mother syrup so that its effectiveness is reduced.

All the trials showed the advantage of using hot water, at a minimum of 80°C, although when using sweet water the storage temperature should not exceed 75°C. A spray is more effective than a drench application, but use of steam gave very poor results.

Spinning times and speeds

Employing a total spinning time of 3½ minutes it was found that the best distribution of time was in the proportions: purge—4, wash—1 and spin after wash—9.

An investigation was made in England in 1946 using 1200 r.p.m. (815 *g*) centrifugals with 40-inch baskets. It was concluded that:

(i) a four-minute cycle, including 3 minutes' spinning, was enough;

(ii) the optimum position in the cycle for application of wash water was 80–100 seconds after "power on"—if the wash water was applied too early it diluted rather than displaced the mother syrup while if applied too late there was a loss of efficiency owing to close packing of the crystals or to drying out of the mother syrup left on them; and

(iii) higher speed did not necessarily give an improved washed sugar and definitely did increase the power consumption. For a given cycle and wash, increasing the gravity factor from 400/500 *g* to 700/800 *g* decreased impurities in washed sugar by 10%; increasing from 815 *g* to 1274 *g* increased power consumption by 45% and gave no advantage in the quality of washed sugar.

It was noted at Plaistow Wharf, however, that to give sugar of the same quality, only half the wash water was required at 815 *g* as at 380 *g*, and that with the same amount of wash water the ash remaining at 815 *g* would be half that at 380 *g*. But, because syrup from the centrifugal spun at 815 *g* was not recycled to magma, these comparisons can be misleading. The important consideration is to reduce to an economical minimum the ash of the washed sugar.

Drying-out of crystals

H. E. C. Powers in 1954 was concerned with the drying-out of crystals during spinning. This was more rapid when atmospheric humidity was lower, as shown in Table X.

Table X

R.H.	*Spinning time (min)*	*% Water*	*% Ash*
80	5	0·58	0·06
	10	0·12	0·06
	15	0·05	0·06
90	5	0·46	0·041
	10	0·33	0·035
	15	0·35	0·031

The porosity of the wall of sugar was about 50% and the weight of air "pumped" through was very large. The sugar at the front of the wall was drier than that at the rear—0·10% water *vs.* 0·34% in one test—and that this was not just due to incomplete separation of mother liquor was demonstrated by the ash content—0·019% *vs.* 0·035% in the respective samples. It appears desirable, therefore, to prevent passage of an excessive volume of air by closing the cover of the basket, or "bottling up" the centrifugal.

Effect of length of spin after washing

The progress of elimination of residual syrup is indicated in Fig. 9. Sugar on the face of the charge is sluiced with low Brix wash water and drains rapidly while sugar at the back of the charge is swept only by high Brix clairce and drainage is much slower. It is therefore highly desirable to have enough centrifugal capacity and to keep the machines spinning.

From an investigation at Plaistow Wharf it appeared that:

(i) the effect of purging time is variable, depending on both the MA and CV, the latter being a larger problem than the former; it should be added, however, that only small differences are concerned, the range of purging times being 34–40 seconds;

(ii) if the washing period is lengthened it should *not* be at the expense of the time of spinning after washing; more water may give worse sugar and spinning is relatively cheap.

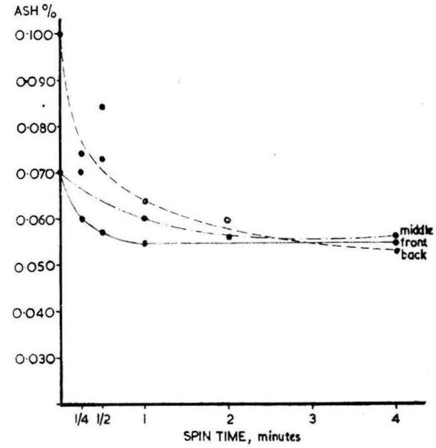

Fig. 9

In Fig. 10 is shown how the amount of syrup separated increases with time of spinning, i.e. rapidly at first but much slower after the first 340 lb. In the case illustrated, elimination of 6 lb of syrup would reduce the residual ash in the sugar by 0·01%.

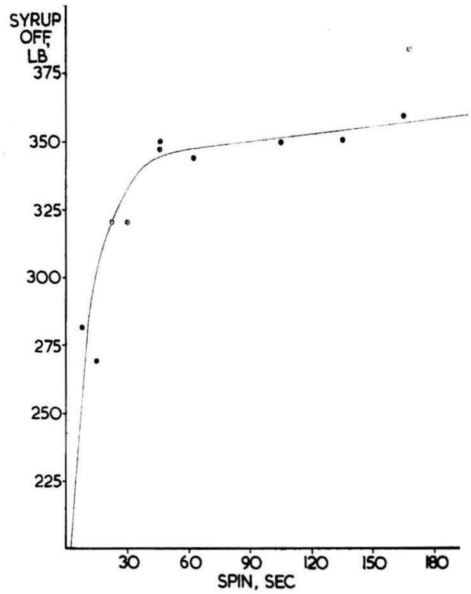

Fig. 10. Effect of extended spin on syrup elimination in affination.

Optimization of affination cycles

At Sucrest Corporation in 1967, T. Kaczorek and co-workers found it best to apply wash water at 700 r.p.m. A split wash was advantageous only when the raw contained more than 15% of fines, and then the bulk of the water should be added in the second wash. Wash water temperature (160°–220°F) they found to be unimportant, 160°F perhaps being better. A slow wash (1 lb/sec) was no better than a rapid wash (2 lb/sec). Extending the spin after washing was considered ineffective as no improvement could be measured. (The author has found that improvement in this respect is best measured by collection of additional syrup and not by analysing the sugar.)

When the ploughs and sprays were in good condition there was little variation in quality of sugar between the front and back of the sugar wall, e.g. 5% difference in the ash content. But neglect of ploughs, or failure to wash screens properly between cycles, led to poor sugar at the back. The best quality washed sugar was generally found at the top of the basket and the worst at the bottom where ploughs tend to leave sugar. For instance, ash in sugar at the top was 10% lower than ash in sugar from the bottom of the basket. But the most important factor was the quality of the raw itself, there being variations of 3:1 in the ash content of washed sugars.

Under the conditions of the trials, KACZOREK found that 3% wash water was optimum, 5% improving neither the ash nor the colour. It was important, however, to fill the basket since a less than full basket was washed with more than 3% of water. It should be noted that the cyclical effect was not considered in these tests on washing; 3% wash, if perpetuated, would dissolve (using fresh water) only 6% sucrose, giving 8·5% wet syrup. This mixed with 3·4% molasses would stabilize the run-off at 78% sucrose on solids, and this might require more wash water. But if the raw sugar gave up only 2·4% molasses, the same wet syrup would stabilize the run-off at 83% sucrose on solids!

Continuous centrifugals for affination

A continuous centrifugal, because it works only a thin layer of sugar, is basically a machine for purging magma or massecuite and is thus unsuitable for any sugar which *must* be washed.

One Dutch refiner tried an Escher Wyss centrifugal for affination but decided that the machine was unsuitable. Feed and speed should be altered with every change in raw sugar supply and this was not possible. At Aarberg in Switzerland two of these machines were used but the results reported seem to be poor, e.g. using 3% wash water the ash content of washed Cuban raws was about 0·3%.

Table XI

	Speed (r.m.p.)	Wash % 0	2	4	6
		Ash content (%)			
Jamaican	820	0·34	0·24	0·17	0·14
	1000	0·45	0·32	0·24	0·19
	1000	0·35	0·30	0·22	0·21
Trinidad	820	0·45	0·33	0·27	0·23
	820	0·37	0·31	0·21	0·17
	1000	0·42	0·25	0·22	0·18
	1000	0·37	0·27	0·25	0·19
Beet and cane mixture	820	0·60	0·45	0·32	0·24
	820	0·41	0·27	0·25	0·17
Averages	820	0·430	0·319	0·234	0·188
	1000	0·378	0·270	0·217	0·186

Results obtained by C. H. ALLEN at Plaistow Wharf in 1962 using a BMA continuous centrifugal are recorded in Table XI; with the same wash, the ash in the affined sugar was found to be 60–70% higher than that obtained using Western States batch machines.

Trials were carried out in 1965 using the "Vibro" machine of Machinefabriek Reineveld N.V. This is a machine developed for dewatering coal and no data were available on its purging efficiency or suitability for sugar. Figures obtained with it and a Western States G-8 batch centrifugal are compared in Table XII.

Table XII

	Speed (r.p.m.)	Ash (%)	Input (tons hr)	Wash water %	Colour	Invert (%)
"Vibro"	1200	0·36				
	1050	0·19				
	900	0·15				
	900	0·15				
	900	0·23				
	900	0·15				
Average			4·1	6·4	1133	0·19
G-8	1100	0·12				
		0·03				
		0·11				
		0·11				
Average		0·09	7·0	5·3	510	0·08

Batch centrifugals

With open-bottomed centrifugals magma can get into the melter, the open bottom is difficult to wash, and windage interferes with sprays.

There should be easy access to feeding troughs; these need frequent inspection and cleaning and the author considers the normal Western States trough—a narrow and deep U-shaped trough with two sets of mixing gear—to be the best available. The arrangement in the Recovery House at Plaistow Wharf, designed as a structure around air ducts, was—as a structure—very good, but its maintenance was expensive since it took six man-hours to remove string from the mingler and cross-mixer, a fitter needed 4 hours to remove the doors and a further 4 hours to replace them, and it took 8 hours for one man to remove the debris.

In 1952 close-fitting mushroom-shaped "hats" were fitted under the baskets at Dinteloord sugar factory to protect washed sugar from massecuite leaks. These were swung out of the way when the machine was discharged, and were still in use in 1966. The design is neat but washed sugar can also be contaminated by massecuite adhering to the walls of the sugar chutes, so that the "hats" are only a partial answer to massecuite leaks.

The gutters of affination centrifugals should never be flushed, as all added water gets into the mingler. Consequently, gutters should have a steep slope, i.e. more than 8° and preferably 20°.

Direct drop premelters are anathema to the author; they cause splashing, which requires enclosure, which results in ignorance and mystification when the ash content of the melter liquor goes up. At Savannah refinery, vapours from the premelter corroded the bottom of the baskets and the securing nuts of the spindles. It should be remembered that all plant has to be inspected; bottom valves leak, massecuite gutters perforate, are damaged by kickers and get choked, so it *must* be possible to get below affination centrifugals easily. In many good refineries the "wet bins" were left in place to facilitate inspection.

One of the best arrangements known to the author was that provided by Mr. D. GUTLEBEN in Pennsylvania Sugar Refinery in 1937, where sugar from the centrifugals dropped into a bin which had very steep sides and a grating bottom. The bin was well lighted and had a single door midway along its length. It was easy to walk below the centrifugals and windage was of no importance.

Centrifugal charging valves *must* have drip trays and it would be sensible to follow the practice at Inland Sugar Co. where the face of the valve housing was coated with epoxy resin to avoid corrosion of the webs behind the stellite. Valves also must not be enclosed, as a piece of wood or tramp iron can cause a great deal of damage in the melter.

Many refineries have enclosed their timers and switchgear in air-conditioned rooms and this precaution, by excluding dust, reduces maintenance on contacts. Such rooms *must* be protected by CO_2 bottles, however, and must have appropriate alarms.

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

By S. ZAGRODZKI

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

PART II

Summary of the results

From calculated values of η_1 and η_2 it is possible to calculate the crystallization rate at individual stages of the process while allowing for the inhibiting effect of non-sugars and colouring matter. Thus we can calculate the crystallization time at individual stages and the rate of weight increase of all the crystals in a vacuum pan in kg/min. Allowing for the proportion of solids (amount of crystals in the massecuite) in the non-sugars and colouring matter, all stages of crystallization have been calculated and are given in Table IV.

The method described was used to represent the theoretical course of an efficient crystallization in a 50-ton capacity vacuum pan and the theoretical course for factory vacuum pans boiling pure sucrose solutions. The crystallization process for impure solutions of 94 initial purity is also given (Table IV). The solutions were almost decolorized. The crystallization process in impure solutions such as normally found in the sugar industry, with an initial colour content in the syrup of $E_{560} = 0{\cdot}320$ is also presented. The results are given in graph form in Fig. 1.

The quantity of sugar crystallized (tons) from the start of crystallization is plotted along the y-axis, while the time (min) of the process is given on the x-axis. The curves represent the course of a normal crystallization in a vacuum pan boiling 50 tons of sucrose. Curve 1 shows the theoretically calculated course of crystallization of pure sucrose solution and assumes a crystallization rate of 7000 mg/sq.m./min. Curve 2 represents the true crystallization process under the same conditions, i.e. a temperature of 70°C, a supersaturation of 1·10 and good circulation. Curve

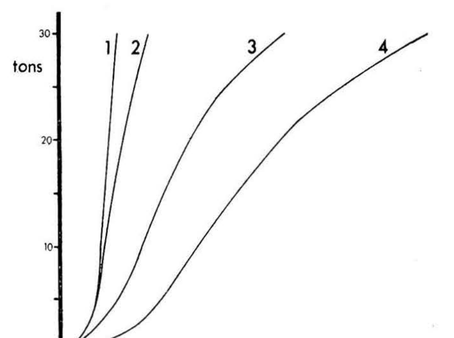

Fig. 1. Progress of crystallization from pure and impure solutions. (1) Theoretical crystallization curve, (2) Practical curve for crystallization from pure sucrose solutions, (3) Curve for crystallization from impure [initial purity 94] decolorized solutions, (4) Curve for crystallization from impure, coloured solutions [purity 94, initial colour $E_{560} = 0{\cdot}320$].

Table IV

Process of controlled crystallization according to non-sugar and colouring matter contents, at 70°C and 1·10 supersaturation under identical circulation conditions. A maximum of 30 tons of crystal sugar from 50 tons of massecuite is assumed. The vacuum pan was injected with 150 × 10^{9} g of seed crystals, each weighing 6·66 × 10^{-9} g, i.e. a total of 1000 g of sugar having 22·5 sq.m. initial total surface area. The initial purity of the solutions is 94, the end purity of the mother liquor 85. The initial extinction of the coloured solutions is $E_{0\ 560}$ = 0·320, the final extinction of the mother liquor En_{560} = 0·800.

