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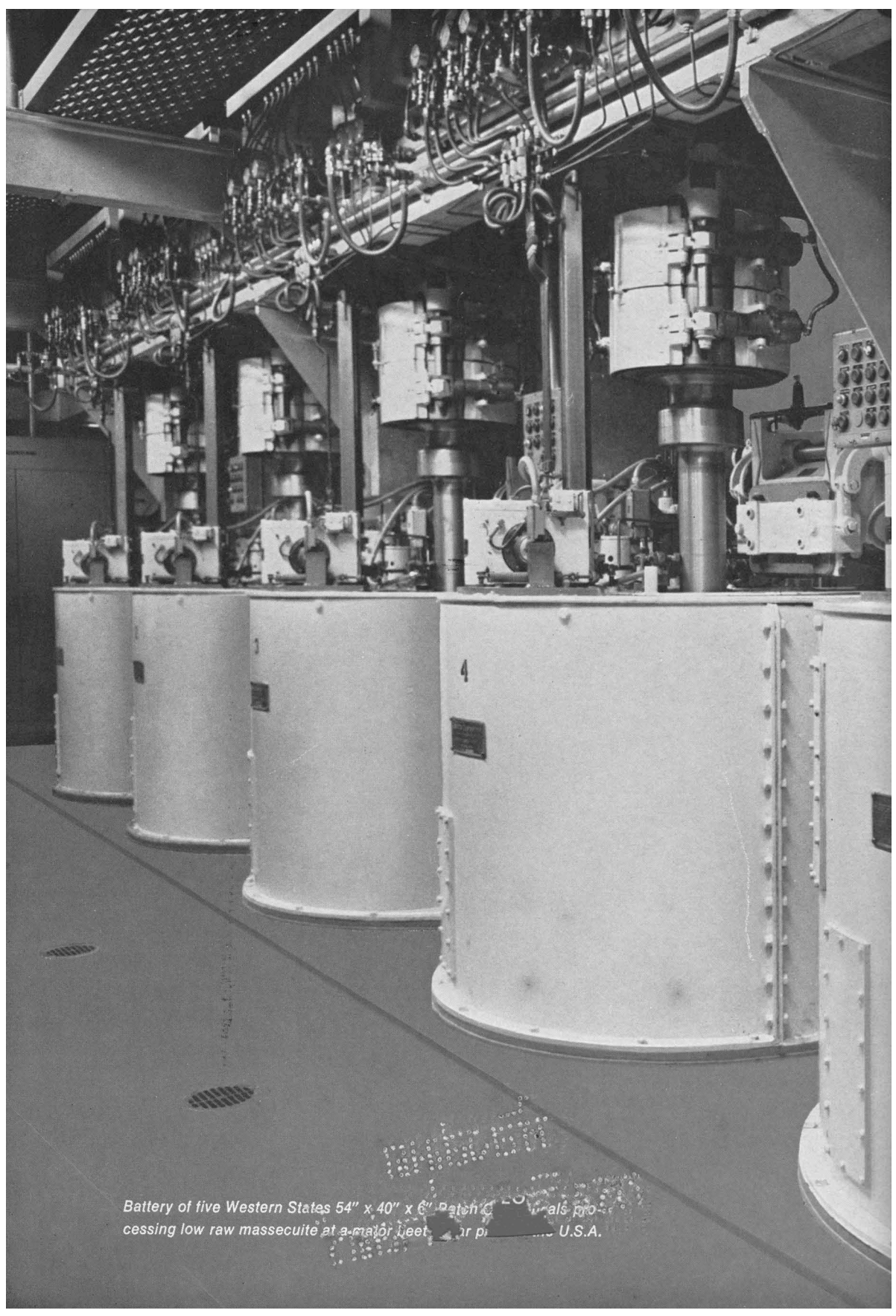
International Sugar Journal



SEPTEMBER 1970

THE
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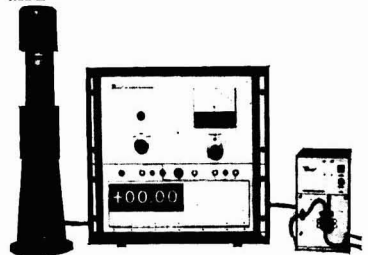


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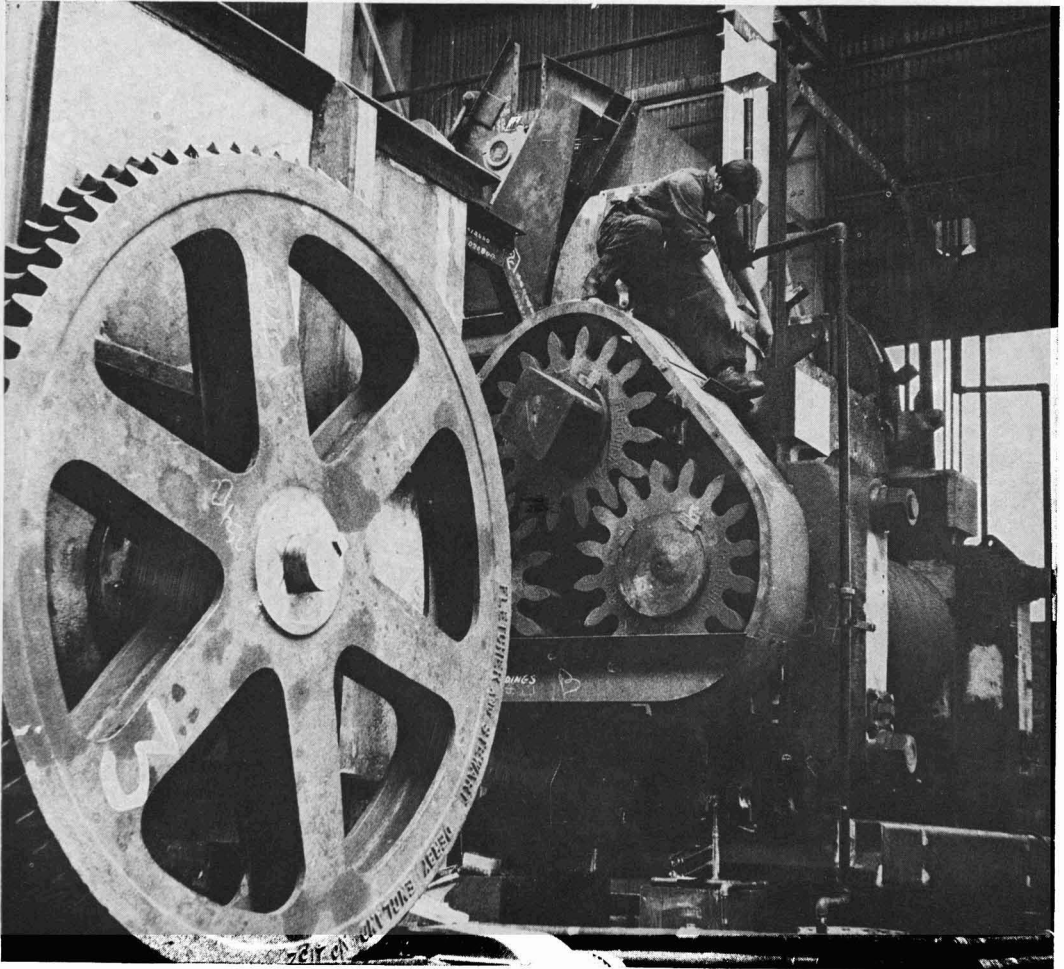


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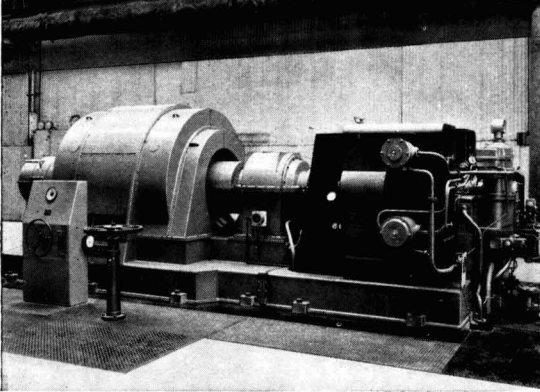
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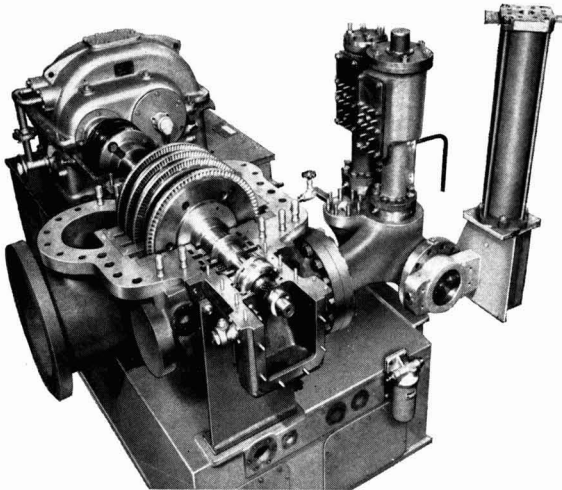