Quantity of crystallized sugar	*Total surface area of crystals*	*Crystallization inhibiting coefficient describing the effect of number of crystals*		*Combined retardation coefficient*	*True crystallization time for impure solutions*		*Crystallization rate of impure solutions*		*Overall retardation coefficient*	*Crystallization time for impure, coloured solutions*		*Crystallization rate of impure, coloured solutions*
					in given time interval	*from start*				*in given time interval*	*from start*	
(kg)	(sq.m.)	(h)	(η_1)	($h\eta_1$)	(min)	(min)	(kg/min)	(η_2)	($h\eta_1\eta_2$)	(min)	(min)	(kg/min)
1	225·5		0·544			0·0		0·591			0·0	
		1·0		0·544	0·489		1·04		0·322	0·826		0·605
1·5	296·2		0·544			0·489		0·591			0·826	
		1·0		0·544	1·014		1·48		0·322	1·715		0·875
3	470·5		0·544			1·503		0·591			2·541	
		1·0		0·544	1·295		2·32		0·322	2·19		1·37
6	746·5		0·544			2·798		0·591			4·73	
		1·0		0·544	1·630		3·68		0·322	2·78		2·16
12	1167		0·544			4·428		0·591			7·51	
		0·999		0·543	2·07		5·80		0·321	3·50		3·43
24	1877		0·544			6·498		0·591			11·01	
		0·998		0·543	2·62		9·16		0·321	4·44		5·41
48	2973		0·544			9·12		0·591			15·45	
		0·997		0·542	3·29		13·68		0·320	5·56		8·09
93	4730		0·544			12·41		0·591			21·01	
		0·994		0·540	4·00		23·60		0·319	6·78		13·92
187·5	7380		0·543			16·41		0·591			27·79	
		0·988		0·536	5·29		35·46		0·316	8·96		20·93
375	11730		0·542			21·70		0·590			36·75	
		0·977		0·529	6·65		56·4		0·312	11·28		33·23
750	18630		0·540			28·35		0·590			48·03	
		0·960		0·517	8·58		97·3		0·305	14·55		51·50
1500	29620		0·535			36·93		0·599			62·58	
		0·920		0·487	11·46		131·0		0·287	19·43		77·3
3000	47050		0·524			48·39		0·588			82·01	
		0·840		0·431	16·34		184·5		0·253	27·80		107·9
6000	74650		0·501			64·73		0·586			109·81	
		0·693		0·327	27·36		219·3		0·191	46·80		128·2
12000	116700		0·442			92·09		0·582			156·61	
		0·520		0·2155	29·34		204·7		0·1253	50·40		119·0
18000	154400		0·386			121·43		0·580			207·01	
		0·370		0·1286	38·92		154·0		0·0746	67·00		89·5
24000	187700		0·311			160·35		0·581			274·01	
		0·250		0·0660	63·95		93·8		0·0389	108·30		55·4
30000	217600		0·217			224·30		0·598			382·31	

3 indicates the course of crystallization in impure, colourless solutions (initial purity of 94). Curve 4 corresponds to impure, coloured solutions (purity of 94, initial colour content E_{560} = 0·320).

The differences between the crystallization rates in pure, impure and coloured solutions are shown by comparison between the calculated and theoretical rates as shown in Fig. 2. The increase in crystallized sugar in kg/min is shown on the y-axis and the crystallization time from the moment of crystal injection (min) is shown on the x-axis. All curves apart from the theoretical have maxima. Curve 1 represents the theoretical crystallization rate. Curve 2 shows the calculated true rate in pure sucrose solutions at given periods of time. Curve 3 refers to impure, colourless solutions and curve 4 impure, coloured solutions. With each successive curve the maxima become gradually smaller and occur after a longer period of time. Curve 4 indicates the crystallization rate in solutions that normally occur in sugar factories. It covers a temperature of 70°C and a supersaturation of 1·10. If the temperature is raised and the mother liquor supersaturation increased, obviously crystallization will be accelerated and its duration shortened.

Fig. 2 shows that while the theoretical crystallization rate in the final stage will be in excess of 1000 kg/min, the true maximum rate is about 500 kg/min. In normal impure solutions the crystallization rate is barely more than 100 kg/min. All results were obtained under conditions of even circulation, a temperature of 70°C and a supersaturation of 1·10.

If the crystallization rate and the increase in the quantity of crystallized sugar at a given time is known, it is easy to calculate the amount of steam required for maintenance of a given supersaturation of the solution during crystallization, in order to ensure a normal process.

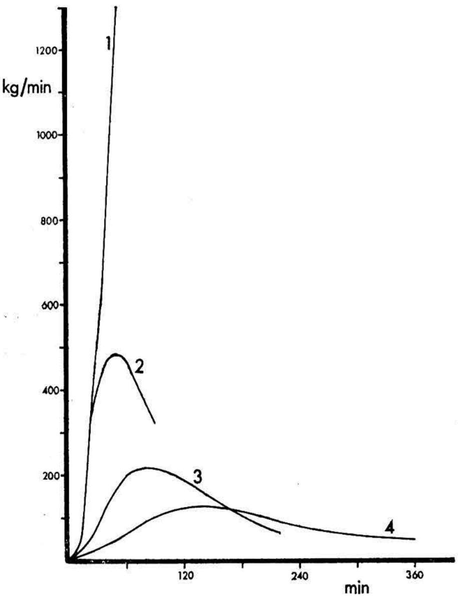

Fig. 2. Comparison of sugar crystallization rates from pure and impure solutions with theoretical rate: (1) Theoretical crystallization rate curve, (2) Practical curve of crystallization rate from pure solutions, (3) Curve of crystallization rate from impure [initial purity 94] decolorized solutions, (4) Curve of crystallization rate from impure, coloured solutions [purity 94, initial colour $E_{560} = 0{\cdot}320$].

Mathematical consideration of the relationship

In a mathematical consideration of the sugar crystallization process in a vacuum pan we must assume that the weight of the individual sugar crystal is x g, the number of crystals a and the surface area of all crystals F sq.cm. In this case the theoretical increase in weight of the crystals is given by

$$\frac{dx}{dt} = K \cdot f\,(c - c_o) \quad \text{......(4)}$$

where K is a proportionality coefficient, f is the average crystal surface area, and $(c - c_o)$ is the supersaturation of the sugar in the solution.

If we assume $f = 4{\cdot}25\ x^{2/3}$ ......(5)

then $F = a \cdot f = 4{\cdot}25\ a\ x^{2/3}$ ......(6)

If we substitute (5) in (4), then

$$\frac{dx}{dt} = 4{\cdot}25\, K x^{2/3}\ (c - c_o) \quad \text{......(7)}$$

$$\int \frac{dx}{x^{2/3}} = \int 4{\cdot}25\, K (c - c_o)\, dt \quad \text{......(8)}$$

By integrating we get

$$3x^{1/3} + C = 4{\cdot}25\, K (c - c_o)\, t \quad \text{......(9)}$$

The arbitrary constant C is found from the so-called initial conditions, i.e. at which the crystal weight corresponds to the weight of the nucleus x_o at time $t = 0$. For $t = 0$ we have $3x_o^{1/3} + C = 0$; hence $C = -3x_o^{1/3}$.

Differential equation (4) is solved as follows:

$$3\,(x^{1/3} - x_o^{1/3}) = 4{\cdot}25\, K (c - c_o)\, t$$

$$\text{hence } x = \left[\frac{4{\cdot}25}{3} K (c - c_o)\, t + x_o^{1/3}\right]^3 \quad \text{......(10)}$$

The weight of all crystals is

$$y = ax \quad \text{......(11)}$$

$$\text{so that } y = a\left[\frac{4{\cdot}25}{3} K (c - c_o)\, t + x_o^{1/3}\right]^3 \quad \text{......(12)}$$

If we use true values for the increase in sugar, we must consider all inhibiting factors. As previous work[23] has shown, the quantity of sugar crystal in the solution causes a reduction in the crystallization rate. The inhibiting coefficient h is given by

$$h = \left(\frac{V_m - V_{kr}}{V_m}\right)^2 \quad \text{......(13)}$$

where V_m is the volume of the solution-crystal mixture and V_{kr} is the sum of the crystal volume.

In this case, for pure solutions the increase in the number of individual crystals in unit time is given by equation (14) instead of equation (7).

$$\frac{dx}{dt} = 4{\cdot}25\, K x^{2/3} (c - c_o)\, h \quad \text{......(14)}$$

For impure solutions

$$\frac{dx}{dt} = 4{\cdot}25\, K x^{2/3} (c - c_o)\, h \cdot \eta_1 \quad \text{......(15)}$$

For impure coloured solutions

$$\frac{dx}{dt} = 4{\cdot}25\, K x^{2/3} (c - c_o)\, h \cdot \eta_1 \cdot \eta_2 \quad \text{......(16)}$$

Using also equations (1) and (3) we can calculate the time required for crystallization of sugar in each vacuum pan under given conditions.

Conclusions

1. The theoretical increase in amount of sugar crystallizing on the surface of crystals in unit time can be expressed by a third order parabola.

2. True increases in weight of sugar crystallizing in a vacuum pan are significantly smaller at individual time stages, even in pure solutions, and particularly at the end of crystallization, so that the curves expressing increase in weight have a sharp deflection.

3. The total crystallization time in a vacuum pan is therefore 60% longer for pure solutions.

4. As a result of the inhibiting effect of the non-sugars and colouring matter in syrups the increase in weight of the crystals, even in 1st strike pans, is very much smaller than in pure solutions.

5. The total time of a normal crystallization at constant parameters in a 1st strike pan is almost 400% longer than in laboratory determinations of the crystallization rate of individual crystals in pure sucrose solutions.

Sugar cane agriculture

The effect of "Telodrin" on nitrification of ammonia in soil and its implication on nitrogen nutrition of sugar cane. S. C. SRIVASTAVA. *Plant and Soil*, 1966, **25**, 471–473; through *Hort. Abs.*, 1967, **37**, 471. Sugar cane plants grown in "Telodrin"-treated and untreated plots, to which 200 kg/ha of N was applied as ammonium sulphate, took up greater quantities of ammonium N from the treated plots, and it appeared that the process of nitrification by soil bacteria was repressed by "Telodrin".

* * *

High crop yields produced with and without tillage on three typical soils of the humid mountain region of Puerto Rico. J. VICENTE C., R. CARO C. and E. GARCÍA B. *J. Agric.* (Univ. Puerto Rico), 1966, **50**, 146–150; through *Hort. Abs.*, 1967, **37**, 469.—In trials on three clay soils with erosion hazards the yields of crops, including sugar cane and beans, were similar under conditions of tillage and non-tillage.

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Deterioration of cane after harvesting. B. T. EGAN. *Cane Growers' Quarterly Bull.*, 1967, **31**, 44–46.—This is a general discussion of the problem in Queensland and the measures that are now being taken to alleviate it.

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Variety trends in the central district. C. G. STORY. *Cane Growers' Quarterly Bull.*, 1967, **31**, 47.—The varietal representation of the cane crop harvested in the central district of Queensland during the years 1962–66 is shown in a table, the varieties being N:Co 310, Q50, Q58, Q63 and Q68. The changes forecast for the 1968 list of approved varieties name H48-3166 for planting in the 8 mill areas of the central district. During 1966 the variety N:Co 310 was the main one harvested in 5 mill areas, Q58 in 2, and Q68 in the one remaining district. Two new varieties will probably be released in 1969.

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The soldier fly problem in central Queensland areas. R. W. MUNGOMERY. *Cane Growers' Quarterly Bull.*, 1967, **31**, 48–50.—Reference is made to the recent discovery in Queensland of a second species of soldier fly and to the change from BHC to "Dieldrin" in recommended treatment. Over 10,000 acres in the central districts are now being treated for soldier fly, such is its importance. The possibility of "Dieldrin" having an adverse effect on the natural predators of other cane pests is discussed.

Control of *Merremia* vine in the far north. H. E. YOUNG. *Cane Growers' Quarterly Bull.*, 1967, **31**, 50.—Trials carried out in the Gordonvale area of Queensland to control this important cane weed (*Merremia quinquefolia*) are discussed. Among herbicides tried, 2,4,5-T at $\frac{3}{4}$ lb/acre gave best results.

* * *

The cane grub pest in the Mulgrave area. P. VOLP. *Cane Growers' Quarterly Bull.*, 1967, **31**, 52.—The writer points out the advantages of BHC treatment in controlling this cane pest in Queensland and deplores the apathetic attitude taken up by some growers. The pest is capable of a rapid population build-up.

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Frenchi grubs in the Burdekin (area). J. WRIGHT. *Cane Growers' Quarterly Bull.*, **1967**, 31, 57–58. Fresh outbreaks of this Queensland sugar cane pest in several areas, previously free of it, are reported. Correct remedial treatment for growers concerned to adopt is given, i.e. application of 90–100 lb of 20% crude BHC to plant cane and application in the drill in replant operations.

* * *

Investigations into the control of leaf scald by sett treatment. D. R. L. STEINDL. *Cane Growers' Quarterly Bull.*, 1967, **31**, 59–60.—Various sett treatments which were tried, including soaking in antibiotics, were not successful in controlling the bacterium responsible. The only treatments from which no disease survived were the standard long, hot-water treatment carried out immediately after 20 to 40 hours' soaking in cold water, and a hot-water treatment for one hour followed by a 16 hour hot-air treatment 24 hours later. Further work on a larger scale is proposed.

* * *

Banded chlorosis at Mackay. C. G. STORY. *Cane Growers' Quarterly Bull.*, **1967**, **31**, 70.—The peculiar symptoms, wide bands of white or chlorotic tissue up to 3 inches wide on the leaves of cane, are described, the marking being also known as cold chlorosis or sectional chlorosis. How cold or frost is responsible is explained. Cells in the leaf, in the unrolled spindle stage, are destroyed by the cold and fail to develop chlorophyll or become green. The condition can be produced artificially by placing water in the spindle.