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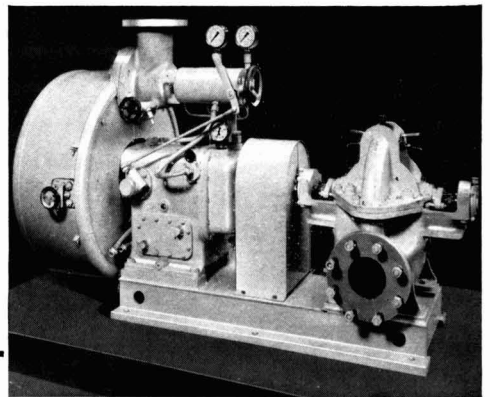
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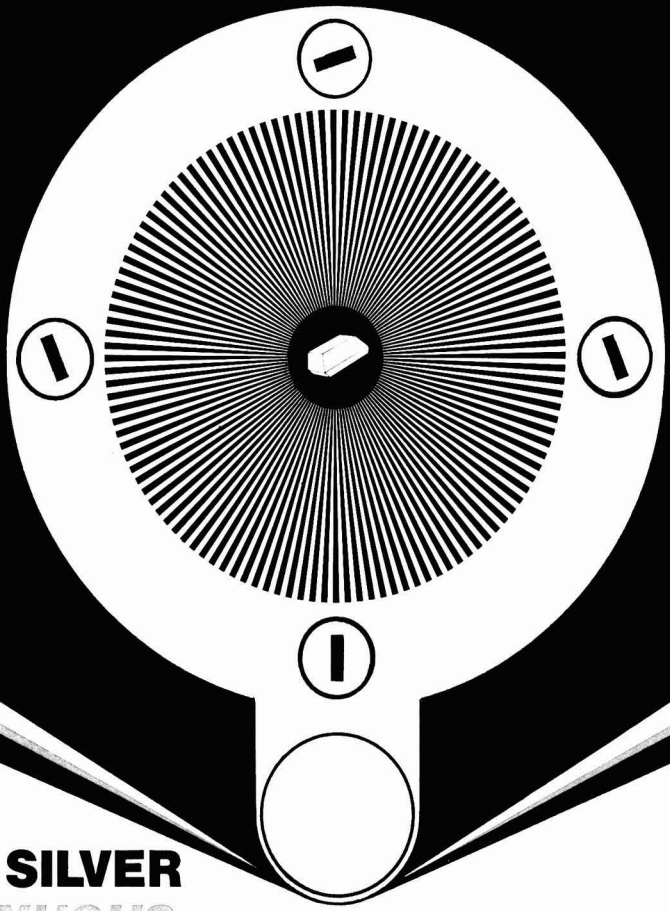
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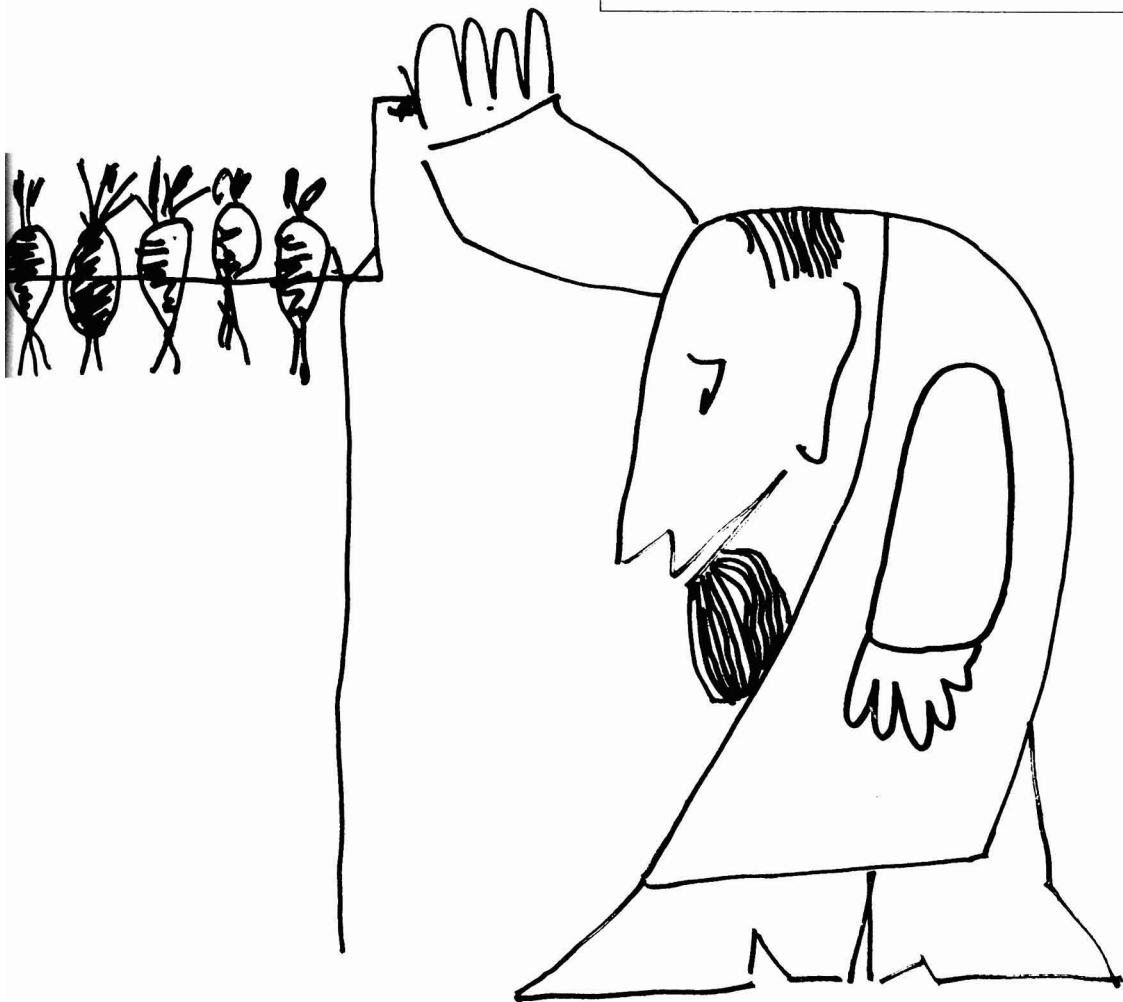
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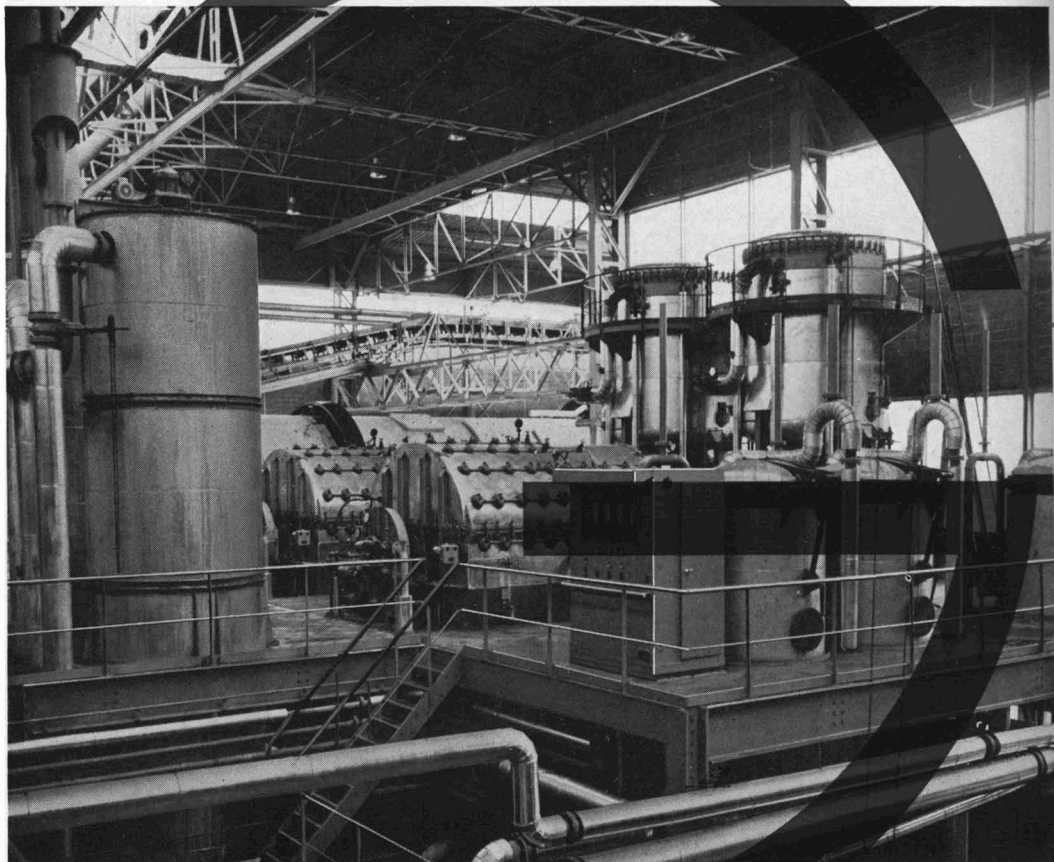
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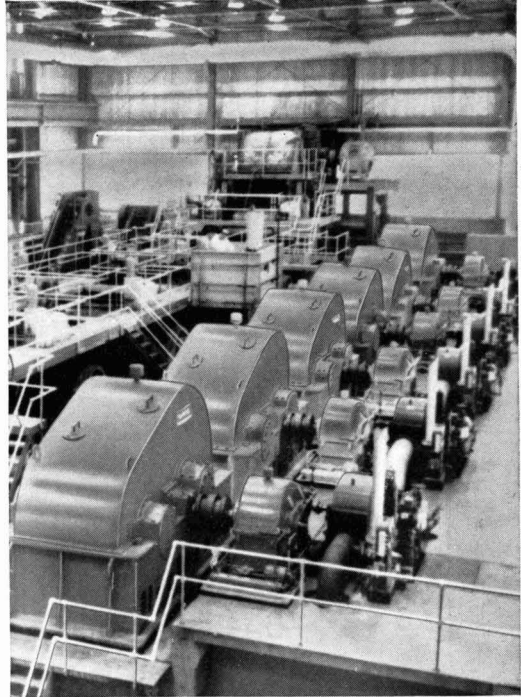
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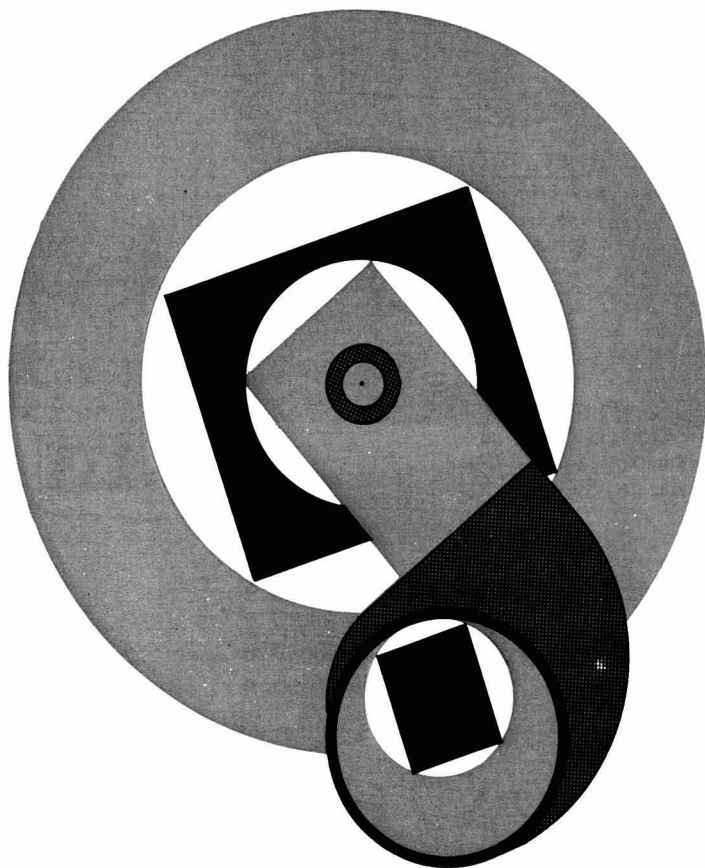
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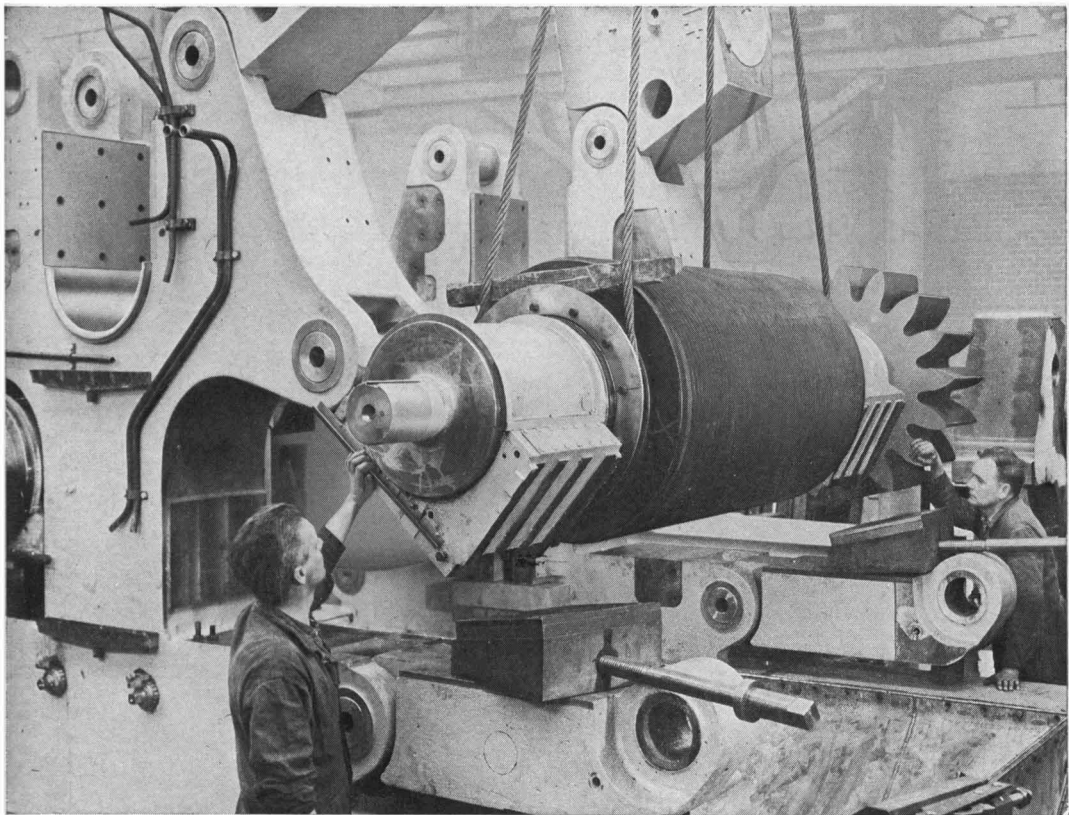
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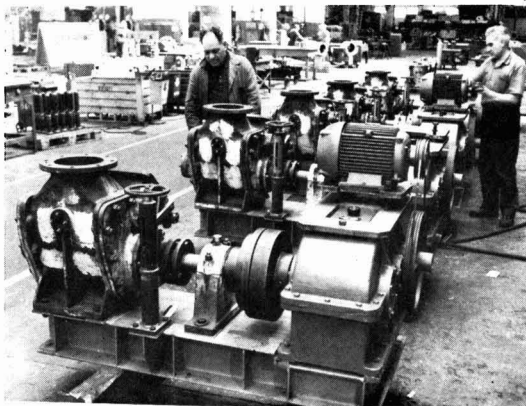
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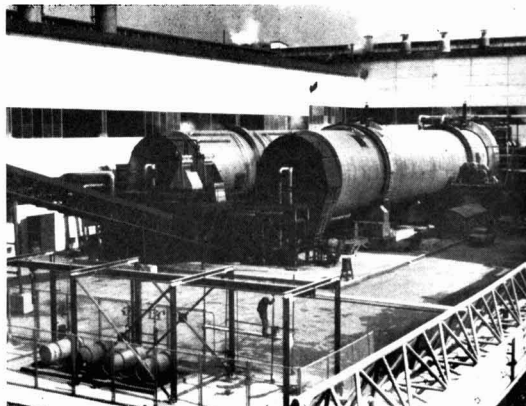
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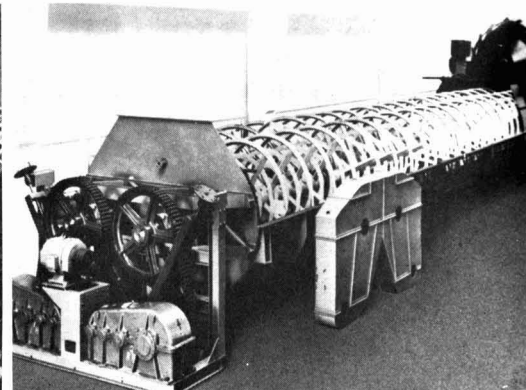
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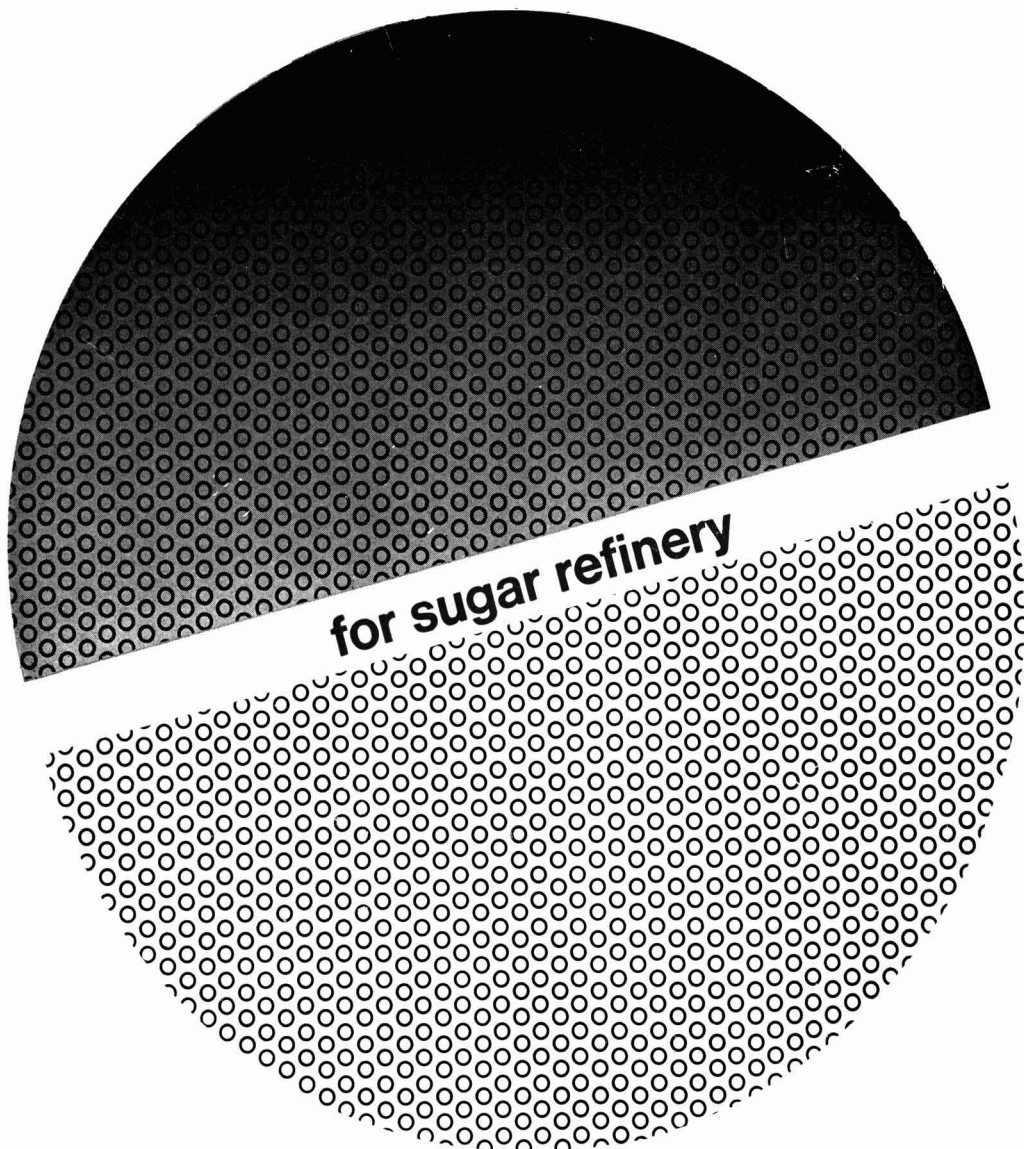
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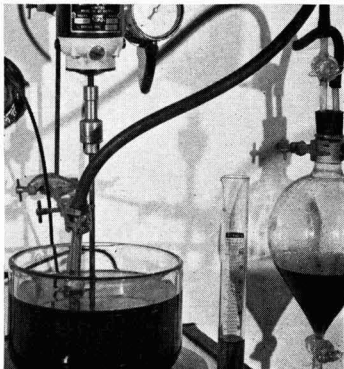
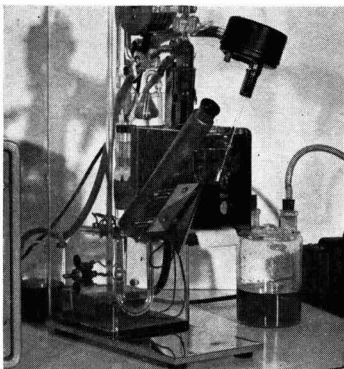
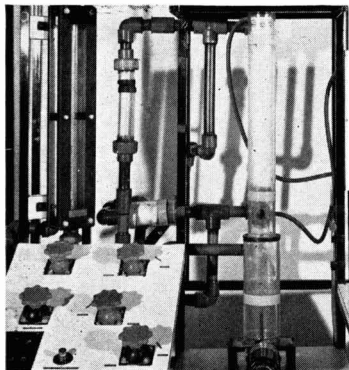
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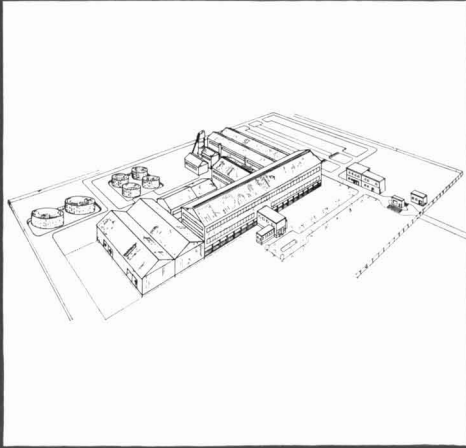