Preliminary investigations of the relationship of pH and sugar cane responses on organic soils. J. R. Iley and S. L. Hooks. *Proc. Soil Sci. Soc. Fla.*, 1965/1966, **25**, 29–35.—Sugar cane growth was increased in greenhouse cultures by the addition of dolomite limestone at the rate of 15 tons/acre to a mucky peat. Covering an area of over 4 square miles it was found that fields of pH 6·2–6·5 produced considerably more cane than those near 5·5 in a second ratoon crop. Cane tonnage was not significantly increased in the plant crop by the addition of high-Ca agricultural limestone, but a trend was found. With the first ratoon crop it was found that 20 tons/acre limestone application resulted in a more vigorous growth and a higher count of millable stalks.

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Fodder cane—a valuable fodder crop for the north coast (New South Wales). J. B. Noonan. *Agric. Gaz. N.S.W.*, 1967, **78**, 721–727.—The value of sugar cane as a fodder crop and the treatment it should receive are discussed, one acre of fodder cane per 15 head of cattle being recommended. Suitable varieties, which should ratoon well and be disease-resistant while not too hard or hairy, are discussed. Supplemented with a protein-rich concentrate or feed, sugar cane constitutes an economical method of feeding dairy stock in times of drought or winter pasture shortage.

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The physiology of sugar cane. IX. Factors affecting photosynthesis and sugar storage. J. C. Weldron, K. T. Glasziou and T. A. Bull. *Australian J. Biol. Sci.*, 1967, **20**, 1043–1052.—Sugar cane, like other tropical grasses, is regarded as highly efficient in its utilization of sunlight. In the experiments described, plants of the variety Pindar were grown in air-conditioned glass houses or artificially illuminated constant-temperature rooms. Photosynthesis in sugar cane was found to be linearly related to light intensity up to full sunlight. Individual leaves orientated at right angles to the incident radiation were saturated at about two-thirds full sunlight irrespective of whether the leaves developed in low or high light intensities.

* * *

Co-operative ownership can reduce harvester costs. Anon. *Producers' Review*, 1967, **57**, (10), iv, 81. Advantages likely to accrue to cane growers, especially the smaller growers, from co-operative ownership of mechanical harvesters are discussed. Already many Queensland growers practise this. The need for such schemes to be established in a proper business-like manner, with a committee of management, is emphasized.

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New Toft harvesters for Queensland and overseas. Anon. *Producers' Review*, 1967, **57**, (10), 73–76.—Two new mechanical sugar cane harvesters (models CH 300 and WS 300) by Toft Bros. Ltd. of Bundaberg, Queensland, are described and illustrated. The CH 300 is claimed to be the only chopper harvester which can top fallen cane prior to the cane being cut into billets, and is said to be the most advanced machine produced from the factory. The WS 300, designed as a dual-purpose harvester, attained a rate of 80 tons per hour under normal field conditions. It performed well with completely fallen cane.

* * *

Investigations into harvested cane deterioration at Tully. Anon. *Australian Sugar J.*, 1967, **59**, 393–394.—An account is given of the nature of an extensive series of investigations being carried out to obtain more information about the deterioration of chopper-harvested cane in comparison with that of whole stalk harvesting. Harvesting by the two methods (on the same block of cane) took place twice a week for 10 weeks, affording a large number of rakes for testing and sampling.

* * *

Whole-stalk harvester that loads the cane. L. G. Vallance. *Australian Sugar J.*, 1967, **59**, 397–399. A description is given of a harvesting unit in which a whole-stalk Ovenden harvester loads directly into a tram truck as it harvests. The tram truck is then winched on to a trailer for transport to the mill. The unit is reported to function very well.

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New Toft whole-stalk harvester loader. Anon. *Australian Sugar J.*, 1967, **59**, 407.—A brief description, with photographs, is given of this new machine. It is powered by a unit developing 110-h.p. with a 16-speed gear range. With this versatile machine, the side delivery may be unbolted and replaced with a bin for bundled cane. It is a single-row machine and with a bin attachment can cut its own breakrow.

* * *

The need to reduce the time vehicles wait to unload cane at the factory. G. J. Durbin. *Sugar Bull.*, 1967, **46**, (3), 6–7.—Methods whereby this might be achieved in Louisiana are discussed, as are the difficulties likely to be involved. First, a high degree of co-operation is needed between grower, haulage contractor and factory manager. The lead would have to come from the factory manager and he would need to know approximately how much cane to expect from each grower, who will haul the cane, type of vehicle used, etc. He would have to establish daily delivery quotas for each grower. The hauler would use only a specified number of vehicles.

* * *

Physiological adaptability of CoS 416 and Co 510 under waterlogged conditions and their spacing and manuring needs. U. S. Singh and N. Ahmad. *Indian Sugar*, 1967, **17**, 405–408.—Results are given of experimental work carried out at the Flood Research Station, Ghographat, Uttar Pradesh, during the period 1960–63. The variety CoS 510 was found to be better suited to waterlogged conditions than CoS 416, giving better germination and significantly higher yields. A row spacing of 90 cm was found to be the most suitable and ammonium sulphate preferable to press mud for fertilizing.

Sugar cane in India. S. C. SEN and H. P. SINGH. *Indian Sugar*, 1967, **17**, 409–415.—The history of sugar cane with particular reference to the Indian sub-continent is given. Present day conditions in regard to sugar cane and sugar are discussed.

* * *

Rats in sugar cane in India. P. N. AVASTHY. *Indian Sugar*, 1967, **17**, 419–421.—This is a review article in which the author attempts to present as complete a picture as possible by incorporating all relevant information on rats in cane published in India so far. No less than eleven different species of rat are known to cause damage to cane in India. These are listed and notes on the habits and biology of some of them given. Control methods are also discussed.

* * *

A new look at field operations in sugar cane. G. Y. EWART. *Ind.-Agric. Research Management Newsletter*, 1967, **7**, (4), 2.—Recent trends in sugar cane agriculture are reviewed. The theme is developed that the age of sugar cane when harvested must vary with different regions and with climate. With the changing pattern of agricultural labour cost and availability sugar mills may, in the future, have to pay more attention to the cleaning of cane themselves.

* * *

Meteorological stations—their value to the sugar industry. J. J. LANDSBERG. *S. African Sugar J.*, 1967, **51**, 931–935.—During the last 2 to 3 years 18 agro-meteorological stations have been established throughout the South African cane belt from Malelane in the north to Umzimkulu in the south. Instrumentation is standardized and provides for measurement of rainfall, temperature, humidity, wind, sunshine hours, soil temperatures and evaporation. The potential value of such information to the sugar industry is lucidly explained.

* * *

Poor germination with sugar cane. F. VEIGA. *Brasil Açuc.*, 1967, **70**, (4), 58–59.—Attention is drawn to the damage that may be caused to planted setts by fungus disease (*Ceratocystis paradoxa*) and the improved germination to be expected from pre-treatment with appropriate mercurial fungicides, such as "Aretan", "Semesan", "Clerite", "Biosan" and "Neantin".

* * *

Mechanizing the sugar industry. ANON. *Sugarland*, 1967, **4**, (3, 4, 5), 12.—An account is given of mechanization in the Australian sugar industry, with special emphasis on mechanical harvesting, many machines having been designed and developed by Australian engineers and growers.

* * *

Record of beetle grub attack in sugar cane in Rajasthan. A. N. KALRA and S. KUMAR. *Indian Sugar*, 1967, **17**, 417, 425.—Damage by beetle grubs (4 species) in India in general is discussed. The occurrence of two more species of beetle grub in Rajasthan State is recorded, these being *Schizonycha fuscescens* and a species of *Holotrichia*. The nature of the damage caused is discussed.

* * *

Sugar cane variety tests in Florida, 1965-1966. E. R. RICE and L. P. HEBERT. *Sugar J.*, 1967, **30**, (6), 28–32.—The performance of several promising new varieties is discussed, these having been grown under several different soil conditions—peaty, sandy and muck soils. Several new, unreleased varieties were superior to the commercial varieties tested in 1965. The varieties that occur only in plant cane trials will be tested more extensively and the data from all experiments evaluated before making final recommendations for rapid multiplication of seed for commercial release.

* * *

Use of asphalt barriers for crop production in Taiwan. K. Y. LI. *Taiwan Sugar*, 1967, **14**, (5), 7–8, 22.—A brief account is given of some preliminary experiments in Taiwan, on the lines of some carried out in Michigan. In these a layer of bitumen 3 mm thick is incorporated in light sandy soils at a depth of about 60 cm in order to reduce water loss through seepage. The asphalt requirement is about 20 tons per acre.

* * *

A review of Taiwan Sugar Corporation's ten-year farm expansion programme. Y. CHEN. *Taiwan Sugar*, 1967, **14**, (5), 9—12.—The programme, begun in 1960, consists of five parts: (1) marginal land reclamation, (2) soil improvement, (3) water resource development (notably deep well drilling), (4) greater use of heavy crawler tractors for deep ploughing on clay soils and soils with hard-pan, and (5) land purchase.

* * *

Effects of seed rate on plant density and yield of ratoon of pre-winter-planted sugar cane. P. S. GILL and M. ALAM. *Indian Sugar*, 1967, **17**, 471–473.—In this field trial at the Indian Institute of Sugarcane Research, Lucknow, a crop of Co 951 was planted in the last week in November with 20,000, 27,000 and 34,000 (control) 3-budded setts per hectare in randomized blocks, with a plot size of 85 sq. metres. Spacing was 92 cm. With the lower seed rate more shoots were produced and survived per stubble base; stalks were also heavier. Yield per hectare did not show any significant differences due to seed rate. Results indicated that the normal seed rate adopted by growers could be advantageously reduced without loss in ratoon crop.

* * *

Enhancing cane yield under late plantings by adjustment in irrigation practices. U. S. SINGH and L. SINGH. *Indian Sugar*, 1967, **17**, 475–481.—Attention is drawn to the common practice of late planting of sugar cane in Uttar Pradesh because of the land being occupied by other crops. Such late planted cane often shows poor germination and yield. Field experiments in this connexion at the Sugarcane Research Station, Shahjahanpur, with three different planting dates (February–April) and different irrigation practices are recorded. Without irrigation, March planting gave maximum germination and yield, April planting the lowest. With April planting, application of water improved germination and yield. With the early planting, irrigation was of no significance.

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Sugar cane smut. ANON. *Bol. Informativo Copereste* (São Paulo), 1967, **6,** (11), 7 pp.—An account is given of the damage that may be done to sugar cane by cane smut (*Ustilago scitaminea*) in Brazil. Photographs illustrate the nature of the damage. A list is given of resistant or fairly resistant varieties that may be grown. Susceptible varieties are also listed.

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Performance of Toft J 150 whole-stalk harvester in far northern areas. L. G. VALLANCE. *Australian Sugar J.*, 1967, **59,** 461–467.—The object of this article is to give a frank commentary on the behaviour of 16 of these machines in use in northern Queensland during the 1967 season. The views of 16 owners or users are quoted verbatim: 14 of the 16 were not disappointed, some being full of praise for the machine. Because of special conditions or varieties of cane grown in northern Queensland some minor modifications were found desirable. One grower reported "rat-eaten cane, short rows and drains caused difficulties—keen to redesign farm to get the best out of the machine".

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Flame throwers at Condong. L. G. VALLANCE. *Australian Sugar J.*, 1967, **59,** 471.—The use of tractor-mounted locally-made flame throwers for burning off the trash on cut cane in northern New South Wales during an exceptionally wet season is described. Diesel oil or kerosene was used in the flame throwers.

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Evaporation studies in Mauritius. H. W. UNDERHILL and K. VENKATASAWMY. *Rev. Agric. Sucr.* (Mauritius), 1967, **46,** 138–144.—The need for evaporation studies is discussed and previous work in Mauritius summarized. Tables are given with results obtained in various parts of Mauritius, as well as a map of the island showing mean annual iso-evaporation lines. Mean annual evaporation is shown to range from about 1870 mm on the western coastal and northern plains to about 1370 mm in the highest parts of the island. By comparison, the mean annual evaporation in Britain is about 500 mm. The variability of monthly evaporation from one year to another in Mauritius is small.

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Lengthening versus shortening dark periods and blossoming in sugar cane as affected by temperature. H. F. CLEMENTS. *Plant Physiology*, 1968, **43,** (1), 57–60.—Earlier work is reviewed, The work here described was carried out in connexion with the Department of Physiology, University of Hawaii. The sugar cane plant, an intermediate day plant, received a stronger stimulus to flower during lengthening nights than during shortening nights. Flowering was vigorous under warm, lengthening nights (21°C) but less so under cool lengthening nights (16°–17°C). Warm or cool shortening nights either failed to induce flowering altogether or reduced it substantially. Under the warmer nights the inductive dark period was 10 hours 57 minutes to 11 hours 26 minutes whether the nights were lengthening or shortening. Under cooler conditions, it was longer by from 20 minutes to nearly 2 hours.

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A comprehensive trial of 6 pre-emergence herbicides in sugar cane. E. O. SANCHEZ, H. N. NARANJO and A. R. GÓMEZ. *Agric. Trop.* (Bogotá), 1966, **22,** 263–266; through *Weed Abs.*, 1968, **17,** (1), 34. "Gesaprim 50M" ("Atrazine"), "Karmex" ("Diuron") and "Gesatop" ("Simazine"), each at 4, 5 or 6 kg/ha were greatly superior to 2,4-D amine, "Dowpon" ("Dalapon") and an Esso herbicide. All three were effective for at least 45 days. The grass, *Digitaria horizontalis*, was resistant to "Gesaprim".

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Weed research at the Tropical Pesticides Research Institute, Arusha. J. FOSTER and P. J. TERRY. *PANS (Pest Articles and News Summaries)*, 1968, **14,** (1), 4.—A series of screening trials with a number of chemical weedkillers in sugar cane is discussed, the more promising of them to be included in a series of large-scale trials. Attention is being given to ascertaining the relative effectiveness of herbicides in furrow-irrigated and in overhead-irrigated fields and attempting to relate this to physical behaviour in the soil. The mode of application of several substituted phenylureas and triazines is being studied, in particular the effect of additives on their post-emergence activity.