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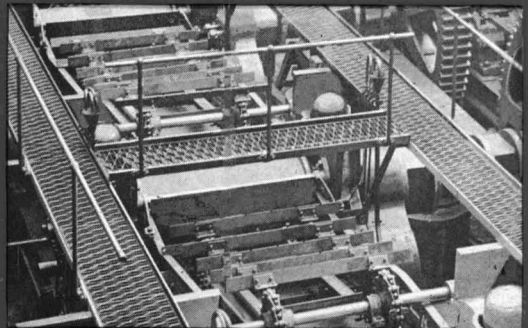
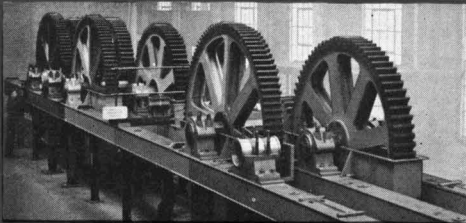
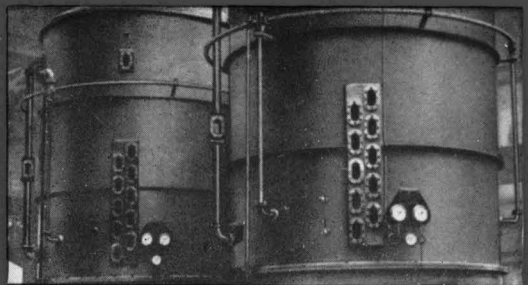
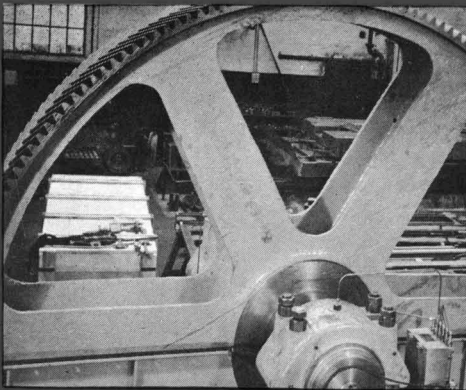
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International Sugar Journal

September 1970

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W. R. CRAWFORD,

Research and Development Engineer, Walkers Ltd.

K. DOUWES DEKKER,

Consultant and former Director, Sugar Milling Research Institute, South Africa.

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The International Sugar Journal Ltd.

23a Easton Street, High Wycombe,
Bucks., England.

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SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

Commission Internationale pour l'Uniformisation des Méthodes d'Analyse du Sucre (ICUMSA). p. 259-263
 On reproduit les recommandations du comité, adoptées par la 15e séance de l'ICUMSA pour les sujets 16-29.

* * *

Cause, prévention et mesure de la prise en masse du sucre raffiné—revue. 1ère Partie. D. F. BAGSTER. p. 263-267

Au cours de cette discussion sur la prise en masse du sucre raffiné, l'auteur traite de l'importance de l'humidité relative à l'équilibre, des conditions de la prise en masse, de la présence et de la mesure de l'eau dans les cristaux de sucre, de l'effet des impuretés sur la teneur en eau et la prise en masse et de la mesure du degré de la prise en masse.

* * *

Le moulin à réglage automatique. M. BEAUVISAGE. p. 267-269

Après une discussion des tentatives faites par divers fabricants de moulins à canne en vue d'accroître l'efficacité de ceux-ci, on donne des détails sur les aspects théoriques du moulin à réglage automatique développé par la Société Fives Lille-Cail. On décrit la construction et les avantages de ce moulin dans lequel le rapport entre les ouvertures de charge et de décharge est maintenu constant.

* * *

Recherche sucrière chez Tate & Lyle. 1ère Partie. p. 270-272

On présente un sommaire du Rapport Annuel pour 1969 du Centre de Recherches de Tate & Lyle traitant de la recherche en canne. Les sujets discutés comprennent la biologie de la canne, en particulier la maturation de la canne, les pertes dues à la cigale écumant (*Aenolamia*) et à la mouche de canne, la photosynthèse et les études enzymatiques.

Internationale Kommission für einheitliche Methoden der Zuckeruntersuchung (ICUMSA). S. 259-263

Es werden die auf der 15. Sitzung der ICUMSA angenommenen Empfehlungen der Referenten für die Referate 16 bis 29 wiedergegeben.

* * *

Ursache, Verhinderung und Messung des Zusammenbackens von Raffinade—eine Übersicht. Teil I. D. F. BAGSTER. S. 263-267

In dieser Abhandlung über das Zusammenbacken von Raffinade behandelt der Autor die Bedeutung der Gleichgewichts-Luftfeuchtigkeit, die Bedingungen, die zum Zusammenbacken führen, das Auftreten und Messen von Wasser in Saccharosekristallen, den Einfluss von Verunreinigungen auf Wassergehalt und Zusammenbacken sowie die Messung des Ausmasses des Zusammenbackens.

* * *

Die sich selbst einstellende Rohrmühle. M. BEAUVISAGE. S. 267-269

Nach einer Diskussion der von verschiedenen Rohrmühlenherstellern unternommenen Anstrengungen, die Mühlenleistung zu verbessern, werden Einzelheiten über die theoretischen Aspekte der sich selbst einstellenden Rohrmühle mitgeteilt, wie sie von der Fa. Fives Lille-Cail entwickelt wurde. Die Konstruktionsmerkmale dieser Mühle, bei der das Verhältnis zwischen den Einlass- und den Auslassöffnungen konstant gehalten wird, werden beschrieben und die Vorteile aufgezeigt.

* * *

Zuckerforschung bei Tate & Lyle. Teil I. S. 270-272

Es wird zusammenfassend über den Inhalt des "Annual Report 1969" des Forschungszentrums der Fa. Tate & Lyle berichtet, in dem Forschungsarbeiten über Zuckerrohr behandelt sind. Zu den abgehandelten Themen gehören die Biologie des Zuckerrohrs, insbesondere das Reifen des Rohrs, die Schädlinge Schaumzikade und Rohrfliege, die Photosynthese und enzymatische Studien.

Comisión Internacional para Métodos Uniformes de Análisis de Azúcar (ICUMSA). Pág. 259-263

Se reproducen las recomendaciones de los Arbitros para los Sujetos 16-29 que adoptó la 15a Sesión de ICUMSA.

* * *

Causa, prevención y medida de aterronamiento del azúcar refinado—una revista. Parte I. D. F. BAGSTER. Pág. 263-267

En esta discusión del aterronamiento de azúcar refinado, el autor trata de la significación del humedad relativa al equilibrio, de condiciones que conducen al aterronamiento, del acontecimiento y medida de agua en cristales de azúcar, del efecto de impurezas sobre el contenido de agua y aterronamiento, y de la medida del grado de aterronamiento.

* * *

El molino de ajuste automatico. M. BEAUVISAGE. Pág. 267-269

Después de una discusión de las tentativas hechas por varios fabricantes para mejorar la eficiencia de su molinos de caña, se presenta detalles de los aspectos teóricos del molino de ajuste automatico que ha desarrollado la Sociedad Fives Lille-Cail. El autor describe y discute las ventajas del diseño de este molino, en que la relación entre las aberturas de alimentación y salida queda constante.

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Estudios azucareros en Tate & Lyle. Parte I. Pág. 270-272

Se presenta un sumario de la Memoria Anual para 1969 del Centro de Investigaciones de Tate & Lyle sobre estudios de la caña. Los sujetos discutidos incluyen la biología de la caña, en particular la maduración de la caña, la ranilla saltadora y la mosca de caña, la fotosíntesis y estudios enzimáticos.

THE INTERNATIONAL SUGAR JOURNAL

VOL. LXXII

SEPTEMBER 1970

No. 861

Notes & Comments

International Sugar Agreement quotas.

As two members of the Organization, Poland (8031 tons) and Uganda (846 tons), are unable to use the additional quota allocation assigned to them recently¹, the total quantity of 8877 tons has been re-distributed. The details of the re-distribution and of the current quotas in effect are as follows:

Member	Allocation (metric tons, raw value)	Current quota
Argentina	91	50,785
Australia	1,813	1,012,925
Bolivia	0	10,000
Brazil	824	461,611
British Honduras	36	20,313
Colombia	0	100,000
Congo (Brazzaville)	68	37,858
Cuba	3,543	1,982,665
Czechoslovakia	0	193,000
Denmark	68	37,188
Dominican Republic	231	129,270
Fiji	255	137,370
Guatemala	0	11,000
Honduras	0	11,000
Hungary	0	45,900
India	412	230,838
Malagasy Republic	68	37,858
Mauritius	288	152,595
Mexico	0	0
Peru	0	0
Poland	0	333,000
South Africa	1,030	573,858
Swaziland	91	50,474
Taiwan	0	427,000
Thailand	59	32,459
Uganda	0	32,769
West Indies	0	80,000
Total	8,877	6,191,736

Further changes are expected in the quotas since a number of countries, including Brazil, Dominican Republic, Fiji, Mauritius and Swaziland, are reported to have applied for hardship quotas under the Agreement, to a total of 180,000 tons. The Hardship Relief Committee of the Council met early in August and, according to C. Czarnikow Ltd.², it is generally believed that agreement has been reached to allot 70,000 tons out of the Hardship Fund, but details of individual allotments still remain confidential until approved by the Executive Committee.

Cuban sugar production 1969/70.

The Cuban sugar crop came to an end on the 25th July with an output of 8,533,312 metric tons. By any standards this was a remarkable achievement, in the face of great difficulties resulting from bad weather and the ill-equipment of mills which have been unable for eight years to obtain spares for their American-made equipment, as a result of the US trade embargo. The crop exceeded the previous 1952 record by about 1,200,000 tons but the latter was achieved in a normal 5-month crop while the 1969/70 crop extended over a full year. It will no doubt be a matter of argument whether the planned 10-million ton crop could have been achieved, and in a shorter time, had there been the free availability of machinery which existed during the BATISTA regime, or if the rigidities of a Communist economy would necessarily have hindered a rate of production possible under a more flexible capitalist system.

Dr. CASTRO has described the crop as a "failure" and has shouldered the responsibility for setbacks, offering to resign his office if this were the wish of the Cuban people. To have produced 1,200,000 tons more than ever before is hardly a failure, however, and it is unlikely that the Cuban Prime Minister will be called upon to resign. Whether it was worthwhile to require a "heroic struggle" by the Cuban people in order to achieve the new record crop is another matter, however, particularly in view of the neglect of other sectors of the economy and the consequent shortage of essential consumer goods. This has been tacitly admitted by the decision not to seek to achieve another huge goal in 1970/71 as originally planned but to return to the normal season which starts just before the end of the year.

Despite the size of the 1969/70 Cuban crop, C. Czarnikow Ltd.³ does not consider it likely that shipments to the socialist countries mentioned in the International Sugar Agreement will be such as to force them to increase their re-exports to the world market. Apart from the fact that this would be

¹ *I.S.J.*, 1970, 72, 225.

² *Sugar Review*, 1970, (982), 136.

³ *ibid.*, (981), 131.

contrary to the terms of the Agreement (to which Cuba has been conspicuously adhering), Czarnikow calculates that, during the current calendar year, production less domestic offtake and compulsory stocks will leave only about 5 million tons for export. Although this would be more than shipped by Cuba in any previous year, it would also be below the total targets of Cuba's trade agreements and, in view of the poor 1969/70 sugar crop in the USSR, could be absorbed without difficulty.

* * *

Colonial Sugar Refining Co. Ltd. 1970 report.

In the 1969 season the company's mills in Australia made 492,000 tons of raw sugar, 71,000 tons less than in the record 1968 season and also less than in the two previous seasons. The crop in New South Wales was particularly poor. Fortunately, the average price received per ton (\$A 99.76) was significantly higher than for the 1968 season's sugar (\$A 82.10). In New South Wales drought in the growing period reduced the cane available for milling and a shortage of cane cutters and wet weather during harvesting caused difficulties and made the season longer than is desirable.

Mechanical harvesting in Queensland expanded to cover 88% of the 1969 crop and is expected to expand to 92% in 1970. Development in mechanical harvesting in New South Wales is continuing but current techniques and equipment cannot yet be regarded as commercially proven for the particularly difficult conditions applying there. It is anticipated that 1970 output by the C.S.R.'s Australian mills will expand to 519,000 tons; this is estimated on marketing requirements but if further markets become available the current cane crop is estimated to be able to provide another 43,000 tons of raw sugar.

In Fiji, the Company's subsidiary South Pacific Sugar Mills Ltd. made 299,000 tons of raw sugar, far short of the objective of 385,000 tons, because of the return of severe drought. Recent rains have given the prospect of enough cane to make 355,000 tons of sugar in the 1970 season.