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Photosynthesis in sugar cane varieties under field conditions. J. E. IRVINE. *Crop Sci.*, 1967, **7,** 297–304; through *Biol. Abs.*, 1968, **49,** (1), 422.—Rates of photosynthesis per unit leaf area (*P*) differed among 10 varieties of sugar cane in a replicated field test. One variety was much higher than all the others. Hybrids of *Saccharum officinarum* were lower than the interspecific hybrids. A correlation between *P* and leaf thickness (0·77) and between *P* and porosity (0·57) was found. Leaf thickness and porosity are more readily determined than *P* and may prove useful in the search for sugar cane varieties of higher photosynthetic potential. No correlations were found between *P* and stomatal number, stomatal length or leaf density thickness.

Sugar beet agriculture

Panning problems: their causes and cure. G. A. SCOTT. *British Sugar Beet Rev.*, 1967, **36**, (1), 17–18.—The harmful effects of soil pans (compacted subsoil) in sugar beet fields, a common cause of poor growth and inferior, fangy roots, are discussed. Methods of dealing with the problem by means of "pan busters" are described and the nature of this type of tractor-drawn implement explained.

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Docking disorder. R. A. DUNNING and D. A. COOKE. *British Sugar Beet Rev.*, 1967, **36**, (1), 23–29.—A detailed account is given, with colour photographs, of this malady which affects sugar beet in Norfolk and is named after the parish of Docking. It is associated with poor, light sandy soil and the presence of nematodes, notably the stubby root eelworm (*Trichodorus*) and needle eelworm (*Longidorus*). Methods of combating the malady are discussed. These include the use of soil fumigants (notably DD) and improving soil fertility. Work in progress is discussed, including attempts to reduce the cost of effective soil fumigation, at present about £16 per acre.

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Sugar beet demonstrations in Shropshire. R. G. DUNICLIFF. *British Sugar Beet Rev.*, 1967, **36**, (1), 30.—Four practical local demonstrations in the Allscott sugar factory area, to meet a growing demand are described. These were on small sites, none more than 10 acres, arranged primarily as demonstrations of spring work in sugar beet: planting to stand, band and overall spraying, gapping and thinning, etc.

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Influence of excessive amounts of mineral fertilizers on yield and quality of sugar beets. H. LÜDECKE and M. NITZSCHE. *Zucker*, 1967, **20**, 461–466, 483–487. Results of trials on applying high dressings of mineral fertilizers are discussed, notably their influence on yield and quality, The root:top ratio was also studied. Results showed clearly the harmful effect of excess nitrogen in reducing the processing quality of the beet and in retarding certain metabolic processes in the autumn before harvest. With the usual supply of nitrogen and phosphorus, excessive potassium had only a small effect on the quality of the beets.

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Chemical weed control advances beet sugar industry in U.S.A. R. T. NELSON. *Sugar y Azúcar*, 1967, **62**, (9), 40–42.—The enormous advantages to the sugar beet industry that accrued with the advent of mechanical harvesting and loading in the 1940's are discussed. Other advances were in the use of segmented seed and mechanical thinning. The early use of chemical weedkillers and the development of selective herbicides are reviewed. The present position regarding herbicides and sugar beet is considered in some detail and the great saving through chemical weed control, with less manpower now available, pointed out.

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Monogerm—seed of the future? ANON. *British Sugar Beet Rev.*, 1967, **36**, (1), 45, 48, 50.—Some of the recent problems and achievements of the British sugar beet seed production industry are explained, with special reference to monogerm seed (one seed per cluster instead of several). About 10% of the 1967 commercial sugar beet acreage in Britain was drilled with monogerm seed. The advantages of monogerm seed and the fact that the newer varieties or strains are less prone to bolt are explained. It is thought that within the next few years there is every likelihood that all the varieties officially recommended will be monogerm and the demand for multigerm varieties will cease.

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Technical problems of fully mechanized harvesting of sugar beet. E. STROOKER. *Zucker*, 1967, **20**, 527–530. The possibilities of increasing the rate of mechanical sugar beet harvesting are discussed. It is pointed out that one of the limits of high speed harvesting is the physical strain on the operator. Mechanical beet toppers should be able to adapt themselves to the different levels of beets above ground. Breeders should pay attention to uniform growth of beets.

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Observations and correlations on the detrimental effects of savoy and yellow vein viruses on sugar beets. R. E. FINKNER and J. P. YODER. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 278–282.—Observations on these two diseases obtained from field trials with numerous sugar beet varieties or strains in central Nebraska are recorded. Marked differences in susceptibility were noted. Varieties resistant to leaf spot (*Cercospora beticola*) were also resistant to savoy disease, which may seriously limit the growth of sugar beets and the accumulation of sucrose. Yellow vein virus can also reduce root yield and percentage sucrose but has not caused serious loss to the beet crop as a whole. It is not strongly associated with either savoy or leaf spot virus.

Weed control in sugar beets. H. A. ALLEY. *Sugar J.*, 1967, **30**, (4), 14–17.—The value of recently evolved pre-plant herbicides in controlling weeds in sugar beet in the United States is described. Success obtained with difficult late-germinating weeds such as Kockia (*Kochia scoparia*) and pigweed (*Amaranthus retroflexus*) is stressed. The kind of weed and other factors, for any one location, may in future be all-important in determining what herbicide to use. The writer considers that weed control in sugar beets is no longer the limiting factor in complete mechanization of the sugar beet industry. Chemical weed control has, in fact, surpassed many of the other tools concerned in the complete mechanization of the sugar beet crop.

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Sugar beet growing nears total mechanization. S. BASS. *Sugar J.*, 1967, **30**, (4), 30–33.—For many years the goal of sugar beet growers and processors in the United States has been the complete mechanization of planting, growing and harvesting of the crop. Complete mechanization has now been fully accomplished in all phases of the crop with the exception of the removal of some excess plants and weeds during early growth stages. The final link to full mechanization is developing slowly but surely with each new growing season. Some present-day large scale field operations with sugar beet are described and the kind of machinery used illustrated.

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Effect of virus yellows on guard cell chloroplasts in sugar beets. R. J. HECKER. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 292–296.—Greenhouse studies are recorded on two varieties of sugar beet in an endeavour to find out whether the chloroplasts in the guard cells of the leaf stomata would constitute useful selection criteria from the breeding standpoint for resistance to beet yellows virus. Results were negative, the number of chloroplasts in the guard cells being unaffected by inoculation with beet yellows or beet western yellows virus.

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Photosynthesis and respiration studies with sugar beets. I. Equipment and methods. M. STOUT. *J. Amer. Soc. Sugar Beet Tech*, 1967, **14**, 302–308.—It is pointed out that the separate or combined effects of light, temperature, nutrient availability or balance, foliar density, carbon dioxide concentration, diseases and variety, may be studied over relatively short periods of time by monitoring changes in the concentration or total amount of carbon dioxide. The infra-red CO_2 analyser, which monitors changes in concentration without adding or removing CO_2, makes it possible to conduct measurements within a hermetically enclosed system. A convenient arrangement for such measurements is described.

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Evaluation of three sugar beet breeding methods. R. J. HECKER. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 309–318.—Three breeding methods were studied for their effect on root weight and percentage sugar, these being modified mass selection, the polycross method and recurrent selection for general combining ability. A sucrose advance was demonstrated in the two populations from recurrent selections. In the two populations produced by polycross methods a root weight advance was indicated. Joint consideration of both characters revealed little difference between breeding methods in relation to gross sugar yield.

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Results of chemical weed control on sugar beets in areas of the Utah-Idaho Sugar Company. R. C. JOHNSON, D. C. KIDMAN, A. W. RICHARDS, J. B. LAW and D. EVES. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 324–333.—Results are given of trials to evaluate new herbicides and to compare them with herbicides already in use. Recommendations are made involving the use of R 2063, "Tillam", "Avadex", H 282 and H 283. These vary according to the kind of weed that is preponderant, "Tillam" being the most widely recommended. Trials were also carried out to determine the most effective depth for incorporating pre-plant applications of herbicides. This was found to be 1½–2 inches for most pre-plant herbicides.

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Herbicide mixtures for post-emergence broad-leaved weed control in sugar beets. R. N. ANDERSEN and D. E. FARUS. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 341–349.—Experiments are reported in which broad-leaved weed control was effective with early post-emergence application of low rates of "Pyrazon" (1 lb per acre) plus H 634 (1 lb per acre). "Endothal" (1 lb per acre) was a promising addition to the mixture and adding a surfactant or wetter was beneficial with some weeds. The most effective time for treatment was when the beet had two true leaves and the weeds were small.

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Effect of beet western yellows virus in sugar beets in Utah and Washington. K. NIELSON, C. L. SCHNEIDER and J. NEMAZI. *J. Amer. Soc. Sugar Beet Tech.*, 1967, **14**, 357–362.—The yellows viruses have not been a problem in beet growing areas of Utah and Idaho but they do appear to be of importance in Washington. Inoculation trials in Utah and Washington are reported. BWYV (beet western yellows virus) reduced gross sugar yield by 27% in Utah and by 12% in Washington. Inoculation trials in Utah and Washington are reported. Figures are given for yield of beets and sucrose percentage.

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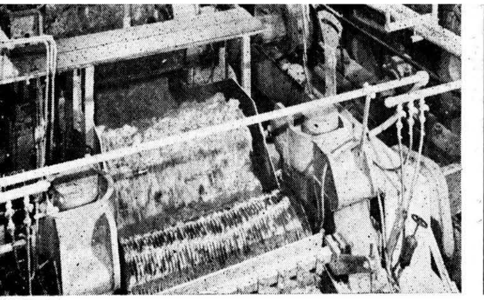
Two-row harvesters popular. ANON. *Up and Down the Rows*, 1967, (143), 2–3.—Reference is made to the trend towards two-row harvesters by Canadian sugar beet growers. Some of the popular makes are described, such as the Farmland, Hesston, John Deere and Allis-Chalmers.



Cane sugar manufacture

The sugar economy of Kenya. H. J. DELAVIER and H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1967, **92,** 459–463.—The history and development of sugar manufacture in Kenya is outlined and information given on cane agriculture and sugar economy, including consumption (direct and industrial), sugar transport and marketing, and the Commonwealth Sugar Agreement price. Details are given of the three existing cane factories with mention of the Chemelil factory (under erection), and the Mumias factory, preliminary plans for which are being drawn up. A short glossary of the more important sugar terms in Swahili is given with the German equivalents.

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Installation of back-pressure turbo-generator of moderate capacity. K. C. CHIANG. *Taiwan Sugar*, 1966, **13,** (6), 11, 24–28; 1967, **14,** (1), 11, 18–19; (2), 14–17; (3), 8, 14–15, 26.—Detailed information is given on the various stages in installation of an impulse steam turbine.

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How to exhaust final molasses. R. PEDROSA P. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (1), 30–44.—The relationships between dimensions and weight of seed and final crystals in pan boiling are calculated using numerical examples, and the immense increase in absolute rate of deposition during a boiling is discussed. Aspects concerned in the exhaustion of molasses in the minimum time include the maximum crystal surface per unit massecuite volume, the maximum porosity of the crystal layer in the centrifugal, and the final molasses purity; each of these is discussed and the factors influencing each are reviewed.

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Vapour cells and juice heaters. F. GARCÍA L. and J. A. CLARK. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (1), 54–72. The nature of vapour cells is described and a series of calculations made on the use of a unit together with four juice heaters under specified conditions. A number of comments are made on the value and operation of the vapour cell.

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Equivalent flow in tubes. O. A. ESPINOSA DE LA T. *Bol. Ofic. A.T.A.C.*, 1967, **22,** (1), 76–79.—Tables of equivalent capacities and areas of tubes are presented and discussed. Where a particular gas flow is arranged through the equivalent number of smaller tubes instead of a single large tube having the same area, the gas velocity will be the same, but the higher surface friction will greatly increase the pressure drop; this is allowed for in the table of equivalent capacities.

Roll opening settings for processing bagasse. U. V. LORENZO. *Power*, 1967, **111,** (1), 84; through *S.I.A.*, 1967, **29,** Abs. 565.—A nomogram is shown which enables the work opening of the bagasse roll of a mill to be found, knowing the weight of cane/day, fibre % cane, bagasse volume/short ton of fibre, and roll length and peripheral speed.

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Sugar manufacture. G. I. RIVERA. *Sugarland*, 1967, **4,** (1), 10–14.—This is the first in a series of articles, describing sugar factory operations, intended for cane planters with little or no knowledge of factory processing. The fundamentals of cane milling are described in this article.

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Fundamentals in the control of vacuum systems on pans and evaporators. H. HUSE. *Sugar J.*, 1967, **30,** (4), 24–27.—The air handling capacity of vacuum pumps is discussed with the aid of graphs showing the equilibrium point at which pump capacity and the volume of air and incondensables to be handled coincide. The two means of changing the system in an evaporator or pan so that the equilibrium point matches the desired absolute pressure, viz. (i) increasing the air load and hence decreasing the vacuum, and (ii) raising the temperature in the condenser, thus increasing the partial vapour pressure of the air-vapour mixture, are discussed. For evaporators and raw sugar pans, where constant vacuum is desirable, (ii) is considered better, while (i) is more suitable for refined sugar pans. The advantages of liquid ring vacuum pumps are briefly considered.

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A new cane sugar factory in Africa. A. BERNARD. *Ind. Alim. Agric.*, 1967, **84,** 1075–1083.—Information is given on the S.I.A.N. (Société Industrielle et Agricole du Niari) and SOSUNIARI (Société Sucrière du Niari) cane sugar factories in Congo (Brazzaville). The S.I.A.N. factory has a crushing capacity of 2400 t.c.d. and is equipped with a refinery producing 50–60,000 tons of sugar annually. Some of the granulated sugar from the refinery is processed into loaf sugar at a subsidiary plant at Fort Lamy. The SOSUNIARI factory has a crushing capacity of 5000 t.c.d.

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Sugar in Red China. H. HIRSCHMÜLLER and H. J. DELAVIER. *Zeitsch. Zuckerind.*, 1967, **92,** 517–527. A survey is presented of the Mainland Chinese sugar industry and sugar economy.