The UK Master of the Rolls, Lord DENNING, made an award in regard to a dispute between the millers and cane growers in Fiji. The Company considers that many errors of fact were made by Lord DENNING in regard to the accounting of costs and profits, in the origins of the sugar price stabilization fund, etc., and a detailed analysis and critique of the award has been published in booklet form. As a consequence of the mistakes, the DENNING award contains two provisions which are crucial: (i) a guaranteed minimum price of \$F 7.75 per ton of cane must be paid to growers irrespective of sugar content or the proceeds of sugar sales, and (ii) the proceeds will be split 65:35 so that the millers will receive less than in the previous eight years of the former contract (average 40.8% of the proceeds). If the 65% share for the growers is insufficient to meet the minimum cane price, it will be made up by payments from the stabilization fund which has been built up with \$F 2½ million provided by the

millers and \$F 3½ million provided by the growers. When this is exhausted, the millers will have to make good the minimum cane price out of their 35% share of the proceeds. Application of the award in the past eight years would have meant a good profit only in 1963—a year of exceptional sugar prices—while in 1970 the profit would be about 2½% on paid-up capital instead of the 7½% dividend paid in recent years. With anticipated cost increases and variable proceeds from sugar, the millers face the prospect of inadequate profits in good years down to disastrous losses in bad years. Since there is no appeal from the award nor a real prospect of seeking a variation after its end in 1980, the Company has signed the contract in order to process the 1970 crop but has given the minimum two years' notice of its termination of the contract and of its intention to discontinue ownership and operation of the mills!

* * *

Booker McConnell Ltd. 1969 report.

Sugar.—Bookers Sugar Estates made 302,000 tons of sugar, 19,000 tons above their previous record crop, and the company made a better profit than in recent years. The value of exports of sugar and molasses from Guyana, representing about a third of the country's total exports, was, at £16.7m, 20% higher than in 1968. The sugar factories will continue to be modernized and expanded so that they can process the steadily increasing acreage of cane planted. The Albion factory has been completely rebuilt and the new Enmore mill was also completed during the year. An experimental unit has been formed to study what systems of mechanical handling and field layout are best suited to Guyana's soil and water conditions.

Innswood Estate shared the misfortunes of the Jamaican sugar industry², producing only 15,500 tons of sugar and having 700 acres of standover cane. Holland Estate, however, did not suffer the extreme drought or labour troubles which affected most of the island and made some 9000 tons of sugar which, whilst below estimate, was better than in 1968.

The Nigerian Sugar Company made 24,100 tons of sugar and is expected to make 27,000 tons in 1970. Production is to be raised over the next three years to 40,000 tons a year.

Bookers Agricultural and Technical Services continued to provide management and technical services to sugar operations in Nigeria, Jamaica, St. Kitts, the Bahamas, Kenya, Trinidad, Tanzania, Malawi and Uganda.

Sugar machinery.—Negotiations for major orders did not turn into firm commitments until mid-year and did not produce any worthwhile factory activity until the last quarter of 1969. Fletcher and Stewart have been working on two large sugar factory orders which were due for shipment in the second and third quarters of 1970 and represent in total some £10m of exports, while there are good prospects of more sugar factory orders to come.

¹ *I.S.J.*, 1970, 72, 160.

² See *I.S.J.*, 1970, 72, 32.

International Commission for Uniform Methods of Sugar Analysis (ICUMSA)

(continued from p. 234)

Subject 16. Ash

(Referee: P. DEVILLERS, France)

- (1) The specific conductivity of a sugar solution should be regarded as having its own significance and the result of the conductivity measurement should be expressed in terms of % conductivity ash.
- (2) The standard temperature of 20°C should be adopted for all measurements.
For the measurement of ash in solutions with a concentration of 5 g per 100 ml, the temperature correction of 2% per °C, with a maximum of $\pm 5^\circ\text{C}$, is definitively adopted.
- (3) For all measurements, water with a conductivity lower than 2 S cm^{-1} shall be used.
For the measurement of ash at 5 g per 100 ml, the coefficient of 0.9 should be definitively adopted.
- (4) For all products with a purity in excess of 90, with the exception of white sugars, a concentration of 5 g per 100 ml should be used, with a coefficient of 18×10^{-4} :
Conductivity ash, % by weight = $18 \times 10^{-4} C_s$
- (5) For white sugars, the conductivity ash method at 28°Brix, as described in Appendix 4 to the present report, and with the coefficient $C = 6 \times 10^{-4}$ is definitively adopted:
Conductivity ash, % by weight = $6 \times 10^{-4} C_{28}$
In the application of this method, a temperature correction factor of 3% per °C, with a maximum of $\pm 5^\circ\text{C}$, shall be used.
- (6) Studies should be undertaken to compare the conductivity ash measured at concentrations of 28°Brix, 5 g per 100 ml and less than 1 g per 100 ml, at all levels of purity.
- (7) Studies should be undertaken on the determination of insoluble ash in white sugars since this is an essential complement to the conductivity (and therefore soluble) ash.
- (8) Conductivity ash should again be compared with ash as measured by ion-exchange techniques.

Subject 17. Inorganic non-sugars

(Referee: R. SAUNIER, France)

- (1) Study of methods already approved should be continued with emphasis on ways of improving the precision of sample preparation and of the preparation of the solutions submitted to analysis.
- (2) Study of new techniques, such as polarography and atomic absorption, should be intensified since, in the case of difficulty with routine methods, these new techniques could be used for testing other less tedious and simpler methods.

- (3) For the determination of copper, the oxalyldihydrazide method of the Syndicat National des Fabricants de Sucre is tentatively adopted. The diethyldithiocarbamate method recommended by the British National Committee should be studied on a comparative basis.
- (4) For the determination of SO_2 in white sugars, the official method of the Syndicat National des Fabricants de Sucre should be supplemented by the rosaniline method as proposed by the British National Committee, as an alternative official method. For products other than white sugar, other methods, particularly that of REITH-WILLEMS, should be further studied.
- (5) For the determination of chloride, the thiocyanate method and other suitable methods should be further studied.
- (6) For the determination of nitrite, the method of BUCKETT should be further studied.
- (7) For the determination of alkali- and alkaline earth metals, the possible use of specific electrodes should be investigated.
- (8) For the determination of arsenic, the silver diethyldithiocarbamate method is tentatively adopted.

Subject 18. Organic non-sugars

(Referee: E. REINEFELD, Germany)

- (1) The several modifications of the KJELDAHL method should be comparatively studied with a view to recommending a method for the determination of total nitrogen.
- (2) In determining amino-acid nitrogen by the method of CARRUTHERS and OLDFIELD, the following should be used as reference standards:
For beet sugar factory juices: glutamic acid (as before).
For cane sugar factory products: asparagine.
- (3) The copper method for determining amino-acid nitrogen (the "blue number" method of STANĚK and PAVLAS), adopted for routine use, should be further investigated with a view to establishing the most suitable procedure and deciding whether the application of the method would be better restricted to raw and pressed juices.
- (4) For the determination of betaine, the method involving precipitation by phosphotungstic acid with subsequent colorimetric evaluation, and also the spectrophotometric method of PREY *et alia*, should be further studied.

- (5) The method of determining the total acid equivalents, the mean equivalent weight of the anions and the salt content of sugar juices, as proposed by STARK and by REINEFELD and GOSCH, should be further studied with a view to establishing the specifications needed in respect of the ion-exchangers.
- (6) With a view to making recommendations on a method for determining lactic acid, comparative studies should be made on existing methods with particular attention to the methods of OLDFIELD and SHORE and of OLDFIELD, PARSLow and SHORE.
- (7) The enzymatic method of BÜSCHING for the determination of citric acid should be studied.
- (8) The method of GUPTA and CHETAL for the determination of aconitic acid in sugar cane juices should be studied.
- (9) The method of analysis of raw sugars of DEVI-LLERS and LOILIER using ion exchangers should be studied with particular reference to the requirements in respect of ion-exchange resins and to its adaptation to the determination of total acid as proposed by CORTIS-JONES.
- (10) Methods for the determination of organic sterilants such as formaldehyde in white sugar should be studied.
- (11) The determination of herbicide and pesticide residues in raw and white sugars should be studied.
- (12) Methods for determining colloids consisting essentially of complex protein and pectic substances (e.g. in beet raw juices) should be left in Subject 18 while special methods for determining pectic acid should be allocated to Subject 15 with methods for the determination of polysaccharides.

Subject 19. Characteristics of white sugars

(*Referee*: R. A. MCGINNIS, USA)

- (1) The Coca-Cola floc test (Appendix 1) should be adopted on a tentative basis.
- (2) Existing methods for the determination of loss on drying should be urgently studied and compared, with a view to providing details of a method suitable for elevation to official status. Such studies should include the recognised EEC method (Appendix 2) and the Danish method (Appendix 3).
- (3) The test for resistance to inversion by heating (*Proc. 14th Session ICUMSA, 1966, p. 116, Appendix 2*) should be retained on a tentative basis.
- (4) The methods used in the formula for the EEC "points classification" of white sugars should be considered by the appropriate Subject Referees; the Index itself is not properly on the agenda of Subject 19.

- (5) Studies of the following should continue on an urgent basis:
 - (a) rapid tests for carbonated beverage floc,
 - (b) completion of the details of the foam test,
 - (c) tests on the conditioning of granulated sugar,
 - (d) rapid tests for moisture in granulated sugars,
 - (e) rapid tests for loss of weight on drying of granulated sugars,
 - (f) procedures for the determination of sucrose in granulated sugars.
- (6) Studies on the following should continue:
 - (a) simple tests for determination of the "strength" of sugar, for routine use,
 - (b) methods for determination of alcoholic haze tendency.
- (7) Studies should be begun and continued *on an urgent basis* in order to provide the analytical methods required by Codex to establish whether the sugar from which powdered sugar is made does or does not comply with the Codex specifications for white sugars.
- (8) The HIBBERT and PHILLIPSON method for the determination of insoluble matter in white sugars should be adopted on a tentative basis.

Subject 20. Deterioration of sugars in storage.

(*Referee*: J. F. T. OLDFIELD, United Kingdom)

- (1) The search for a suitable method for assessing sugar explosion hazard from sugar dust particle size and concentration should be continued.

Subject 21. Microbiological tests

(*Referee*: R. WEIDENHAGEN, Germany)

- (1) There should be consultation on the most expedient method of preparing a sugar containing a known number of organisms for sending to the Associate Referees for investigation.
- (2) The recommendations on incubation made in 1966 (*Proc. 14th Session ICUMSA, 1966, p. 124, Recommendation 2b*) should be further studied. It seems that an incubation temperature of 35°C for determining mesophilic bacteria is not suitable.
- (3) For the enumeration of organisms by a membrane filtration method, filters with pore sizes between 0.2 and 0.6 μ are tentatively suggested.
- (4) The heat treatment of samples prior to the enumeration of thermophilic spores should be further studied.
- (5) Phase-contrast techniques should be further studied.
- (6) The methods proposed by the American Bottlers of Carbonated Beverages and by the National Canners' Association for the enumeration of micro-organisms in white sugars should be further studied with a view to their tentative adoption.

Subject 22. Colour and turbidity

(Referee: P. F. MEADS, USA)

- (1) Methods 1A† and 1B† should be discontinued as general ICUMSA methods but be retained for possible regional use where a particular instrument can be employed.
- (2) The filtration step for method 2† should be better defined.
- (3) In the procedure for method 4†, paragraph 2, the second sentence should be changed to: "White sugar solutions and light-coloured liquors should be filtered through a membrane filter with a pore size of 0.45 μ (as measured by the mercury extrusion method)." (This eliminates filtration through a sintered-glass filter). The next sentence should start: "Slower filtering solutions . . ."
- (4) In method 4†, paragraph 4 should be changed to read: "4. Remove entrained air under vacuum or in an ultra-sonic bath, being careful to minimize evaporation. Check solution density after de-aerating."
- (5) Instruments with integrating spheres and similar devices should be evaluated for both Colour Index and turbidity readings.
- (6) Other instruments designed to measure light scattering should be evaluated as devices for measuring turbidity in sugar solutions.
- (7) The use of standardized yellow glasses and carefully prepared mineral solutions as transmission standards should be further studied.
- (8) Wavelength standards should be further studied; this will include special lamps or special glass filters.
- (9) Method 7 (not yet published in ICUMSA Proceedings) should be discontinued.

Subject 22A. Reflectance and visual appearance

(Referee: D. HIBBERT, United Kingdom)

- (1) In view of its already widespread use, the Brunswick "colour type" series should be tentatively adopted, pending the development of a more precisely defined series.
- (2) Further work should be undertaken to enable recommendations to be made in 1974 on light sources, background conditions, sample containers and operator position in the visual grading test.
- (3) Information should be obtained to enable the formulation of precise recommendations on the use of dyes and on the necessary frequency of replacement of dyed standards.
- (4) The possibility of producing permanent synthetic standards should be investigated.

- (5) Techniques to overcome the difficulties resulting from difference in particle size between standard and sample should be investigated.
- (6) Consideration should be given to the development of suitable techniques for assessing the visual appearance of cubes, tablets, etc.
- (7) Extensive inter-laboratory collaborative studies should be undertaken to establish the relative merits of instruments and systems currently in use for reflectance measurement. Such tests should be directed towards the acquisition of precise data on within-laboratory and between-laboratory accuracy. Samples used in these tests should cover a wide range of particle size distribution, origin, colour "type" and colour intensity.
- (8) Work on reflectance techniques should as far as possible be carried out in such a way that results may be correlated with the results of measurements made with the visual technique.
- (9) Relative merits of methods based on tristimulus measurements should be evaluated by comparison with methods based on reflectance differences and reflectance ratios using wavelength filters.

Subject 23. Viscosity and surface tension

(Referee: J. H. PAYNE, USA)

- (1) The rotating cylinder method should be tentatively adopted for determining the viscosity of molasses.
- (2) Investigations of massecuites should be continued with a view to developing suitable rheological techniques for testing them.
- (3) The title of Subject 23 should be changed to "Rheological Properties".

Subject 24. pH

(Referee: A. LEMAITRE, France)

- (1) The pH values of the N.B.S. phthalate, phosphate and borax buffer solutions should be definitively adopted. Solutions of potassium tetraoxalate and calcium hydroxide may be used on a discretionary basis.
- (2) Buffer solutions applicable at temperatures up to 130°C should be studied.
- (3) The principle of the measurement of pH by potentiometry should be definitively adopted. After standardization with a buffer solution, the electrodes are rinsed with distilled water and then immersed in distilled water for 5 minutes. The measurement is made by immersing the electrodes in the sugar solution and taking the reading after a minimum immersion of 5 minutes.

† The methods referred to in Recommendations 1, 2, 3 and 4 above are those outlined in the 1966 Report (*Proc. 14th Session ICUMSA, 1966, pp. 129-130*).

- (4) (a) The following procedure for measuring the pH of an industrial sugar solution at a desired temperature should be definitively adopted: the pH of the solution should be measured at its original concentration; for temperatures between 20° and 90°C, the measurement should be made at the temperature under consideration; for temperatures in excess of 90°C, measurements should be made at 20°C and 90°C and the result at the temperature under consideration obtained by linear extrapolation. In cases where the concentration of solids results in very high viscosity, the solution should be diluted to 50°Bx.
- (b) The behaviour of sugar solutions as a function of the combined action of Brix and temperature should be further studied, with special reference to the function of organic non-sugar quality.
- (5) The use of Pyrex glass vessels for the storage of water of low conductivity should be definitively adopted. The influence of the method of preparation of water of low conductivity on the pH of sugars should be further studied.
- (6) The reference method of DUBOURG, SAUNIER and DEVILLERS for determining the pH of white sugars should be definitively adopted. The concentration of salts added to the dilution water to adjust the pH should not exceed 0.01N. On a tentative basis, the pH of white sugars may be measured directly on a solution of the sugar at 50°Bx and 20°C, in which case the water used for dilution should have a conductivity less than $2\mu\text{S cm}^{-1}$.