Hawaii's hydroseparator systems transform cane cleaner effluent. A. R. DUVALL. *Sugar y Azúcar*, 1967, **62,** (10), 31-33.—Details are given of the system used at a number of Hawaiian sugar factories and pioneered at Ewa for re-utilization of cane cleaner water and disposal of the separated muds. The scheme incorporates a screen to remove the larger solid particles and a hydroseparator, which consists of a large-diameter (e.g. 120 ft) raked earth basin. Provision is made for recycling the water to the cane cleaner and/or using it for irrigation. The mud is pumped together with filter mud to reclamation areas, where it is settled in a pattern of dyked ponds, draining and drying in turn until a 2-ft top soil layer is formed on the infertile coral or sand; the areas can then be planted to cane.

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New bagasse handling system for Mhlume. ANON. *S. African Sugar J.*, 1967, **51,** 747.—The system, designed and built by Macmill Structural Engineering (Natal) (Pty.) Ltd. to handle 60 tons of bagasse/hr, includes a scraper conveyor to transfer the bagasse from the last mill to three vibrating bagacillo screens, and a conveyor which takes the bagasse from the screens to five boilers. Excess bagasse is fed by belt conveyor to a 1000-ton bagasse store, in which it is discharged via a chute onto a rake conveyor suspended from a crane running the length of the store. Reclamation involves lowering of the rake conveyor into the stockpile and transference of the bagasse to a return belt conveyor running in a trench along one side of the building.

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Ma-ao sugar central. ANON. *Sugarland*, 1967, **4,** (2), 25-31.—The history of this sugar factory is outlined, with information on the managerial staff and illustrations of the equipment. Its average crushing capacity is just over 4500 t.c.d.

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Diffusion applied to sugar cane. E. O. TATE. *La Ind. Azuc.*, 1967, **73,** 251-252.—Information on the Silver ring diffuser system, obtained during a seminar in Hawaii, is presented. It is considered that the opportunities for improvement, the high capacity possible, and the flexibility of the system will ensure its replacement of the cane milling system of extraction in the future.

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Busy year of Sugar Research Institute (Queensland). ANON. *Australian Sugar J.*, 1967, **59,** 338-341. Problems examined during the year covered by the Institute's annual report include the deleterious effect of dirt accompanying cane on equipment, deterioration of chopper-harvested cane, which proceeds at a faster rate than with wholestick-harvested cane, and cane transport on tramways, studies of which have shown that substantial savings are obtainable through improved scheduling and running of the trains. The use of a brake wagon at the end of trains has shown promise.

Sugar and its origins. L. VANOSSI. *Ind. Alimentari*, 1967, **6,** (33), 73-76.—A brief review is presented of the bringing of cane sugar to Europe, of the origin of the sugar cane and its cultivation, and the production of sugar from beet and other sugar-bearing plants. Some of the principal sugar-producing countries of the world are listed.

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Research design and development for sugar and distillation industry in India. B. B. PAUL. *Indian Sugar*, 1967, **17,** 355-359.—Design and development in the Indian sugar industry are exemplified by the author's experience with a number of projects, which are described.

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Combustion control system for sugar mill boilers. J. QUINTERO. *Sugar J.*, 1967, **30,** (5), 14-15.—A description is given of a bagasse furnace control scheme in which bagasse feed is governed by a steam pressure controller and by the bagasse:air ratio, the steam pressure control signal also regulating supplementary fuel flow and fuel:air ratio. Furnace draught and boiler feed water flow are also automatically controlled.

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Control of micro-organisms. C. K. CLONINGER. *Sugar J.*, 1967, **30,** (5), 17-19.—Causes and determination of inversion losses in a cane sugar factory are discussed and the advantages of using a cane mill bactericide, whereby a reduction of up to 70% in inversion loss may be obtained, are briefly considered.

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Muhoroni sugar factory in Kenya. H. J. DELAVIER, H. BOURZUTSCHKY and N. BARKOW. *Zeitsch. Zuckerind.*, 1967, **92,** 571-576.—Details and illustrations are given of Muhoroni cane sugar estate and factory. The latter was equipped by Gutehoffnungshütte Sterkrade AG for a crushing capacity of 1200 t.c.d., expandable to 1800 t.c.d. A 3-boiling scheme is used; *C*-sugar is used as footing for *B*-strikes, while the *B*-sugar is partly used as footing for *A*-strikes and partly melted with the *A*-sugar. The remelt syrup is limed, sulphited and recrystallized to give two grades of refined sugar; the second refined sugar run-off is mixed with syrup for feeding to the *A*-strike.

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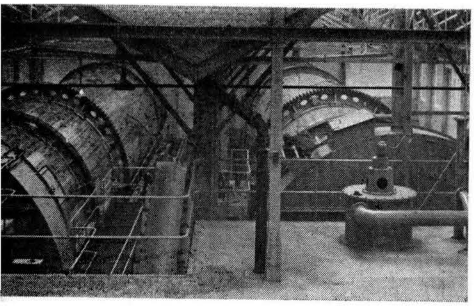
Clarification with emphasis on starch removal. G. G. CARTER. *Proc. 41st Congr. S. African Sugar Tech. Assoc.*, 1967, 37-41.—Four methods of starch removal tested at Tongaat are discussed and their efficiencies compared. The enzymatic process used for some years removes 50-60% starch, middle carbonatation 42%, the Rabe process 82·5%, and sedimentation up to a maximum of 85%. However, carbonatation was better than sedimentation and the Rabe process as regards removal of total filtration-impeding impurities, although the overall efficiency of the Rabe process was only 10% lower than that of carbonatation at two-thirds of the cost of the latter.



Beet sugar manufacture

Modern technique for separation and washing of 1st and 2nd carbonatation muds. P. LUTTON. *Ind. Alim. Agric.*, 1967, **84**, 1029–1034.—Details are given of the juice purification plant, and particularly of the Gaudfrin filter-thickeners and leaf filters used for 1st and 2nd carbonatation mud treatment, at Eppeville sugar factory. Tabulated results show a mud sugar content in the range 0·844–1·03% over three campaigns, with an average filtrate purity of 88·28. At Vauciennes sugar factory, equipped with an identical filter station, mud sugar content averaged 0·5% during two campaigns, with a filtrate purity of 89·7.

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Improvements and installations for sonic wave screening in the sugar factory. P. KORDA. *Ind. Alim. Agric.*, 1967, **84**, 1051–1061.—Various aspects of sonic wave screening for various types of sugar are discussed with the aid of numerous illustrations and diagrams of equipment available.

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Application of mist and warm aerosols for the protection of stored beet. J. ZAHRADNÍČEK, L. SCHMIDT and A. HAVRÁNEK. *Listy Cukr.*, 1967, **83**, 193–197. Details are given of tests in which the effects on loss reduction in stored beet were compared for ten physiologically-active preparations applied on an aerosol base at the rate of 4 and 8 g/cu.m. of beet, respectively. "Faltan" (*N*-trichloromethyl phthalamide), 2,4,5-T butyl ester and copper naphthenate were the most effective and approximately halved the losses sustained by the controls, being better than chloroform applied as aerosol. Even at the higher concentration their use was economically justifiable.

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Planning of thin juice de-liming stations. I. P. STRÁNSKÝ. *Listy Cukr.*, 1967, **83**, 205–210.—Periodical softening of thin juice with a strongly acid styrene-divinylbenzene cation exchanger in Na^+ form at Novy Bydžov sugar factory in 1963 proved economically and technically better than continuous treatment, although it was found that more scale forms in the evaporators after a long campaign than would do so with continuous treatment. This could be overcome, it is suggested, by shortening the regeneration time. Softened juice was found to dissolve incrustation already formed on evaporator heating surfaces. Various methods of cation exchange softening of thin juice are discussed, and the more important parameters are listed. An equation is derived for calculating the amount of resin required for a given juice volume and flow rate. The use of a series of interconnected exchanger columns and sand filters is suggested, and the performance of a "Štrobach" filter for lime salts removal from water used for exchanger regeneration is evaluated.

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Full-scale tests on forced ventilation of beet piles in the 1966/67 campaign. A. HAVRÁNEK, L. SCHMIDT, J. ZAHRADNÍČEK and P. FEKETE. *Listy Cukr.*, 1967, **83**, 217–221.—Storage tests over 36–60 days showed that ventilation of the piles reduced the average daily sugar losses from 1·14% to 0·676%. Conditions have been established under which even better results are obtainable. Temperature fluctuations in the pile and the length of the storage period are considered the two main factors affecting sugar loss.

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The operation of thin juice de-liming stations. K. ČÍŽ. *Listy Cukr.*, 1967, **83**, 232–234.—Various aspects of cation exchange de-liming of thin juice are considered, including washing off mechanical impurities with water or HCl, storage of the resin during the inter-campaign period, and utilization of discard resin, e.g. for treatment of water.

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Charging and discharging of coke-fired shaft lime kilns. M. SCHOLZ. *Zucker*, 1967, **20**, 549–553.—The importance of efficient charging and discharging of lime kilns for high thermal efficiency and uniform burning is discussed and various types of skips are described, including one with a special closing device. Details are also given of a vibratory discharge device.

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The Sugar Institute of Turkey: two organs, one objective. T. M. OZIL. *Sugar y Azúcar*, 1967, **62**, (10), 36–37.—Information is given on the Sugar Institute, situated near Ankara. which combines two autonomous bodies: the Sugar Beet Research Institute and the Sugar Technology Research Institute.

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Development of Braunschweiger Zucker-AG. H. MATHEIS. *Zucker*, 1967, **20**, 573–581.—This company was formed in 1959 by amalgamation between Eichthal, Broitzem, Vechelde and Wierthe sugar factories. The first three were subsequently dismantled in succession and some of the plant used to expand Wierthe factory, which was converted to white sugar production. In 1962 Barum white sugar factory was acquired and subsequently expanded. The layouts of both existing factories are given and the modifications described.

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Conversion of Wierthe sugar factory to white sugar production. K. Jörn. *Zucker*, 1967, **20**, 581–586. Details are given of plant and processes at Wierthe sugar factory (see preceding abstract).

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Electrical equipment for the sugar conveyors and packing station at Wierthe sugar factory. G. Asmer. *Zucker*, 1967, **20**, 586–587.—Information is given on the electric controls for sugar conveyors connecting the centrifugal station, ring silo, screens, classification hopper, packing station and main silo. Details are also given of the sack filling and packaging equipment.

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Organization and equipment of sugar factory beet yards. A. Palczyński. *Gaz. Cukr.*, 1967, **75**, (8), 196–199, (10), 222–227.—Various aspects of beet reception, sampling and storage are discussed, particularly ventilation and protection of the beet piles against atmospheric conditions. Types and dimensions of forced ventilation ducts are considered, as are the construction and working costs. Results obtained at Ketrzyn sugar factory in Poland are given as an example.

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Effect of harvesting methods on the storage of sugar beet. A. Karatnicki. *Gaz. Cukr.*, 1967, **75**, (10), 227–230.—Results of tests showed that losses in mechanically-harvested beet were greater than in beet topped while in the ground and then lifted.

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Juice purification at the new Fermo sugar factory. F. Zama. *Ind. Sacc. Ital.*, 1967, **90**, 237–246.—A detailed account is given of the juice purification scheme at this new factory. Raw juice from a DDS diffuser is heated, sent to a vertical continuous counter-current Naveau-type prelimer, and then to main liming. After further heating and continuous 1st carbonatation, it is filtered on continuous Gaudfrin filters and then passes to 2nd carbonatation and filtration on Terom candle filters. The juice is then aerated to eliminate CO_2 and again filtered on candle filters. The plant involves a high degree of automation and labour economy.

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The sugar industry in Italy. G. Buggo. *Ind. Alimentari*, 1967, **6**, (33), 77–85.—Basic processes employed in the Italian beet sugar industry are reviewed.

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Further possibilities of improving the quality of sugar. I. Uscatu. *Ind. Alimentara*, 1966, **17**, 464–467; through *S.I.A.*, 1967, **29**, Abs. 587.—The sugar boiling scheme at Roman factory, Rumania, is described with a material balance and flow diagram. The factory produces 70% of its white sugar for export. Two-thirds of the thick juice (90·6 purity) is boiled in a white sugar massecuite, together with affined remelted 1st and 2nd product sugar. The run-off syrup and the remaining one-third of the thick juice are boiled in a 2-massecuite system. Process features leading to a high quality of the white massecuite (95·0 purity) and sugar, especially a low colour, are enumerated; the use of Kestner film evaporators is important. Only high-grade beet can be processed by this scheme.

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Effect of anti-foaming agents on purified juice quality. F. N. Dobronravov and G. V. Achkasova. *Sakhar. Prom.*, 1967, **41**, (9), 13–14.—Addition of mineral (machine and solar) oil as anti-foam agent to 1st carbonatation juice caused an increase in the lime salts content of the 2nd carbonatation juice, while the colour content fell slightly and the purity remained unchanged. Addition of animal fat and vegetable (cottonseed and sunflower) oils caused a drop in lime salts and colour contents and a rise in purity; on the other hand, the presence of a thin layer of fat on heating surfaces when these are used as anti-foam agents reduces heat transfer.

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Examination of white sugar drying in a continuous fluidized bed dryer. V. D. Karmazin and A. I. Chernyavskii. *Sakhar. Prom.*, 1967, **41**, (9), 22–26. Formulae are presented for calculation of various factors involved in fluidized bed drying, and tests with a laboratory fluidized bed dryer are described. Tabulated data show that the moisture reduction in white sugar from 0·9–1·3% to 0·15% was better than with three different types of Soviet-designed drum dryers, but that the power consumption per ton of dry sugar was much higher than in the drum dryers. Despite this, fluidized bed drying is recommended for white sugar.

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Relationship between white sugar yields and syrup and molasses purity. A. I. Vostokov. *Sakhar. Prom.*, 1967, **41**, (9), 35.—Tabulated data showing the white sugar yield calculated for syrup purity in the range 85–95 and molasses purity in the range 55–65 at constant beet sugar content and sugar loss to molasses indicate that a unit rise in syrup purity is much more effective in raising white sugar yield than is a unit reduction in molasses purity.