Subject 25. Crystallizing qualities of sugar solutions

(Referee: A. VANHOOK, USA)

- (1) The table computed by VAVRINECZ for solubility of sucrose in water should replace the often-used values of HERZFELD on an interim basis until more critical assessment of available data and further work at temperature extremes are completed.
- (2) For crystallization rates, separate Sub-Committees should be formed to consider the scientific aspects of sucrose crystallization and the application of these principles to factory testing and crystal quality.
- (3) The "Saturoscope" method for saturation temperature should be elevated from tentative to definitive status and investigation of other methods particularly suited to low purity products should continue.
- (4) The surge of interest in crystal habit modification should be encouraged.

Subject 26. Refining qualities of raw beet sugars

No report presented.

Subject 27. Refining qualities of raw cane sugars

(Referee: C. W. DAVIS, Australia)

- (1) The grist procedure of the Hawaiian Sugar Planters' Association [PAYNE: "Sugar Cane Factory Analytical Control", revised edn., (Elsevier, Amsterdam) 1968, pp. 85-86] should be adopted as a tentative ICUMSA method.
- (2) The C.S.R. method for the determination of starch in raw sugar (reproduced in Appendix 1) should be compared with other similar methods.
- (3) Further information should be obtained relating the C.S.R., C. & H., A.S.C. and B.C.S.R. filtrability tests, and comparing the results of each test with refinery filtration performance.
- (4) Work should be continued on relating *specific classes* of (a) insoluble particles, (b) colour bodies, and (c) alcohol-insoluble impurities to refinery performance.
- (5) A copy of the Referee's Report on Subject 27, together with the discussion and final Recommendations, should be sent to the Secretary of the International Society of Sugar Cane Technologists by the Secretary of ICUMSA.

Subject 28. Bone charcoal and other adsorbents

(Referee: E. G. MULLER, United Kingdom)

- (1) The procedure described in the 1966 Report (*Proc. 14th Session ICUMSA*, 1966, p. 158, Appendix 1) should be definitively adopted for the turbidimetric determination of sulphate in bone charcoal.
- (2) The procedure described in Appendix 1 to the present Report should be tentatively adopted for the determination of the total surface and carbon surface of bone charcoal.
- (3) The procedure described in Appendix 1 to the present Report, using cetyltrimethylammonium bromide only, should be tentatively adopted for the determination of the carbon surface of granular carbon.
- (4) The procedures described in the 1966 Report (*Proc. 14th Session ICUMSA*, 1966, pp. 160-161, Appendix 3) should be definitively adopted as methods for ion exchange resins.
- (5) The procedure described in the 1966 Report (*Proc. 14th Session ICUMSA*, 1966, p. 162, Appendix 4b) should be tentatively adopted for the determination of the exchange capacity of ion exchange resins.
- (6) The deterioration, fouling, regeneration and other important properties of ion exchange resins should be studied.

Subject 29. Starch hydrolysis products

(Referee: W. KEMPF, Germany)

- (1) The following methods as published by ISO/TC 93 should be tentatively adopted: WG 3/1, KJELDAHL-GUNNING method for protein nitrogen; WG 3/2, PARNAS-WAGNER method for protein nitrogen; WG 3/3, Spectrophotometric method for protein nitrogen; WG 3/4, MONIER-WILLIAMS method for sulphur dioxide (all in starch hydrolysis products).
- (2) With regard to methods already adopted by ICUMSA for the analysis of starch hydrolysis products, three restrictions should be applied as follows: application of the methods should be limited to those starch hydrolysis products

specifically mentioned in the scope of each procedure; all terms and definitions such as temperature should be expressed only in the metric system (to exclude, for instance, Imperial measures and °F); all trade names should be strictly avoided in descriptions of analytical methods and procedures.

- (3) A complete register, enumerating and describing all the analytical methods and procedures already adopted by ICUMSA, on a tentative or definitive basis, for the analysis of starch hydrolysis products, should be prepared and edited.

Corrigendum: Line 18 in Column 1 of p. 234 in the August issue should read "order that the curves adopted in 1966 (*Proc. 14th*)"

Cause, prevention and measurement of the caking of refined sugar—a review

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PART I

Introduction

LAWRENCE¹ defined caking as a change of state from a mass of discrete, more or less free flowing particles to an agglomerated solid mass that is definitely not free flowing at least in terms of particles of the initial size.

The caking of raw sugar has long been a problem and has received considerable attention over the years^{2,3,4,5,6}. Caking and stickiness of white sugar have been a serious problem since the introduction of bulk handling^{7,8,9,10}. LYLE⁷ mentioned how, in transporting thirteen bulk tons of refined sugar, a ton would not run from the tanker.

The caking of sugar is obviously concerned with the surface properties of the grains and is generally attributed to sucrose crystallization associated with the water content of the crystal. A point worthy of comment is the smallness of this water content, rarely above 0.06% for refined white sugar^{11,12,13}. The mechanism postulated is that of bridges between crystals of sugar, the bridges being made up of sucrose crystallized from syrup on or near the surface of the grains¹⁴.

SILVERBERG *et al.*¹⁵ have actually shown intergranular bonds of crystals of potassium nitrate and ammonium chloride alteration products in fertilizer granules.

HEISS¹⁶ presented a schematic drawing of the formation of an intercrystalline bond of surface water molecules between sugar grains. Caking was then discussed in terms of water lost.

MEADE⁸ mentioned increased viscosity as a mechanism for the caking of brown sugars when the impurity level is high.

LAWRENCE¹ pointed out that in the manufacture of lump sugar or in the setting of cement the property of caking is useful.

Equilibrium relative humidity

The explanation of the intergranular crystallization is generally given in terms of the concept of an equilibrium relative humidity (ERH). A fairly pure

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¹ *Am. Fertilizer*, 1945, **102**, (9), 7.

² BEHNE: *I.S.J.*, 1940, **42**, 283.

³ DOUWES DEKKER: *ibid.*, 1941, **43**, 224.

⁴ DUKER: *ibid.*, 1923, **25**, 131.

⁵ MCALLEP: *ibid.*, 1931, **33**, 385.

⁶ RUSH and THOMPSON: Colonial Sugar Refining Co. Ltd Unpublished Report, 1959.

⁷ LYLE: "Technology for Sugar Refinery Workers", 3rd Edn. (Chapman & Hall, London), 1957, p. 380.

⁸ MEADE: "Cane Sugar Handbook", 9th Edn. (Wiley, New York), 1963, p. 263.

⁹ RODGERS and LEWIS: *I.S.J.*, 1962, **64**, 359; 1963, **65**, 12, 43, 80.

¹⁰ STACHENKO *et al.*: *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 75-122.

¹¹ DONALDSON and JOYNER: *Research Dept. Rpt.* (Godchaux Sugars Inc.), 1953, (23), 701A.

¹² HOWES: *Proc. 40th Congr. S. African Sugar Tech. Assoc.*, 1966, 214.

¹³ POWERS: *I.S.J.*, 1960, **62**, 307.

¹⁴ *idem ibid.*, 1954, **56**, 314.

¹⁵ *Agr. Chem.*, 1957, **12**, 38.

¹⁶ *Zeitsch. Zuckerind.*, 1961, **86**, 73.

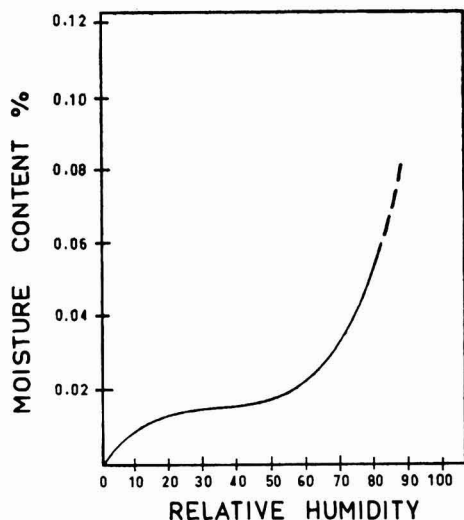


Fig. 1. Moisture content of refined sugar

white sugar has an ERH which varies for a given temperature in a manner illustrated by Fig. 1^{11, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25}. More impure sugars generally have a higher water content at a given humidity¹⁷, a fact illustrated in Fig. 2.

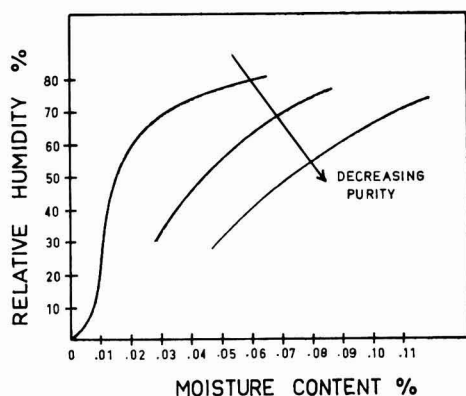


Fig. 2. Effect of purity on equilibrium relative humidity

NELSON pointed out that discrepancies in comparing results in the past may be due to carrying out ERH measurements at different temperatures²¹.

MAGEE²⁰ stated that the shape of the ERH curve changed little with temperature between 77° and 104°F. DONALDSON and JOYNER indicated the same¹¹, pointing out moisture content of interstitial air must be expressed as relative humidity. WEBSTER²⁶ showed curves of ERH vs. water content for various temperatures, showing that the higher the temperature the greater the water content of raw sugar. WERNER²⁵ in

a definitive article on the problem indicated how the water content of a white sugar decreases with increasing temperature at a given relative humidity. STETSYUK²⁴ found practically identical curves for -5°, 0° and 20°C above 75% relative humidity. At 40°C there was lower water content throughout the range than at the other lower temperatures.

POWERS²⁷ and DE WHALLEY²⁸ described a method of measuring the ERH. It is interesting to note that when DE WHALLEY wrote (1962), no method of relative humidity measurement could be recommended other than the old ether cup dew point method.

Conditions leading to caking

As stated above, caking is generally attributed to intercrystalline bridging by crystallization of residual syrup at or near the surface of the crystal. Probably the most common cause of this crystallization is moisture migration away from some region in the bulk of the sugar owing to the occurrence of temperature gradients. LYLE⁷ and MAGEE²⁰ described the effect in terms of a warm mass of sugar in bulk, cooling down at the boundaries of the mass. In cooling down, the water in the interstitial air is at a higher relative humidity and the sugar absorbs water. Since the water content of the interstitial air is limited, the relative humidity is lowered in the colder regions and moisture migrates from the warmer parts. Water in sucrose crystals in warmer regions then evaporates, as predicted using the ERH curve, so that sucrose in the syrup layer crystallizes with resultant caking. The sugar in the cooler parts in absorbing moisture becomes damp if the relative humidity is above say 70%. Thus ZABORSIN²⁹ described a case where sugar originally of 0.12% water was found to have 0.10% at the centre and 0.20% at the walls of a bin and caking was reported in both regions. It is important to distinguish between hard caking and poor flow characteristics due to stickiness. The latter condition can lead to caking if the damp sugar dries out. HOWES¹² mentioned heat absorption through silo walls in hot climates, also an undesirable temperature gradient situation.

Another way of producing a temperature gradient is if sugar of one temperature is loaded into a bin containing sugar of another⁸. Also two sugar bulks with different water contents would presumably gain and lose moisture with consequent caking and stickiness.

¹⁷ BIENENSTOCK and POWERS: *I.S.J.*, 1951, **53**, 254.

¹⁸ KELM and BECK: *Zeitsch. Zuckerind.*, 1962, **87**, 547.

¹⁹ MCGINNIS: "Beet Sugar Technology" (Reinhold, New York), 1951, p. 386.

²⁰ MAGEE: Paper presented to the *Inst. Fuel*, 15th March 1951. (*J. Inst. Fuel* preprint).

²¹ NELSON: *Food Tech.*, 1949, **3**, 347.

²² SCHWEITER: *Zeitsch. Zuckerind.*, 1956, **81**, 534.

²³ *idem*: *Sugar*, 1957, **52**, (5), 26.

²⁴ STETSYUK: *Sakhar. Prom.*, 1964, **38**, (1), 27.

²⁵ WERNER: *Zeitsch. Zuckerind.*, 1963, **88**, 193.

²⁶ *I.S.J.*, 1941, **43**, 46.

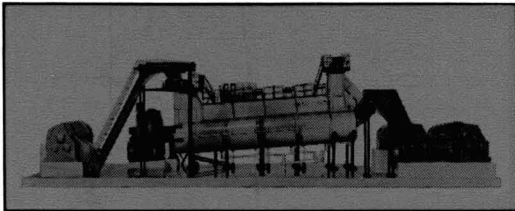
²⁷ *Proc. 13th Session ICUMSA*, 1962, 93.

²⁸ DE WHALLEY: "I.C.U.M.S.A. Methods of Sugar Analysis" (Elsevier, Amsterdam), 1964, p. 87.

²⁹ *Kharchova Prom. Inf. Nauk. Tekh. Zhornik*, 1965, (1), 18.



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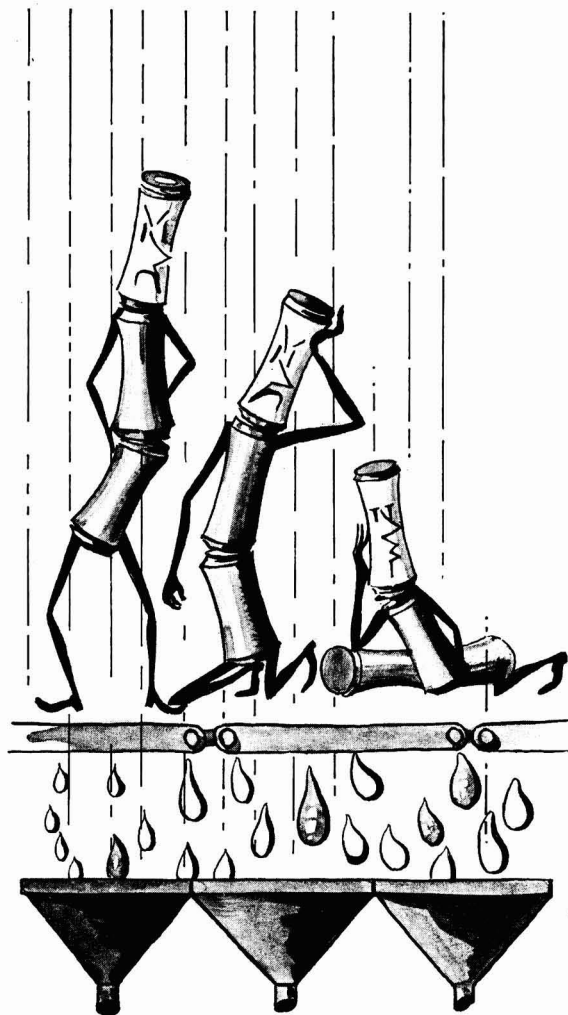
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BEHNE³ described caking of sugar due to overall heating of the mass and attributed caking to a lowering of the relative humidity with consequent evaporation of water from the sugar. Crystallization due simply to the cooling of a mass of sugar does not appear as an explanation. MCALLEP⁵ explained caking on transport simply as the result of cooling but it could well be the result of associated moisture migration.