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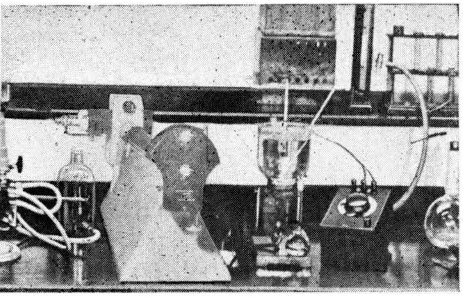
Automation of 1st carbonatation. A. Papchenko. *Sakhar. Prom.*, 1967, **41**, (9), 36–38.—Details and diagrams are given of a 1st carbonatation control scheme in which a control regulating the juice:milk-of-lime ratio is linked to a control regulating the ratio between milk-of-lime, juice and CO_2. The CO_2 feed is also controlled on the basis of the juice pH, the CO_2 regulator also being linked to the juice:milk-of-lime ratio control.



Laboratory methods & Chemical reports

Colloid disperse systems in the sugar industry. I. Classification of liquid sugar factory products and evaluation of modern methods for determination of "colloidal matter" in the sugar industry. R. BRETSCHNEIDER and I. BOHAČENKO. *Listy Cukr.*, 1967, **83**, 174–180.—Beet sugar factory intermediate products have been classified as disperse systems under two groups: (i) raw juice, the most complex disperse system, and (ii) thin and thick juice, syrups and molasses, which contain mainly colouring matter and high molecular colloids. A study of methods used to determine colloid matter has shown that none was capable of determining specifically those substances having a size in the range 1–1000 nm.

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Beet preservation by ionizing radiation. O. LANZER. *Listy Cukr.*, 1967, **83**, 180–182.—Information is given on preliminary tests in which beets were irradiated with γ-rays from a ^{60}Co source. Daily sugar and weight losses fell with increase in radiation dosage.

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(Determination of) Sucrose content of sugar beets and process products by thin-layer chromatography. K. SASAMORI and T. YAMADA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1967, **18**, 10–17.—A 0·25-mm layer of silica gel is dried on a glass plate for 30 min at 100°C and 10 μlitres of the test solution containing 300–600 mg/100 ml of 50% ethanol solution spotted onto the plate. A 7:2:1 *n*-propanol: ethyl acetate:water mixture is then allowed to ascend the plate for 90 min. The silica gel zone corresponding to the sucrose spot is scraped off into a test tube, reacted with anthrone reagent for 20 min at 60°C, and the resultant mixture filtered to remove the silica gel. The sucrose concentration in the filtrate is then determined by measuring the absorbancy at 622·5 nm. A mean of 47·76 γ of sucrose was determined from an original 48 γ. This method and Horne's dry lead method were used to determine the sucrose content in (i) cossettes, (ii) raw juice, (iii) thin juice and (iv) final molasses, and corresponding correlations for sucrose content are given as: (i) 1·098 pol—1·865; (ii) 0·786 pol—2·420; (iii) 1·068 pol—1·268; and (iv) 0·469 pol—21·333.

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Determination of raffinose by paper chromatography using indent-cut filter paper. K. YAMAMOTO, S. YOSHIDA and K. KATO. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1967, **18**, 18–25.—Cutting a strip of filter paper originally measuring 20 cm long × 5 cm wide so that the width of the last ~ 7 cm of its length (the end where the sample is applied) was 1 cm (2 cm removed on each side), halved the time normally required for separation of sucrose and raffinose by a previously described paper charomatographic method[1]. However, the shape is suitable only where the sucrose content of the test solution is below 2000 γ. With a raffinose content in the range 50–175 γ, the error is only about 6%.

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On the oxidative decomposition products of sucrose by ozone. II. On the sucrobionic acids. T. SHIGA, S. NOMURA and T. KANEUCHI. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1967, **18**, 26–32.—Invertase hydrolysis of an organic acid spot (not hydrolysed by HCl) on a paper chromatogram developed in a study of the organic acid fraction in ozone oxidation products of sucrose[2] followed by acid hydrolysis of the unhydrolysed residue revealed three isomers of sucrobionic acid: a glucuronic acid-fructose, a glucose-2-ketogluconic acid and a glucose-fructuronic acid.

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Filtrability of raw sugar and clarifying filtration of sugar liquor. A. KAGAYA. *Proc. Research Soc. Japan Sugar Refineries Tech.*, 1967, **18**, 40–59.—A discussion of theoretical and practical aspects, with 66 references to the literature.

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Determination of sucrose in wines and musts by two-dimensional thin-layer chromatography. R. MATTIONI and G. VALENTINIS. *Ind. Alimentari*, 1967, **6**, (30), 71–76.—Sucrose is separated from glucose and fructose by two-dimensional chromatography on a thin layer of boric acid-impregnated Silica Gel G using 40:50:10 butanol:acetone:water as developer in one direction and 3:1:1 methyl ethyl ketone:acetic acid: water in the other. The spots are revealed with naphthoresorcine-phosphoric acid or diphenylamine-phosphoric acid reagent, and the technique is sensitive to 0·2 per 1000 of sucrose in dry wine and 0·5 per 1000 in sweet wines and musts.

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A rapid method for estimating starch in sugar products. R. D. ARCHIBALD and R. P. JENNINGS. *S. African Sugar J.*, 1967, **51**, 671.—The method, which can give results within 1 hr of sampling, involves adding 40 ml of 45% $CaCl_2$ solution to (a) 50 g of a 50°Bx sugar solution or (b) to 140 g of clarified juice, and boiling for 15 min. The boiled mixture is transferred

[1] KATO *et al.*: *I.S.J.*, 1963, **65**, 183.
[2] SHIGA *et al.*: *I.S.J.*, 1966, **68**, 185.

to (a) a 100-ml flask or (b) a 200-ml flask, and made up to volume. After centrifuging, the mixture is divided into 10-ml aliquots, to which are added in succession 2·5 ml of 2N acetic acid, 0·5 ml of 10% potassium iodide solution, and 5·0 ml of 0·01N potassium iodate solution. The mixture is made up to volume in a 50-ml flask and the absorbance measured spectrophotometrically at 600 nm or with an absorptiometer using a 607 filter. Standard deviation between the rapid and standard methods was 28·8 p.p.m. at a mean starch content of 468 p.p.m. in the case of sugars (+ 26% to — 14%), and 42·2 p.p.m. at 230 p.p.m. starch in the case of clarified juice (+ 7% to + 26%). The method proved unsuitable for mixed juice. While it is proposed for absolute starch measurements, it provides a quick comparative measure for examining the effect of process changes. It has been used to determine the correlation coefficient (0·87) between turbidity and starch in clarified juice. This confirmed that good indication of the performance of a starch-removing agent is obtainable from the turbidity of the clarified juice.

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Cane cleaning drum. ANON. *Australian Sugar J.*, 1967, **59**, 227.—A pilot-plant 3 ft × 8 ft dia. tumbler drum for cane cleaning developed at the Sugar Research Institute is described. Test results have shown that over 80% of the total dirt content on cane is removed after 10 revolutions of the drum, 50–70% of normally removable trash also being separated. Although originally intended for use in cane inspection by cleaning selected truckloads, the drum may find wider application.

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Nucleation in the metastable zone of sugar solutions. A. V. ZUBCHENKO. *Izv. Vuzov, Pishchev. Tekhnol.*, 1967, (4), 56–59.—Formulae are derived for calculation of the variables involved in nucleation. Tabulated data and corresponding graphs are presented for use in calculating the number of molecules in a nucleus of critical size (n_k) and the rate of nucleation (f_k) at varying supersaturation in the range 1·20–1·26. The value of n_k fell sharply with increase in supersaturation. At the temperature considered (70°C) the boundary of the metastable zone, above which spontaneous nucleation is theoretically possible, should be assumed as >1·23, at which point the value of log f_k changes from negative to positive.

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Influence of extraneous material on laboratory calculations. F. FERNÁNDEZ S. *Bol. Ofic. A.T.A.C.*, 1967, **22**, (1), 5–19.—Mechanical harvesting has resulted in the presence of extraneous material in the cane supply, and even with cleaning equipment, dirt is carried to the mill and enters the mixed juice, where it can cause error since it is recorded by the weigher as mixed juice while not having the measured pol content. The effect of this inaccuracy is indicated by calculation of correction equations and by drawing up balances, true and ignoring the dirt content of the juice.

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Fractionation and determination of the main sugars in cane juice by ion exchange chromatography. P. T. HSIEH, T. S. SHIH and K. N. LI. *Chung Kuo Nung Yeh Hua Hsueh Hui Chih*, 1963, **1**, (1–2), 14–23; through *S.I.A.*, 1967, **29**, Abs. 621.—Clarified cane juice and standard sugar solutions were passed through a column of "Dowex-1 × 8" (0·9 × 4 cm, 200–400 mesh, borate form), and the sugars were eluted from the resin with $Na_2B_4O_7$ solutions of increasing concentration. The fractions were analysed by the anthrone method. Sucrose, glucose and fructose were identified by paper chromatography, but no pentose was detected. The method required 14 hr. Recoveries of the standard solutions were 101·4% for sucrose, 102·3% for glucose, and 97·7% for fructose.

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Thermomoisture conductivity of beet pulp. M. G. PARFENOPULO. *Izv. Vuzov, Pishchev. Tekhnol.*, 1966, (6), 93–96; through *S.I.A.*, 1967, **29**, Abs. 637.—The ends of a cylinder of pulp were maintained at 70°C and 14°C. Temperatures along its length were indicated by thermocouples. 24–28 hr after reaching a steady state, the sample was dissected into five equal lengths and their moisture contents (u) determined as % dry solids by drying to constant weight. The thermal moisture transfer coefficient δ reached a maximum of 7·4% of moisture/°C at u = 220%. It is suggested that at moderate values of u, water is transferred both in the vapour phase and in the liquid phase. When u < 4%, diffusion of vapour against the heat flow causes δ to become negative. As u rises from 220%, more pulp pores become filled with water, to the exclusion of air and vapour, so that δ decreases.

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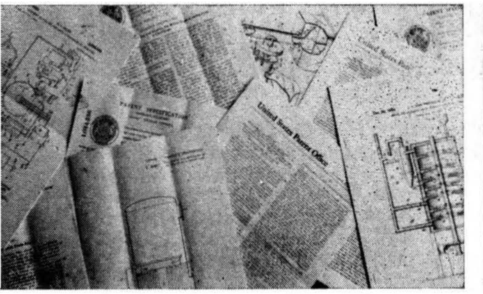
Sucrose activity coefficients. S. E. KHARIN and I. P. PALASH. *Izv. Vuzov, Pishchev. Tekhnol.*, 1966, (6), 88–92; through *S.I.A.*, 1967, **29**, Abs. 640.—Thermodynamic equations are obtained from first principles and the Van Laar theory. These are used to calculate the activity coefficients (γ_2 and γ_1 respectively) of sucrose and water from data of different authors for 0·90% sucrose solutions at 0·90°C. The equation [$\log \gamma_2 = -2U_0x(1-\frac{x}{2})/2{\cdot}3\,KT$], where U_0 = exchange energy, x = mole fraction of sucrose, gives values which agree well with a previous graphical integration at concentrations >30%. Below this, experimental errors prevent reliable direct calculation, and a graphical extrapolation is used. For a particular concentration γ_1 and γ_2 are constant at >60°C, and $-U_0/KT$ becomes constant: $-U_0/KT$ = 7·06, 6·0, 5·3, 5·0 respectively at 0°, 30°, 50° and ⩾60°C. γ_2 is tabulated for various concentrations expressed as mole fraction (0·01–0·10), molar or molal at 0°, 30° or 60°C.



Patents

UNITED STATES

Fermentation to produce L-glutamic acid. G. M. MIESCHER, of Terre Haute, Ind., U.S.A., *assr.* COMMERCIAL SOLVENTS CORPORATION. **3,326,775.** 24th April 1961; 20th June 1967.—L-Glutamic acid-producing strains of *Brevibacterium divaricatum* (NRRL B-2311 or B2312) are cultivated on an aqueous nutrient medium (containing e.g. molasses) in the presence of 0·01–0·1% (0·03%) w/v of oleic, linoleic or linolenic acid or a water-soluble salt of one or more of these.

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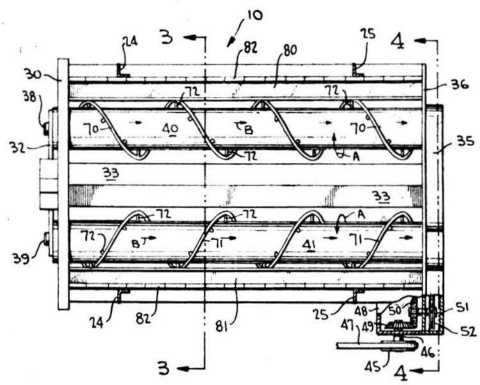
Beet cleaner. R. J. RUSH, B. H. RUSH and W. J. HAHN. **3,329,263.** 1st December 1965; 4th July 1967.

The cleaner, located between the beet elevator and beet hopper, includes a housing at one end of which is a drive mechanism for two rolls 40, 41 which rotate in opposite directions and which carry helical rods 70, 71 wound in relatively opposite directions and spaced apart from the rolls by short bars 72. Between the rolls is a triangular section divider having its apex upwards. Baffle plates 80, 81 are located on each side of the housing, hinged at the outer edges and spring-loaded at the lower inner edges against the rolls.



When beets fall into the housing from the elevator they are carried along towards the discharge end by the rotation of the spirals. Small debris, weeds, mud, etc., falls through the gap between the spirals and the rolls and pass beneath the rolls where there are two openings. The roots will float and will not be damaged in their passage. Heavy material such as rocks will be carried round the roll and will be pushed out of the outer gap when the baffle plates open against the spring pressure.