WUTHRICH³⁰ discussed another caking mechanism in white sugar, where heavy dew collected on bags of sugar at night. During the day the sugar dried out, producing caking.

MEADE⁸ summarized conditions conducive to caking.

HEISS¹⁴ measured the humidity changes in a sample of caster sugar as it dried out when one end was exposed to silica gel.

Occurrence of water in sucrose crystals

RODGERS and LEWIS⁹ classified water associated with sugar crystals into three kinds:

(1) *Free moisture*. All the individual crystals coming from the centrifugals are surrounded by a more or less dilute solution, easily and quickly removed in conventional driers. This water probably corresponds to the constant rate period^{31, 32, 33}.

(2) *Bound moisture*, more difficult to remove in that it takes time. This is said to be the type of moisture content which leads to caking and is discussed further below.

(3) *Inherent moisture*, pockets of water actually trapped within the sucrose crystals. POWERS^{34, 35} has discussed the internal water, having detected it by measuring the very high ERH of large crushed crystals and by electron microscopy. STACHENKO¹⁰ quoted some authors as suggesting the existence of sucrose hydrates but said that it is unlikely that these exist at room temperature. There is a possibility that this water is part of a sucrose complex including trace amounts of hydrophilic polysaccharides which have hydrated strongly where the water cannot be removed. POWERS noted that there is more included water with larger crystals¹⁴. RODGERS and LEWIS stated that internal water does not affect caking⁹.

Returning to the bound moisture, POWERS¹⁴ said that the act of drying the crystals causes the syrup on the surface of the grain first to become supersaturated and then to add further layers of sucrose molecules on the surface of the crystals. The remaining syrup thus becomes progressively lower in quality as more of the water is evaporated. As the purity of the surface layer becomes lower, so does its vapour pressure (or ERH as Fig. 2 shows).

POWERS³⁶ referred to the low vapour pressure of supersaturated syrups and MAKOWER and DYE³⁷ noted the low vapour pressure of amorphous sugar produced by spray drying. POWERS¹³ pointed out that syrups in very thin films, as say on the surface of a crystal, have in fact less volume to contain nuclei and there

is therefore less likelihood of crystallization taking place at a given supersaturation.

DOWLING³⁸ supported POWERS in claiming that bound moisture is created by too rapid a drying rate. Sugar dried at 110°C had a greater water content than that dried at 55°C which in turn had more water than sugar dried in air at room temperature.

SCHWER³³ produced some evidence against the low vapour pressure skin effect submitted by POWERS. Samples of wet sugar and of freshly dried sugar were taken simultaneously ahead of and after the driers and dried at room temperature. The same rate of loss of moisture was obtained during the "diffusion-controlled" period of the drying curve regardless of the history of the samples.

STACHENKO *et al.*¹⁰ mentioned that bound moisture may be trapped syrup in the interstices of poorly formed crystals (agglomerates) which could be considered sub-surface water; the authors favoured supersaturated syrup created in the drying process. DOWLING³⁸ stated that bound moisture may occur on the surface either as a supersaturated solution or as an amorphous sucrose and is very hard to remove.

Measurement of water in sucrose crystals

RODGERS and LEWIS⁹ demonstrated the great errors in trying to determine moisture in granulated sugar by drying for three hours at 105°C. After allowing sugar to stand in a desiccator for some days following such a determination a further determination on the same sample can reveal a greater weight loss than took place in the first determination. The liberation of moisture is apparently a slow process and at room temperature can take the order of a hundred hours. Obviously the comparison of the results of moisture determinations by different workers is rendered difficult.

RODGERS, LEWIS and OSBORNE³⁹ reported some encouraging results in using the Karl Fischer method for water content. STACHENKO *et al.*¹⁰ also used the Karl Fischer method and, by noting the titre of reagent used, as a function of time, fitted two rate constants for moisture uptake by Karl Fischer reagent, the larger constant suggesting a correspondence with the liberation of free moisture, the smaller with bound moisture.

BENNETT, RUNECKLES and THOMPSON⁴⁰ compared the Karl Fischer method with the vacuum distillation method of HILL and DOBBS⁴¹ and stated that the

³⁰ *I.S.J.*, 1923, 25, 192.

³¹ MCCABE and SMITH: "Unit Operations of Chemical Engineering", (McGraw-Hill, New York), 1956, p. 888.

³² PERRY: "Chemical Engineers' Handbook", 4th Edn. (McGraw-Hill, New York), 1963, pp. 15-35.

³³ SCHWER: *Proc. 24th Meeting Sugar Ind. Tech.*, 1964, 115.

³⁴ *I.S.J.*, 1956, 58, 246.

³⁵ *ibid.*, 1959, 61, 17, 41.

³⁶ *Rpts. 19th Meeting Hawaiian Sugar Tech.*, 1960, 135-149.

³⁷ *J. Agric. Food Chem.*, 1956, 4, 72.

³⁸ *Proc. 25th Meeting Sugar Ind. Tech.*, 1966, 34.

³⁹ *I.S.J.*, 1963, 65, 261, 293, 324.

⁴⁰ *ibid.*, 1964, 66, 109.

⁴¹ *Analyst*, 1958, 83, 143.

Karl Fischer method confirms the findings from vacuum distillation in that the available external water increases over a period of storage. The Karl Fischer method gave higher moisture content results and this may be due to moisture in the conglomerates being more readily available to the methanol used.

MOROZ *et al.*⁴² used formamide as a solvent and suggested rather arbitrarily that the titre at one minute corresponds to free water and after thirteen minutes to internal water.

DOWLING^{38, 43} described the use of a radio frequency power absorption method of water detection in solid sugar.

Effect of impurities on water content and caking

BIENENSTOCK and POWERS¹⁷ showed how sugars of different purity have ERH curves of different shapes. POWERS²⁷ showed how ERH varies with % non-sugars, generally increasing with the amount of non-sugars.

It is well-known^{44, 45} that impurities are concentrated near the surface of a crystal and therefore are likely to have a great effect on the surface properties of a crystal.

As stated above, POWERS¹⁴ described how impurities are likely to be at the surface during the drying process. He also pointed out¹³ that a hypothetical 0.03% water even at 50% ERH is associated with some 90% dissolved solids in the surface syrup, not 67% as in the case of saturated pure sucrose solution at 86% ERH. This corresponds to 0.3% of syrup, not 0.1%. Thus, as NELSON²¹ emphasized, small amounts of impurity can have a large effect.

HIBBERT and WOODWARK⁴⁴ referred to a correlation between % ash and moisture absorption in storage and HEISS¹⁶ demonstrated this too. WEBSTER²⁶ found that an increase in invert sugar in a raw sugar corresponded to an increase in water % at given ERH but found no correlation with ash.

DOWLING³⁸ found that higher purity sugars lose moisture at a greater rate and he attributes this to a greater crystallization rate corresponding to a conversion of bound to free moisture.

YAMANE and IWAKURA⁴⁶ studied the caking of soft brown sugar by first holding samples at 66% relative humidity and then in a dry atmosphere. They found a linear relationship between the strength of caked sugar samples and the moisture loss, and between the strength of caked sugar and the reducing sugar content. ABE⁴⁷ found a linear relation between equilibrium moisture, relative humidity and reducing sugar content.

DOUWES DEKKER³ indicated that for molasses sugars the water:invert ratio should be below 0.5 to avoid hardening.

Measurement of the extent of caking

A number of different physical measurements has been made to express how badly a granular mass has caked, or, looking in another sense, how well granules have cohered. Generally the overall technique is the

same in principle, to decrease the relative humidity of the atmosphere between the grains so that bonds form between the grains. Having caused caking, a strength measurement is made.

For sugar, the atmospheres are generally controlled in humidity by placing samples in desiccators in the bottom of which are saturated salt solutions which have known vapour pressures.

MAHONEY and REED⁴⁸ put samples into 8-oz bottles and observed if the sugar set. HEISS¹⁶ used a small rod to touch the samples and assigned numbers to the "subjective hardness", e.g. 0 unchanged, 1 scarcely noticeable formation into balls, 2 decidedly caked but easily crushable, and so on to 5, hard. DONALDSON and JOYNER¹¹ used a tilting method, measuring the angle to which the surface of a bulk of sugar had to be tilted before the bulk breaks and flows (angle of break). This may be compared with the angle of tilt, the same measurement made after the initial set or cake is broken.

HERMANS⁴⁹ quoted HAWKSLEY⁵⁰ on the use of sand added to coal to give a particular flow through an orifice. MOSS *et al.*⁵¹ measured the time for 110 cc of sugar to run out of a container in testing the effectiveness of various percentages of tricalcium phosphate as a caking inhibitor. ANDREASEN *et al.*⁵² used a dropping technique, when the amount of coal not run out of a tube in a set time is a measure of caking. HERMANS also mentioned the use of air flow to dislodge particles of coal as a measure of caking⁴⁹.

For fertilizers the crushing strength of briquettes of the material is well established^{53, 54}. WHYNES and DEE⁵⁵ used an unconfined compression test of pre-treated cylindrical samples.

PIETSCH *et al.*⁵⁶ measured the tensile strength of moist agglomerates of limestone.

YAMANE and IWAKURA⁴⁶ and DOUWES DEKKER^{57, 58} placed known weights on cakes of sugar and found the weight required to produce a depression. DE WHALLEY²⁸ recommended this procedure for raw sugar. EBERT⁵⁹ used a penetrometer, a weighted point dropped from a height.

⁴² *Proc. Tech. Session Cane Sugar Refining Res.*, 1966, 102.

⁴³ *Proc. 20th Meeting Sugar Ind. Tech.*, 1961, 12.

⁴⁴ HIBBERT and WOODWARK: *I.S.J.*, 1951, 53, 277.

⁴⁵ KEANE *et al.*: *Ind. Eng. Chem.*, 1935, 27, 30.

⁴⁶ *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1963, 12, 84.

⁴⁷ *ibid.*, 1957, 6, 1.

⁴⁸ *Proc. 19th Meeting Sugar Ind. Tech.*, 1960, 137.

⁴⁹ "Flow Properties of Disperse Systems" (North Holland, Amsterdam), 1953, pp. 382-422.

⁵⁰ *Proc. Pulverised Coal Conf.* (London), 1947, 679.

⁵¹ *Ind. Eng. Chem.*, 1933, 25, 142.

⁵² *Kolloid. Z.*, 1939, 86, 70.

⁵³ ADAMS and ROSS: *Ind. Eng. Chem.*, 1941, 33, 121.

⁵⁴ HARDESTY and KUMAGAI: *Agr. Chem.*, 1952, 7, (2), 38.

⁵⁵ *J. Sci. Food Agric.*, 1957, 8, 577.

⁵⁶ *Ind. Eng. Chem., Prod. Res. and Devel.*, 1969, 8, (1), 59.

⁵⁷ *Proc. 11th Session ICUMSA*, 1954, 97.

⁵⁸ *S. African Sugar J.*, 1955, 39, 271.

⁵⁹ "The caking of raw and refined sugars" (*M. Eng. Sci. Thesis, Univ. Sydney*), 1957.

IRANI, CALLIS and LIU⁶⁰ measured the weight of fertilizer caught on a particular size screen.

KAMODA⁶¹ allowed raw sugars to stand in an atmosphere of 67–69% relative humidity and 20–21°C for ten days. The aim was to study stickiness, not caking, but from the considerations of MAGEE²⁰ this is equally important since (a) sticky sugar will not flow, (b) when damp sugar dries out it will cake. KAMODA draws on the terminology of classical soil mechanics and introduces the Coulomb equation⁶² $\tau = \sigma \tan \varphi + c$, where τ = shear stress on a plane of failure within a granular mass, σ = normal stress on the failure plane, φ = angle of friction, and c = cohesion.

Measurement of corresponding values of τ and σ enables a value of c , the cohesion, to be found. In

this terminology the stickiness c varied for raw sugars from 0.08 to 0.175 kg/cm².

PILPEL⁶³ recently gave a general description of the measurement of the shear strength of powders. Particular emphasis was laid on the shear cell determinations of JENIKE⁶⁴.

RUSH and THOMPSON⁶ measured cohesion by shearing a section of a cylinder of caked sugar.

(To be continued)

⁶⁰ *Ind. Eng. Chem.*, 1959, **51**, 1285.

⁶¹ *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1966, **17**, 79.

⁶² TERZAGHI: "Theoretical Soil Mechanics" (Wiley, New York), 1966, p. 7.

⁶³ *Manuf. Chem. and Aerosol News*, 1969, (Feb.), 29.

⁶⁴ *Univ. Utah Eng. Exp. Sta. Bull.*, 1961, (108).

The self-setting mill

By M. BEAUVISAGE

(Société Fives Lille-Cail, Paris, France)

Introduction

TO increase the efficiency of the three-roller mill, manufacturers have investigated various roller arrangements in order to obtain maximum extraction. In particular, improvements have been made to facilitate displacement of the top roller and thus obtain better distribution of the hydraulic pressure between the feed and discharge rollers.

However, the results obtained have not been completely satisfactory and this because of the very concept of the mill. Referring to Fig. 1, it may be seen that, since the feed opening is necessarily greater than the discharge opening, the reaction of the layer of bagasse on the top roller side is greater than on the

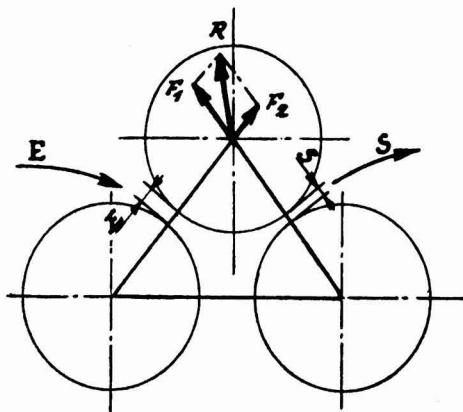


Fig. 1

feed side. The resultant of these forces on the top roller is inclined at an angle of the order of 15° towards the feed side. As a consequence, the lift of the top roller is hindered by jamming of the journals in their vertical housing, the journals being subjected to forces of inclination.

To remedy this defect, certain manufacturers have moved towards the feed side the axis of the hydraulic pistons acting on the top roller and have fitted in the journal housings roller bearings or plates of synthetic material having high wear resistance and a very low coefficient of friction. Other manufacturers have arranged the rollers in such a way that the displacement of the top roller follows the direction of the resultant of forces, either by sloping the head of the mill housing at 15° towards the feed or by raising the feed roller at an angle of 15° to the horizontal. None of these modifications has been a complete answer to the problem of top roller displacement, although friction forces are clearly reduced.

Moreover, to obtain perfect distribution of pressure on the rollers, it is essential to maintain a constant ratio between the feed and discharge openings, irrespective of top roller lift. In the existing concept of the mill this is not possible; thus, if for a given throughput the feed opening is 14 mm and the discharge opening 7 mm, i.e. a ratio of 2:1, for a lower throughput we will have a lowering of the top roller, say by 5 mm, which will give a feed opening of 10 mm and a discharge opening of 7 mm, i.e. a ratio of 3.3:1 which corresponds to a 66½% increase in the initial ratio.

The effect is even more exaggerated in a mill of the classical type with an inclined headstock or with a raised feed roller. Taking the same example as above,

The self-setting mill

when the top roller drops by 5 mm, the opening at the feed roller will decrease by 3.1 mm and that at the discharge roller by 4.6 mm. The settings become 10.9 mm at the feed side and 2.4 mm at the discharge, giving a ratio of 4.5:1, i.e. a 124% increase on the initial correct ratio.

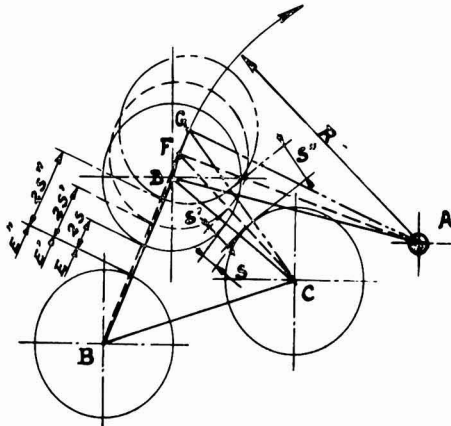


Fig. 2

Theoretically, to maintain a constant ratio between the feed and discharge openings, it would be necessary to adjust the thickness of the bagasse blanket by means of a control system acting on the speed of the mills and the carriers to give a uniform thickness—a method which would involve costly and sensitive equipment.

The self-setting mill

To get over these difficulties, Société Fives Lille-Cail, a company well known throughout the world, particularly for its cane mill engineering, has developed an original solution—the self-setting three-roller mill—which permits at one and the same time maintenance of a constant ratio between the feed and discharge openings and elimination of the problems due to top roller displacement.

In the new mill, the locus of the different positions of the centre axis of the top roller for which the feed: discharge ratio is constant is not a straight line but a curve which approximates to an arc of a circle the centre of which is located approximately on the line of the centre axes of the bottom rollers and behind the discharge rollers (Fig. 2).

On this basis, the new mill is built in the following manner (Figs. 3 and 4): each mill comprises two housings and three rollers, the fixed lower section receiving the journals of the bottom rollers, the axle for movement of the turnplate and the axle for movement of the upper housing. This last, supporting the top roller journal, is connected, on the side opposite to the axle, to a hydraulic jack which provides the necessary pressure to the top roller. This arrangement provides a lever arm thus permitting equivalent pressures to be obtained with jacks of smaller diameters and using lower unit pressures.

Referring again to the example above concerning a conventional mills set to give, during operation, a feed opening of 14 mm and a discharge opening of 7 mm, in the self-setting mill when the top roller is in its lowest position the feed opening will be 9 mm and the discharge opening 4.5 mm, i.e. a ratio which is still 2:1.

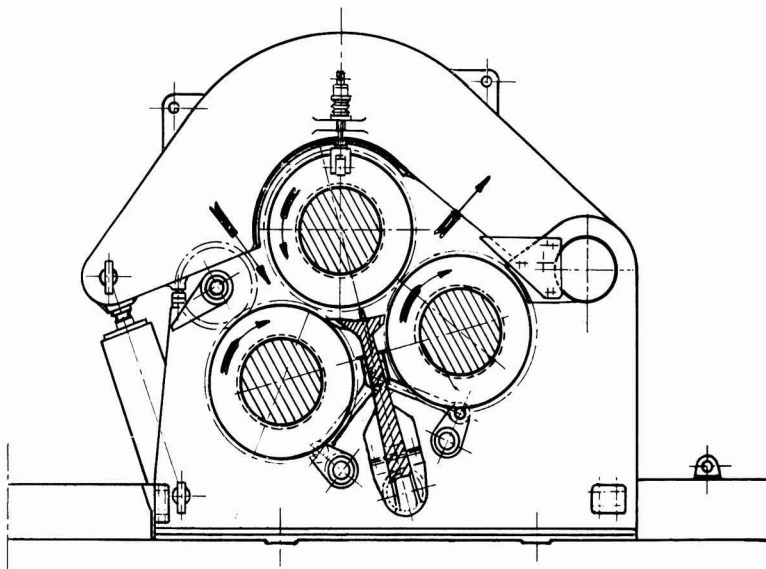


Fig. 3

Advantages of the self-setting mill

The self-setting mill has the following advantages:

(1) Better extraction as a result of a constant feed: discharge opening ratio which permits regular distribution of hydraulic pressure on the bagasse blanket. The ratio investigated may be regulated between 2 and 2.5:1 by pre-setting the relative position of the bottom rollers by means of eccentric wedges located below the journals.

(2) Reduction in power consumption as a result of decrease in the losses due to friction, the displacements being made about an axis provided with swivel joints.

(3) Better cane feed by means of the floating top roller which practically eliminates chokes and permits a higher throughput than with conventional mills of the same dimensions.

(4) Free juice flow because of the lower position of the feed roller relative to the discharge roller (See Fig. 3).

(5) Possibility of increased imbibition with consequent higher extraction as a result of the better grip arising from the mill design.

(6) Easier dismantling and maintenance, the three rollers being accessible by the hooks of a travelling crane once the hydraulic jack has been disconnected from the housing and the latter swung back (Fig. 5).

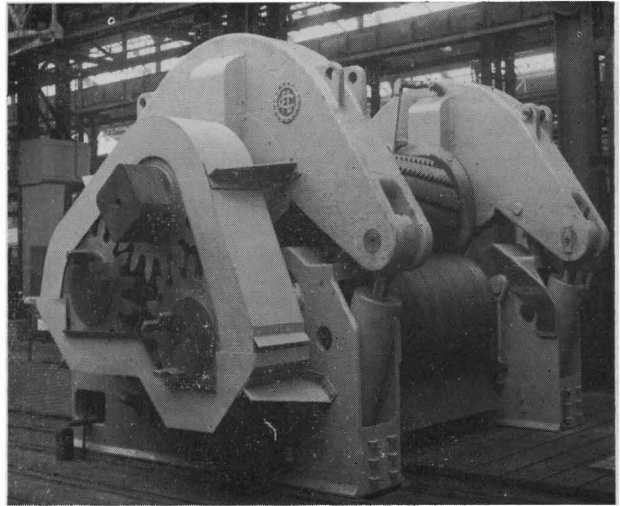


Fig. 4

Conclusion

Since 1964 all these advantages have made these mills particularly popular with sugar factory customers both in new and in existing sugar factories. To date, 25 are in operation in South Africa, Somalia, Mexico, Ecuador and Cameroun, while another 26 are being built or assembled for Uruguay, the Philippines, Réunion and again for Mexico. In Ecuador, the five mills of the new Aztra sugar factory are the biggest in the world, with rollers of 1150 mm outside diameter and 2300 mm long.

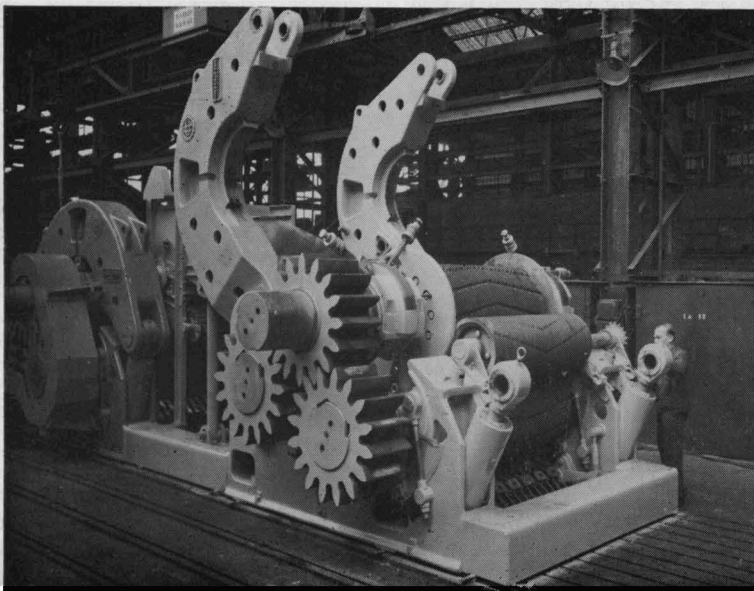


Fig. 5

Sugar research in Tate & Lyle

(Annual Report, 1969, Tate & Lyle Research Centre, Keston, England)

PART I

IN his introductory remarks the Director of Research (Dr. A. J. VLITOS) states that the year 1969 was a productive one for research. Contributions of real significance came from each of the many research projects—ranging from the patenting of an entirely new process for decolorizing raw sugars to the discovery of new chemicals which ripen sugar cane. The fundamental studies on photosynthesis have already attracted world recognition. The year also witnessed considerable progress on the microbiological front. New processes were developed for converting molasses, bagasse and other substrates to new products. Some of these are ready for pilot plant study. Work has been done on treating “sour” cane (cane delayed in reaching the mill after cutting) so that losses of sucrose in the raw sugar factory may be kept to a minimum. Some interesting results have taken place in the breeding of certain sugar cane insect pests under the artificial conditions that must prevail in the climate of Britain.

CANE RESEARCH

Biology-Agriculture

Various projects or lines of research are discussed under this heading. These fall into three main categories—growth hormone studies, chemical ripening and entomology. It is now known that growth in plants is governed or regulated by a balance between growth-promoting hormones (i.e. auxins, gibberellins and cytokinins) and growth inhibitory hormones such as abscisic acid (ABA). Three plant growth inhibitory extracts were obtained from immature stem apical tissue of sugar cane (variety B 41227). One of these extracts contained a chloroform-soluble plant growth inhibitor which was purified and identified as abscisic acid. The other two extracts were water-soluble but one was adsorbed onto “Celite” and charcoal and could be eluted with acetone, whilst the other remained in aqueous solution. Both extracts appeared to contain at least two plant growth inhibitors.

A hypothesis is advanced to explain the rôle of plant growth hormones in cane ripening when this is induced by the onset of a dry season or dry weather. Cytokinins and gibberellins are synthesized in the root and are translocated to the stem apex where they promote cell division and cell elongation. When the soil begins to dry out the synthesis of these hormones is lowered and smaller amounts are translocated to the stem apex. This results in a retardation of stem growth. The synthesis of plant growth inhibitors (specifically ABA) in the leaves is enhanced by mild moisture stress. Higher levels of growth inhibitor moving into the stem tend to suppress growth and, possibly, to promote lignification of the cell walls. The results of some recent experiments provide support for this scheme. There is clear

evidence that the imposition of a mild moisture stress (water withheld from one to three days) markedly increases the growth inhibitor content of sugar cane leaves. The inhibitor is soluble in chloroform and its chromatographic behaviour is similar to that of ABA. Preliminary experiments also indicate that the imposition of a mild moisture stress reduces the level of cytokinin-like substances in the bleeding sap of sugar cane plants.

It is of interest to observe that the pods of the carob tree (*Ceratonia siliqua*), which have been a food of man and beast in the Mediterranean region from the earliest times, contain several plant growth inhibitors which may possibly be of interest as chemical ripeners of sugar cane. Carob beans have long been imported into Britain and used mainly for feeding sheep, the very hard seeds being separated. These seeds were long regarded as a nuisance and valueless until it was discovered that they could be used as a source of gum very similar to gum tragacanth. It has similar uses and has become a commercial product.

Four extracts were prepared from fully expanded, green carob pods. These extracts all inhibited the growth of wheat coleoptile sections and also inhibited their growth response to indole acetic acid and to gibberellic acid. Two extracts each contained two inhibitory components while two contained one inhibitor. Two of the inhibitors were indistinguishable from one another and from abscisic acid. From commercial carob syrup two similar or identical plant growth inhibitors were extracted. The syrup is a concentrated extract of carob pods and it was possible to obtain sufficient quantities of these inhibitors for their identification by gas chromatography/mass spectrometry. Both inhibitors were identified as ABA. Apparently diethyl ether removed about half of the ABA from an aqueous extract of carob syrup at pH 5, leaving a similar amount to be taken up by subsequent extraction with ethyl acetate.

With regard to chemical ripening of cane, the work begun last year on screening chemical ripeners for sugar cane has been transferred from the C.N.R.S. phytotron in France to the Research Centre, where a large heated glasshouse now provides facilities for the work. Techniques now include direct estimation of stem sugars in addition to the growth measurements and phytotoxicity assessments made previously. Methods for measuring the rate of photosynthesis of leaf discs and of whole plants are under development. All experiments were conducted at temperatures of 25°C to 32°C and at natural daylength (June to October). Lights have been installed to maintain a constant 12-hour daily photoperiod during the winter. The test plants were grown in glass fibre with a layer of vermiculite at the top of the pot and fed and watered automatically. Single-stemmed sugar cane plants, of variety B 49119, were used at 3 to 6 months of age. Treatments were applied as aerosol

Froghoppers and cane fly

sprays in sufficient quantity to wet both sides of each green leaf. From previous work a chemical thus applied at 1000 p.p.m. is roughly equivalent to a low-volume aerial application of 2 lb per acre in the field.

Five chemicals showed particular promise as ripeners. These were "Azauracil", CP 41845, DA 5, "Ethrel" and gibberellic acid (GA). At 400 p.p.m. "Azauracil" proved an effective growth retardant over 5 weeks, causing little phytotoxicity and a significant ($p = 0.01$) increase in total sugars % dry weight. Mixtures of "Azauracil" and GA were less effective in retarding stem elongation and gave a smaller increase in sugars % dry weight than "Azauracil" alone. However, the total stem sugar contents of plants treated with the "Azauracil"-GA mixture were higher than those of plants treated with "Azauracil" alone. It is known that treatment with GA initially promotes the elongation of sugar cane stems and that, in some instances at least, this is followed by a phase of "compensatory" slow growth during which ripening may occur. In two experiments conducted under relatively long day conditions (mid-summer) the secondary phase of slow growth did not occur. However, the stem sugar contents of the treated plants were similar to those of the untreated plants so that there was a net increase in sugar yields as a result of treatment with GA.

Application of "Ethrel" using a new formulation suppressed stem elongation and the emergence of new leaves for two weeks. In contrast to results with an older formulation the rapid emergence of new leaves in the third week was not accompanied by a "compensatory" rapid elongation of the stem. In consequence the early gains in stem sucrose were maintained over four weeks. With three-month old cane, treatment with "Ethrel" resulted in a fairly small increase in total sugar accumulation, amounting to approximately half a gram per stem. On six-month old cane however, the advantage of the "Ethrel" treatment was more marked, with a yield increase of about four grams of sucrose per stem over the untreated controls. Two experimental compounds, CP 41845 (Monsanto) and DA 5 (Dupont) proved very effective growth retardants and also induced an increased accumulation of sugar when applied to sugar cane plants. "Dalapon" and "Pesco 1815" were again shown to retard the growth of sugar cane over at least a month, but their ripening effects were rather weak.