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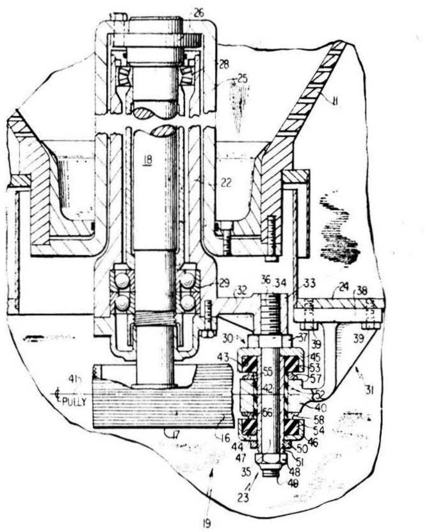
Continuous centrifugal basket mounting. J. B. BANGE and T. R. LAVEN, of Hamilton, Ohio, U.S.A., *assrs.* THE WESTERN STATES MACHINE COMPANY. **3,333,707.** 19th May 1964; 1st August 1967.

The basket 11 of the continuous centrifugal is provided with a downwardly-opening hollow hub 25 within which extends shaft 18 which has an upper flange 26 to which the top of the hub is bolted. The bottom of the shaft 18 carried the pulleys for the belt drive whereby the basket 11 rotates. Coaxially with and between shaft 18 and hub 25 is the bearing housing 22 which contains bearings 28 and 29 at the



upper and lower ends. These bearings are sufficiently far apart for gyration of the basket, caused by imbalance in the loading, to produce only moderate stresses on the bearings.

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).

The housing 22 is supported by at least three mounting assemblies 23. These are in two parts one of which, 30, is connected firmly to the housing through an arm 32 extending from a boss 33 which is internally threaded to take a spindle 35 which extends downwardly through two cup-shaped elements 45, 46. The second part, 31, is rigidly attached to the outer stationary housing of the centrifugal, being bolted to plate 24 and being in the form of a bracket carrying a lug 40 which surrounds the spindle 35 and surrounding tube 47 with ample clearance. The lug is provided with stepped washers 55, 56. Between the spindle and the lug, and within the cup-shaped elements on either side of the washers is a buffer of rubber or other elastomeric material, the assembly 23 being adjusted by tightening the hexagon nut 48 which locks the spacer tube 47 against the upper element 45. The rubber buffer prevents the transmission of undesirable vibrations to the base of the centrifugal or its housing.

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Beet harvester automatic steering device. L. W. SCHMIDT, of Rio Vista, Calif., U.S.A., *assr.* L. K. SCHMIDT, A. M. JONGENEEL, G. C. GORDON, E. F. BLACKWELDER, L. W. SCHMIDT, C. A. LOUCKS, D. P. NEWELL, P. G. HOLT, F. H. HOLT, R. E. HOLT, H. H. SHELTON, F. A. GUERNSEY and D. A. GUERNSEY. **3,326,319.** 19th November 1965; 20th June 1967.

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Animal fodder containing molasses. M. SENYI, of Mayaguez, Puerto Rico, *assr.* LIQUIDOS DIVERSIFICADOS S.A. **3,329,504.** 28th August 1964; 4th July 1967.—Fish stick water (steam distillate from fish plus presswater from fish wastes) is mixed with cane or beet molasses and yeast [H_2SO_4 added to reduce the pH to 4·3–5·5 (4·8–4·9)] and the mixture fermented (at < 30°Bx and < 92°F) until all the sugar content is converted to alcohol. The latter is distilled off and the slops concentrated, mixed with the distilled alcohol and more molasses to give an animal feed supplement.

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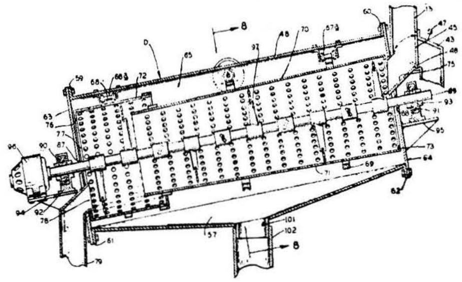
Depithing bagasse. L. FREEMAN, of Baton Rouge, La., U.S.A., *assr.* GRUENDLER CRUSHER & PULVERIZER CO. **3,334,386.** 27th October 1961; 8th August 1967.

The bagasse fibre and pith are separated in three stages in series. The first receives bagasse which has passed through a bale-breaker and is in the form of a cylindrical chamber formed by a solid semi-cylindrical upper half flanged and bolted to a corresponding semi-cylindrical lower half constructed of perforated sheet. A driven shaft passes through apertures in the end walls of the cylinder and carries a spaced set of paddle-like blades with pitches which convey the bagasse from the upper entry point along the housing to the lower discharge point at the other end. The blades also separate part of the pith which passes through the perforations into a collector housing which is connected to a cyclone separator. The treated fibre passes out of the discharge port 13 and over a deflector mechanism 45 whereby it may be sent to process or may be sent to the second stage.



This consists of an inclined housing formed by an upper semi-cylindrical section flanged and bolted to a lower section having straight vertical sides connected at the bottom to a second collector housing 57 through which further separated pith is withdrawn to a second cyclone. The ends of the inclined housing are closed by walls 63 and 64 through which pass the feed port 13 and a lower discharge port 78. The walls also have central apertures through which passes a shaft 89 supported by bearings 90, 91 and driven by motor 96. The shaft carries beater arms 97 spaced along it, at 90° rotary invervals except for the last two which are at a 180° interval. At the ends of the arms are lengths of free-swinging chain which do not quite reach the surface of an internal screen 70. This is formed of perforated plate and is of hexagonal section, tapering from the feed to the discharge, and having its end enclosed within a cylindrical screen 72 which is larger in diameter than the feed end of the hexagonal-section screen. The ends of the screens have inward flanges 73, 76 but are otherwise open. The screens are provided with mounting rings 68 and 69 which are located by and supported by trunnions 66a, 67a at the top and similar trunnions spaced around the inclined housing. A circular gear ring surrounding the middle of the screen engages with a worm drive which turns the screen in opposition to the rotation of the beater arms, causing further separation of the pith. The shaft 89 may be hollow and may be provided with a water supply which is delivered through apertures in the beater arms to provide wet depithing within the unit.

The separated fibre which leaves through port 78 passes over a second deflector mechanism whereby it may go either to process or to a third stage of the type described by U.S. Patent 2,825,935[1], from which it then goes to process.

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Centrifugal drums. W. JAEKEL and K. BUEGE, *assrs.* SALZGITTER MASCHINEN A.G., of Salzgitter-Bad, Germany. **3,334,751.** 14th June 1965; 8th August 1967.—See U.K. Patent 1,040,223[2].

[1] *I.S.J.*, 1958, **60**, 243.
[2] *I.S.J.*, 1967, **69**, 27.

Citric acid fermentation. M. A. BATTI of Elkhart, Ind., U.S.A., *assr.* MILES LABORATORIES INC. **3,335,067.** 25th May 1965; 8th August 1967.—In order to minimize oxalic acid formation in a citric acid fermentation for use in animal feed, the citric acid-producing strain of a fungus (e.g. *Aspergillus niger*) is grown on a carbohydrate fermentation medium (e.g. containing refined cane sugar) containing alkali metal (potassium or a potassium/sodium mixture) and phosphate nutrients in a weight ratio of less than about 0·83:1 (less than about 0·6:1) until a desired amount of citric acid is produced, the pH being maintained below about 2·0 for substantially all the fermentation run.

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Bagasse soil conditioner. H. M. MAY and H. A. NADLER. **3,337,326.** 28th December 1964; 22nd August 1967.—Compressed (at 100–150 p.s.i.) baled bagasse is weathered for at least 30 days until it contains less than 20% moisture by weight. It is then comminuted (by hammer milling) until substantially all of it will pass a No. 4 Tyler screen and water added to achieve a relatively uniform moisture content of 40–70% by weight. It is then weathered in compacted piles until the moisture content is reduced to 30–60% (30–40%) and treated with plant nutrient chemicals to bring the nitrogen content to 0·6–1·5% (0·9–1·0%), phosphorus to 0·3–1% (0·45–0·65%) as P_2O_5, and potassium to 0·3–1% (0·45–0·65%). The treated bagasse may then be mixed with an aqueous slurry of wood cellulose fibres with constitute 1–3% of the weight of the nutrient-containing bagasse.

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Cane planter. L. S. BARILLEAUX and N. G. RICHARD, of Thibodaux, La., U.S.A., *assrs.* SOUTHDOWN INC. **3,338,439.** 7th May 1965; 29th August 1967.

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L-Glutamic acid fermentation. S. YAMAMOTO, T. GOTO and T. OHSAWA, of Miyazaki-ken, Japan, *assrs.* ASAHI KASEI KOGYO K.K. **3,338,793.** 18th September 1964; 29th August 1967.—Carbohydrate material (cane molasses) is fermented by culturing *Microbacterium ammoniaphilum* strains (e.g. ATCC 15354) in a nutrient culture medium in the presence of a nonionic surface-active agent (polyoxyethylene sorbitan monostearate or monopalmitate, polyoxyethylene monostearate or monopalmitate or alkylamine), subsequently adding (during the period from the middle to the last part of the logarithmic growth phase) an ionic surface-active agent (laurylamine, stearylamine, palmitylamine, alkyl trimethylamine chloride or benzalconium chloride) and an antibiotic (penicillin, erythromycin, leucomycin or streptomycin), continuing the culture aerobically, thereby forming L-glutamic acid which is then isolated and collected.

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Purification of low-grade syrups. B. CORTIS-JONES and R. T. WICKHAM, *assrs.* COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **3,340,093.** 17th August 1965; 5th September 1967.—The pH of the syrup (of ≯60°Bx) is lowered to below 4 (about 3) by adding an acid (H_2SO_4, H_3PO_4 or a superphosphate) which forms insoluble calcium salts. Suspended flocculated and precipitated solids are separated (by filtration or centrifuging) and, in the presence of orthophosphate and ammonium ions, the pH raised to about 7 by adding a suitable base (ammonia) (at ambient temperature) followed by separation of precipitated material. The syrup while at pH < 4 may be heated or treated with yeast invertase to yield an invert syrup.

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Beet topper. A. F. BARNES, of Longmont, Colo., U.S.A. **3,343,348.** 5th May 1964; 26th September 1967.

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Centrifugal (bagasse) press. K. PAUSE, of Grevenbroich, Germany. **3,344,738.** 22nd January 1965; 3rd October 1967.—See U.K. Patent 1,067,941[1].

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Cane planter. O. O. LONGMAN, of Baldwin, La., U.S.A. **3,344,830.** 9th September 1965; 3rd October 1967.

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Beet or cane juice extraction. E. V. JUNG, of Landskrona, Sweden, *assr.* KNAPSACK A.G. **3,347,705.** 10th October 1966; 17th October 1967.—Beet cossettes or cane chips are extracted with a solution containing (0·02–0·10% on cossette or chip weight of) polyphosphoric acid (or polyphosphoric acid combined with a dicarboxylic acid, e.g. itaconic acid) to which has been added 0·0001–0·3% (0·01–0·1%) on cossette or chip weight of colloidal silicic acid.

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Fermentation process for citric acid production. M. A. BATTI, of Elkhart, Ind., U.S.A., *assr.* MILES LABORATORIES INC. **3,349,005.** 25th May 1965; 24th October 1967.—When a fermentation medium (containing high-test cane molasses or refined sugar solution) contains an excessive amount of inhibiting material (Cu) this can retard citric acid production. The effect is counteracted by adding sufficient of an alkaline material (NH_4OH) to increase the pH to at least 3·0 (3·0–5·0).

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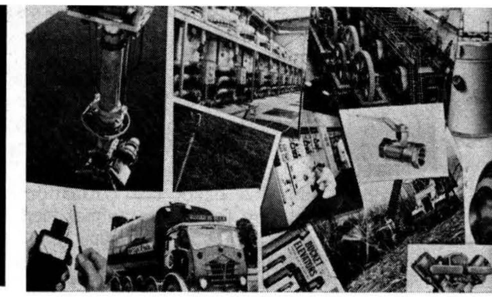
Phosphorus-containing polyols. J. T. PATTON, R. J. HARTMAN and A. L. AUSTIN, *assrs.* WYANDOTTE CHEMICALS CORP., of Wyandotte, Mich., U.S.A. **3,350,389.** 30th December 1964; 31st October 1967. The title compounds, useful as flame-retardants, are prepared by adding an acid of phosphorus (85%, 100% or 115% phosphoric acid) to sucrose in the presence of a diluent (water) while maintaining at 0–50°C (20–40°C), and contacting with an alkylene oxide (ethylene oxide, propylene oxide, epichlorhydrin) at 20–100°C (20–80°C) and thereafter recovering the polyol.

[1] *I.S.J.*, 1967, **69**, 382.

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.

Continuous centrifugals. The Western States Machine Co., Hamilton, Ohio, U.S.A.

Bulletin 68-1 gives details of the Western States 1300-r.p.m. conical-basket continuous centrifugal designed for commercial raw sugar. Data from a Jamaican sugar factory which used the machine for about half of its sugar output show an average pol of 97·4 and a moisture content of 0·57%, with a grain size of 21·3% through 25 British mesh (28 Tyler mesh) compared with 15·3% using batch machines. The built-in sugar discharger is a slowly rotating stainless steel conical section with stationary discharger blades which keep the sugar moving through the centrifugal. The basket is of stainless steel with a capacity of 200–250 cu.ft./hr of "normal" high-grade massecuite. The "thin metal" parts of the syrup compartment inside the 96-in diameter monitor case are also of stainless steel, while other surfaces in contact with sugar or syrup are of epoxy-coated carbon steel. Massecuite feed is automatically controlled, and many parts of the machine are interchangeable with existing Western States low-grade continuous centrifugals. Diagrams and illustrations of the machine and its component parts are given.

* * *

Clarifier. Dorr-Oliver Inc., Stamford, Conn., U.S.A.

The new Dorr-Oliver "RapiDorr 444" combines four independent clarifiers in a single housing and is intended for mixed raw juice treatment. Major features include: individual compartment feed arrangements, which guarantee uniform distribution through the centre tube; individual internal withdrawal tubes which provide uniform juice withdrawal; one oversize clear juice overflow box, designed to carry high throughput; floating hinged rake blades accommodating contour variations in the bottom of the trays; mud seals which isolate the individual compartments and prevent mud reaching the clear juice in successive compartments; separate withdrawal of mud from each compartment; and large diameter piping throughout the clarifier, which permits high capacity flow and eliminates potential juice stagnation in the vent pipe. The feed entering each compartment strikes a deflector plate and then flows outwardly at a decreasing velocity, thereby creating minimum turbulence. The rotary rake arms in each compartment move the settled mud to the discharge boot at the centre of each tray. The "RapiDorr 444" is available in sizes from 10 to 36 ft diameter.

* * *

Granular active carbon. Suchar, Division of Bangor Punta Operations Inc., 9 East 41st Street, New York, N.Y., 10017 U.S.A.

"Suchar 68" is a new granular activated carbon intended for use in packed bed adsorption systems, being particularly suitable for use in cane sugar refineries. It is a dense, hard, regenerable carbon made from coal, and is available in 50-lb bags.

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PUBLICATIONS RECEIVED

"AQUALARM" ELECTROLYTIC CONDUCTIVITY CONTROLLERS. Electronic Switchgear (London) Ltd., Hitchin, Herts., England.

Bulletin EE-023/2/68 gives information on the "Aqualarm" water purity monitor which can be used for such applications as detection of contaminants in steam condensate returned to boilers as "make-up" and indication of ion exchanger exhaustion (automatic initiation of the regeneration cycle), signalling the rinsing end-point, as well as other applications involving water purity monitoring.

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PNEUMATIC GRAVIMETRIC FEEDER. Wallace & Tiernan Ltd., Priory Works, Tonbridge, Kent, England.

Technical Publication BP.310.140 gives details on the range of "Superweigh" pneumatic gravimetric feeders, in which a control system regulates the weight output at a pre-set rate, a pneumatic meter producing a signal proportional to the flow. A model is also available for flow regulation on a volumetric basis. Materials that can be handled include any dry or semi-moist free-flowing materials from fine powder to 1½-in lumps. Flow rate is within the range 0·2–1000 lb/min.

* * *

BMA centrifugals for South Africa.—During 1968 BMA is to supply 20 continuous centrifugals for *C*-massecuite treatment to the South African sugar industry. During the last 9 years more than 1000 continuous BMA machines have been supplied to nearly the whole of the sugar-producing world.

* * *

Moroccan sugar factories.—Two factories supplied by a consortium comprising BMA, Maschinenfabrik Buckau R. Wolf A.G. and Lucks & Co. G.m.b.H. have recently started operations in Morocco. They are the Mechra Bel Ksiri and the Sidi Allal Tazi factories; each has a daily beet slicing capacity of 4000 tons. Erection of the factories took less than 12 months.

US Sugar Supply Quota, 1968[1]

	Quotas as at 18th July	Changes in quotas	Revised quotas
	(short tons, raw value)		
Domestic beet	3,115,667	— *	3,115,667
Mainland cane	1,169,333	17,333	1,186,666
Hawaii	1,191,704	—	1,191,704
Puerto Rico	525,000	—	525,000
Philippines	1,126,020	—	1,126,020
Argentina	71,522	1,998	73,520
Australia	193,582	8,388	201,970
Bolivia	6,920	193	7,113
Brazil	581,399	16,242	597,641
British Honduras	15,057	335	15,392
British West Indies	206,680	4,596	211,276
Colombia	61,522	1,718	63,240
Costa Rica	68,443	1,912	70,355
Dominican Republic	664,854	17,672	682,526
Ecuador	84,594	2,363	86,957
Fiji	42,481	1,840	44,321
French West Indies	65,018	1,445	66,463
Guatemala	57,680	1,611	59,291
Haiti	32,300	902	33,202
Honduras	6,920	193	7,113
India	77,433	3,355	80,788
Ireland	5,351	—	5,351
Malagasy	9,142	396	9,538
Mauritius	17,745	768	18,513
Mexico	594,470	16,608	611,078
Nicaragua	68,443	1,912	70,355
Panama	43,069	—5,259*	37,810
Peru	463,736	12,955	476,691
Salvador	42,299	1,183	43,482
South Africa	56,999	2,471	59,470
Swaziland	6,991	304	7,295
Taiwan	80,659	3,495	84,154
Thailand	17,745	—17,745*	—
Venezuela	29,222	816	30,038
	10,800,000	100,000	10,900,000

* Net result of increased quota and deficit declarations.

C.I.T.S. Proceedings publication.—As we go to press we learn that the Proceedings of the 13th General Assembly of the Commission Internationale Technique de Sucrerie, held in Falsterbo, Sweden, in June 1967, has been published and is available from the General Secretary of the Commission, Dr. J. HENRY, 1 Aandorenstraat, Tienen, Belgium, at a cost of 850 Belgian francs per copy.

* * *

The late A. G. Keller.—Professor ARTHUR G. KELLER died in May of this year at the age of 66. During the many years he had spent in the sugar industry he had earned a distinguished reputation. After graduation he worked for the Cuban-American Sugar Company at Central Mercedita from 1923 to 1932, thereafter returning to Louisiana State University for graduate study and, from 1936, as head of the Audubon Sugar School where he was responsible not only for training of students from all over the world as sugar technologists but also for research into processing particularly applicable under Louisiana conditions. He became a consultant to many of the Louisiana sugar factories and also to sugar companies in many other Western Hemisphere countries as well as to US Government agencies. In 1958 he founded Arkel Engineering Corp. and other consultancies, and these companies have designed major production facilities in a number of countries including the Bryant and Glades sugar factories in Florida. Following Professor KELLER's death the consultancies have been reorganized as F. C. Schaffer & Associates Inc., still in Baton Rouge, La.

Brevities

Malawi sugar production, 1967[2].—The annual report of Lonrho Ltd. which owns The Sugar Corporation of Malawi Ltd. states that the Corporation produced 18,000 tons of sugar in the 1967 season and that production in 1968 is again expected to increase to 22,000 tons. As from April 1967 the Sugar Corporation of Malawi assumed responsibility for supplying Malawi with its total internal sugar requirements.

* * *

World per caput consumption[3].—Calculations, based on the world sugar consumption figures of F. O. Licht K.G. and United Nations estimates of population, indicate that world per caput consumption for the crop year 1967/68 is 42·78 pounds, raw value. This compares with 42·12 pounds for 1966/67, 41·20 pounds for 1965/66 and as little as 29·50 pounds in 1952/53.

* * *

Portugal refineries modernization[4].—Tate & Lyle Enterprises Ltd. have secured contracts to modernize and expand three of the four sugar refineries in Portugal. In Lisbon and Oporto the Company are engaged in work to a total value of £700,000. Their contracts embrace consultation, technical design and the procurement and supply of plant. Plant supplied from the UK will form three-quarters of the contract value. Domestic sugar in Portugal is marketed in soft, moist, partially-refined form; an order of the Government requires that by May 1970 consumption should be of fully-refined, dry, granulated sugar. Considerable plant addition and process alteration will be involved in the change. Portuguese sugar production is about 250,000 tons annually. The three refineries in which Tate & Lyle Enterprises are engaged account for almost 80% of this quantity.

* * *

Sugar production costs in USSR[5].—Recently published data on beet sugar production show that the beet processing costs have risen from 4·89 roubles per zentner in 1950 to 5·50 roubles per zentner in 1966 (1 rouble = approx. 9s 0d; 1 zentner = 100 kg). Among the factors contributing to the increased costs are the price paid for the beet and the higher labour costs. The latter have risen from 0·65 roubles in 1950–1955 to 0·72 roubles in 1961–66, despite a cut in manpower of more than 40%, the net increase resulting from higher paid labour of better quality. An increase in the ratio of beet required for production of white sugar from 7·16 in 1950–1955 to 7·87 in 1961–66 has increased the price of sugar by 2·2 roubles per zentner. Of 296 sugar factories examined, only one had a beet:sugar ratio of less than 6·3 in 1961–65, while those in Latvia, Kirgiziya and Kazakhstan and most of those in the Russian Federation had a ratio greater than 8·3. Consumption of limestone also increased by 26% between 1952/53 (6·1% on beet weight) and 1966/67 (7·7%). On the positive side, management costs were reduced from 0·82 roubles per zentner of sugar in 1950–1955 to 0·56 roubles in 1961–1966.

* * *

Hawaii sugar factory closure[6].—Kahuku Plantation Company which was established in 1890 is to close permanently at the end of 1971. Because of the limited cane producing acreage available, and the long, narrow operating area which increases hauling costs, the plantation has been marginal for several years. The plantation's parent company, Alexander & Baldwin Ltd., has two other sugar plantations.

1 *Lamborn*, 1968, **46**, 121.
2 *Commonwealth Producer*, 1968, (425), 68.
3 *Lamborn*, 1968, **46**, 89.
4 *Tate & Lyle Times*, June 1968, 3.
5 *Sakhar. Prom.*, 1968, **42**, (6), 1–6.
6 *Sugar y Azúcar*, 1968, **63**, (6), 36.

Brevities

Sudan factory closure possibility[1].—The Guneid sugar factory may be compelled to cease operations as a result of a sudden outbreak of a plant disease in the sugar cane plantation. The disease will reduce production to less than 10% of normal.

* * *

South African sugar exports, 1967[2].—Exports of sugar from South Africa in 1967 reached 921,110 metric tons, raw value, compared with only 585,044 tons in 1966. The largest amount went to Japan (370,931 tons compared with 188,295 tons in 1966), while other major customers were the UK (226,070 tons in 1967 and 107,430 in 1966), Canada (216,322 tons in 1967 and 179,109 in 1966) and the USA (59,950 tons in 1967 and 85,988 in 1966). Other exports included 21,470 tons to France (10,620 tons in 1966), 13,020 tons to Hong Kong (0 in 1966), 10,708 tons to Ceylon (0), and 1587 tons to the Seychelles (1577). No sales were made to Finland, whereas 10,926 tons were sold to that destination in 1966. The balance of exports were to other countries and amounted to 1052 tons (1099 in 1966).

Belgium/Luxembourg Sugar Statistics[3]

	1967	1966	1965
	(metric tons, tel quel)		
Imports:			
Cuba	—	982	5
Czechoslovakia	4,171	—	—
France	1,110	9,022	3,130
Germany, East	4,118	1,100	—
Germany, West	1,513	—	—
Holland	3,416	3,763	15
Mexico	3,000	—	—
Peru	—	836	—
Poland	2,700	11,866	—
USSR	1,941	15,870	—
Other countries	587	—	3
	22,556	43,439	3,153
Exports:			
Algeria	10,983	—	—
France	1,437	2,444	2,418
French Pacific	680	225	2,743
French Somaliland	2,209	—	—
Germany, West	40,204	24,312	36,692
Greece	1,150	856	2,452
Holland	9,032	3,877	4,635
Iran	7,951	7,503	7,292
Italy	5,064	5,411	1,241
Morocco	—	7,390	7,307
Norway	1,702	—	—
Persian Gulf	1,281	106	1,541
Saudi Arabia	630	250	357
Spain	5,516	—	—
Switzerland	16,030	358	401
UK	5,168	—	—
USA	2,515	134	1,695
West and Equatorial Africa	24,928	25,721	37,429
Zambia	3,000	—	—
Other countries	5,939	1,605	2,705
	145,419	80,912	108,908

Brazil Sugar Exports[4]

	1967	1966	1965
	(metric tons, tel quel)		
Canada	—	—	8,627
Chile	80,615	89,282	88,551
Finland	10,723	—	—
France	43,220	62,551	31,561
Germany, West	—	—	999
Hong Kong	—	20,739	—
Iraq	10,564	20,048	41,567
Italy	—	—	9,707
Japan	13,049	—	23,185
Kenya	—	—	7,907
Korea, South	—	—	10,482
Lebanon	10,441	19,877	45,474
Malaysia	21,428	—	—
Morocco	52,214	—	6,500
Portugal	—	10,890	10,296
South Africa	—	—	31,542
Swedan	—	—	10,704
Syria	—	9,614	10,578
Tunisia	51,113	58,587	47,464
UK	18,445	167,272	54,910
USA	590,773	491,564	322,934
Uruguay	47,236	67,239	34,761
Vietnam, South	29,761	—	—
Zambia	21,165	10,430	—
Total	1,000,747	1,007,354	818,488

Ban on artificial sweetener in Japan[5].—The Japanese Government has banned the use of "Dulcin", an artificial sweetener, to come into effect on 1st January. Japan has been consuming 600 tons of "Dulcin", equivalent to 150,000 tons of sugar, a year, mostly in soft drinks and bottled and tinned food. Two other artificial sweeteners, saccharin and sodium cyclamate, have not been banned. The Japan Sugar Refining Association are hoping to be able to sell 50,000 tons of sugar as a result of the ban on "Dulcin".

* * *

New sugar factory for Mozambique[6].—A sugar factory with an annual output capacity of 150,000 tons is to be built at Dondo, near Beira, in Portuguese East Africa. The order for the plant has gone to the South African firm James Brown and Hamer Ltd., of Durban, which has already built the Maragra sugar mill near Manhiça. The new project includes, besides building of the sugar factory, establishment of an irrigation system for the sugar cane plantations.

* * *

Australian sugar exports, 1967[7].—Total sugar exports in 1967 amounted to 1,822,081 metric tons, tel quel, equivalent to 1,910,125 tons, raw value. This compares with exports of 1,446,208 tons, tel quel, or 1,524,426 tons, raw value, in 1966. The 1967 total included 700,431 tons to Japan, 479,205 tons to the UK, 169,719 tons to the US, 158,529 to Canada, 114,479 to New Zealand, 80,016 to Malaysia, 35,686 to Singapore, 25,658 to Oceania, 25,425 to France, 21,656 to Hong Kong, and 11,277 tons to Sweden.

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Proceedings of the 12th Congress of the ISSCT, Puerto Rico, 1965.—The price of this book, a review of which appeared on p. 248 of our August 1968 issue, was unfortunately given as £10. In fact, the true price is £40.

[1] *Barclays Overseas Review*, June 1968, 47.
[2] *Lamborn*, 1968, **46**, 93.
[3] C. Czarnikow Ltd., *Sugar Review*, 1968, (862), 81.
[4] *Willett & Gray*, 1968, **92**, 148.
[5] *Public Ledger*, 22nd June 1968.
[6] F. O Licht, *International Sugar Rpt.*, 1968, **100**, (18), 6.
[7] *Willett & Gray*, 1968, **92**, 216.