Treatment with "Dalapon" also tended to increase total sugars % fresh weight but failed to enhance actual sugar accumulation. Mixtures of "Dalapon" with "Ethrel" had a ripening effect on sugar cane but showed no advantages over treatment with "Ethrel" alone. Three chemicals, abscisic acid, "Alar" and "Thiouracil", which have been shown to retard the growth of sugar cane under short (9 or 12 hour) day conditions, proved ineffective when tested during the summer. Under these relatively long day conditions, JF 2578 also proved ineffective as a growth retardant.

In the entomological sphere work was concerned mainly with froghoppers and to a less extent the West Indian cane fly, both bad pests of sugar cane in the Caribbean region. Cultures of the froghoppers *Aeneolamia postica jugata* from British Honduras and *Aeneolamia* var. *saccharina* from Trinidad are now well established in heated glasshouses at the Research Centre. The basic rearing unit is an aluminium cabinet in which sugar maize or sweet sorghum plants established in fibrous "jiffy" pots are stood on a strip of "Vyon" (a water-permeable polyethylene material) bedded on moist sand which is fed with plant nutrient solution via glass fibre wicks. The roots of the host plants grow through the sides of the pots and extend over the moist "Vyon" surface. Froghopper nymphs introduced into the cabinet soon begin to feed on the roots and to produce their characteristic spittle masses. Newly emerged adults are trapped in a beaker baited with a leaf cutting and inverted over a plastic funnel at the top of the cabinet. Adults are reared separately in cages provided with sugar maize, sweet sorghum or sugar cane plants with a circle of moist filter paper at the base for oviposition. Both species have been successively reared through several generations using these techniques. The same principles have been used in the design of large walk-in cages for mass rearing froghoppers and smaller units for experimental work involving detailed observations on the growth and development of froghopper nymphs.

Measurements were made on the rate of growth of froghopper nymphs of both species by making daily measurements of the diameter of their spittle masses. Newly hatched nymphs were established on the roots of sugar maize in small polyethylene culture boxes. It was found that there is much variation in the size of the spittle masses of nymphs of the same age. This applied to both species. It is thought that the measurement of spittle mass diameters may provide a useful, indirect method of estimating the rate of growth of froghopper nymphs without disturbing them from their spittle masses. The spittle mass diameters of nymphs older than 13 days increased fairly rapidly (1 mm in 4 or 5 days) so that the effects of chemical treatments upon growth rate should become evident within 5 to 10 days.

Experiments were carried out on the effect of two triazine herbicides on froghopper nymphs. In a preliminary experiment third and fourth instar nymphs of *Aeneolamia* var. *saccharina* were established on the roots of young rice plants grown in the manner already described, the young rice plants being supplied with a nutrient solution to which "Atrazine" or "Simazine" had been added. At first the nymphs appeared unaffected, but five days later some of the nymphs were dead (with both herbicides) and six days after treatment all had died. At the rates used in the experiment "Atrazine" and "Simazine" had no apparently harmful effects upon the rice plants. This finding could prove of economic import-

ance as these herbicides are probably lethal to frog-hopper nymphs only when they are ingested. They may, therefore, selectively kill frog-hopper nymphs without affecting their natural enemies.

Reference is made to the assistance being given to the Commonwealth Institute of Biological Control in the search for a measure of biological control of frog-hoppers. Natural enemies of frog-hoppers in Uganda and Pakistan are to be despatched to the Research Centre where attempts will be made to rear them and to provide sufficient material for release in British Honduras and Trinidad. A small consignment of larvae and pupae of a Syrphid predator (*Asarcina ericetorum albifacies*) of frog-hopper nymphs (*Locris* spp.) was received from Uganda in June 1969. Unfortunately only one of the Syrphids transformed successfully to the adult stage. Further consignments are planned when the Syrphids become numerous enough.

With regard to the West Indian cane fly (*Saccharosydne saccharivora*), the major sugar cane pest in Jamaica, eggs were imported and newly hatched nymphs transferred to the leaves of sugar cane plants where several completed development to the adult stage. The adults subsequently mated and produced eggs, thus establishing the culture for subsequent work.

Photosynthesis in sugar cane

With the known existence of two types of chloroplast in the sugar cane plant, instead of only one as in other plants, it was thought that the separation of the two types of chloroplast, using density gradients, might allow of investigations of their respective functions in the overall process of CO₂ fixation and carbohydrate biosynthesis. It was found that chloroplasts isolated from cane using conventional techniques did not fix CO₂. Furthermore, it was found that extracts of cane leaves inhibited both oxygen evolution and CO₂ fixation by viable spinach chloroplasts. Similarly these extracts inhibited ribulose diphosphate carboxylase, the enzyme responsible for the introduction of CO₂ into the reductive pentose phosphate pathway of photosynthesis. Much of the work during the year has been devoted to investigating the nature of the inhibitory compounds, the mechanism of inhibition and ways of counteracting their action. The method employed for investigating the inhibitory cane extracts are described. The major inhibitory compounds were characterized as chlorogenic and caffeic acids. Other matters discussed include: action of phenols on photosynthesis by isolated chloroplasts, mechanism of inhibition and reversal of inhibition. A medium was devised containing polyethylene glycol and thioglycollate which improved the activity of isolated cane chloroplasts.

Enzyme studies

The enzymes investigated were mainly those concerned with the primary processes of CO₂ assimilation and the immediate utilization of initial products of CO₂ fixation. A comparison of the levels of various enzymes in partially purified extracts of leaf protein

was made between tropical grasses (e.g. sugar cane, sorghum and maize) and temperate plants such as spinach and the common weed "fat-hen" (*Chenopodium album*). These two temperate plants showed high activities of ribulose diphosphate carboxylase but unlike the tropical grasses had low levels of endogenous phenols. Other enzymes showed barely significant differences in activity between the two groups of plants. The location of various enzymes within the subcellular organelles was also investigated. In spite of differences in enzyme activity between the tropical and temperate plants, the enzymes were located similarly throughout. Pyrophosphatase was associated with chloroplasts, NAD-dependent malate dehydrogenase with mitochondria, and peroxidase and polyphenol oxidase probably with the cytoplasm. Other matters discussed include light/phosphoenolpyruvate-dependent CO₂ fixation, and dielectric measurements on chloroplast membranes.

With the aid of electron microscopy, in collaboration with the Botany Department of King's College, University of London, ultrastructural studies were carried out on chloroplasts, both *in vivo* and after isolation and separation. Meristematic regions, developing tissue and tissue culture have been studied in detail as a preliminary to investigations of effects of potential ripeners on cell division, differentiation and chloroplast development.

(To be continued)

Brevities

French sugar group rationalization¹.—The French sugar company Raffineries et Sucreries Say was acquired in 1967 by a consortium formed by Tate & Lyle Ltd., Raffinerie Tirlemontoise S.A., Société F. Beghin, Eridania S.p.A. and Süd-deutsche Zucker A.G. Since then the group acquired a company called S.I.A.S. which had a sugar factory at Goussainville and a small refinery at Tergnier. The Paris refinery was badly placed for raw sugar supplies and has been closed while the site was sold and has provided funds for improvements elsewhere. The small factory at Sermaize has also been closed but its small refinery has been kept open, while the factories at Pont d'Ardres, Chalons and Chevières are being enlarged and rebuilt.

* * *

Sierra Leone sugar imports, 1969².—Imports of sugar by Sierra Leone amounted to 24,117 long tons, tel quel, in 1969 compared with 25,370 tons in 1968. Suppliers included Belgium with 531 tons (1475 tons in 1968), China with 2091 tons (1445), Czechoslovakia with 1621 tons (2430), Finland with 2960 tons (0), France with 1590 tons (1591), West Germany with 1374 tons (1674), Hungary with 544 tons (17), Italy with 246 tons (0), Poland with 1497 tons (1890), the USSR with 8521 tons (8123), and the UK with 3141 tons (4460). Other countries supplied 1 ton in 1969 but 2265 tons in 1968.

* * *

Mexico sugar consumption, 1969³.—Sugar consumption in Mexico in 1969 amounted to 1,731,555 metric tons, compared with 1,625,934 tons in 1968, an increase of 6.5%.

¹ Tate & Lyle Times International, 1970, (7), 3-5.

² C. Czarnikow Ltd., Sugar Review, 1970, (977), 117.

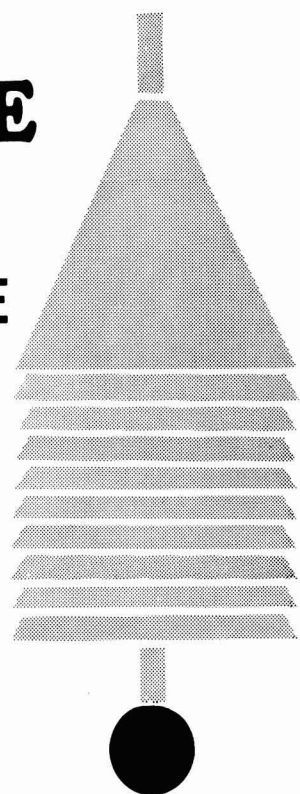
³ F. O. Licht, International Sugar Rpt., 1970, 102, (16), 6.



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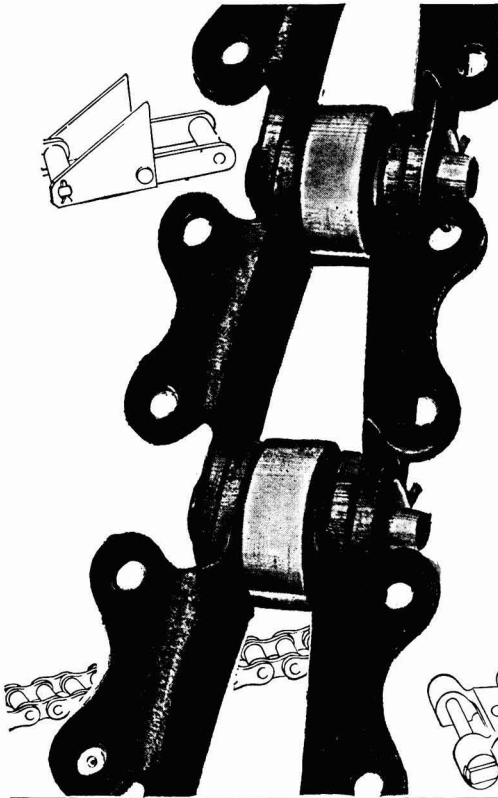
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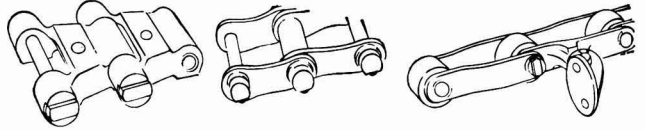
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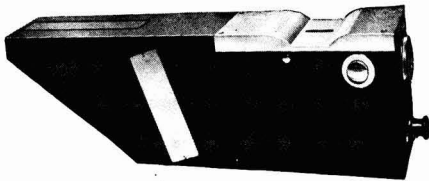
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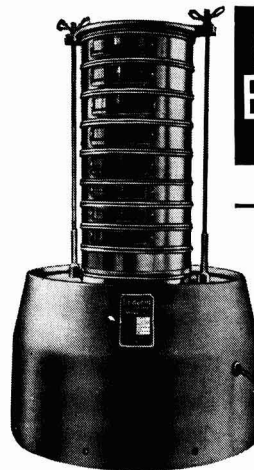
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Sugar cane agriculture

Effect of the herbicides 2,4-D and 2,4,5-T on parasitism of the eggs of the sugar cane borer (*Diatraea saccharalis*) by *Trichogramma minutum*. S. R. CORNEJO. *Rev. Peru. Ent.*, 1967, (1), 157-158; through *Weed Abs.*, 1969, 18, (5), 362.—Both 2,4-D and 2,4,5-T are widely used in sugar cane in Peru. Because of conflicting reports small-scale field tests were carried out where the parasite had been released at a rate of 120,000/acre. Pre-germination treatment with 2,4-D amine and post-germination treatment with 2,4,5-T had no effect on egg parasitism, which reached 73.9-78.9% in the treated fields and 74.3-77.3% in the untreated ones.

* * *

I.I.S.R. technique to triple sugar cane yield in North India. R. R. PANJE, P. S. MATHUR and S. R. SETH. *Indian Farming*, 1968, 18, (6), 4-7, 52; through *Hort. Abs.*, 1969, 39, 708.—Experiments at the Indian Institute of Agriculture Research at Lucknow are reported. The technique is to plant "long rayungans" (several-noded, 40 cm top-sets with side shoots) vertically in deep, fully fertilized and irrigated trenches. The soil in the trenches is loosened to a depth of 45 cm, mixed with fertilizer, replaced and soaked with water before the planting material is pressed in. The method worked well in loamy soils, lodging being the only problem.

* * *

The use of herbicides in sugar cane crops on two soil types in São Paulo state and their effect on yields. H. DE OLIVEIRA and J. C. OMETTO. *Bragantia*, 1967, 26, 409-421; through *Hort. Abs.*, 1969, 39, 709.—The soils were a mixed terra-roxa and a sandy soil, and the herbicides applied at the commercially recommended rates and at half these rates. On sandy soil the cane and sugar yields were improved by the use of 2,4-D compounds, "Simazine", "Kuron" and a mixture of 2,4-D amines and MCPA, but on the terra-roxa soil the cane yield and sugar content were not affected by any of the herbicides.

* * *

Reaction of juice quality of sugar cane to temperature depressions in Northern India. R. R. PANJE, B. SINGH and S. K. SAXENA. *Indian J. Agric. Sci.*, 1968, 38, 677-684; through *Hort. Abs.*, 1969, 39, 710.—The effect of minimum temperatures of below 7°C on the juice quality of three different varieties of cane was determined by making weekly analyses during the cold season. Differences between different varieties were pronounced. In one variety the juice in all parts of the stalk was affected by cold but in the other two the top portion of the stalk was hardly affected.

Soluble and total silicon in sugar cane. R. L. FOX *et al.* *Plant and Soil*, 1969, 30, 81-92; through *Hort. Abs.*, 1969, 39, 712.—Total and soluble Si were higher in leaf sheaths than blades, and total Si was much higher in sheaths and blades than in internodal tissue. Soluble Si was highest in the least mature tissues, whereas total Si was highest in the most recently mature tissue. Once the leaf was mature there was little further change in total Si. Applications of slag had more effect on total Si in the leaf blades than in the sheaths but the reverse was true for soluble Si. The mature stalk was the more responsive tissue.

* * *

Performance of some sugar cane varieties under water-logged and kallar affected areas. S. FASHI and H. AHMAD. *Agric. Pakistan*, 1967, 18, 457-465; through *Soils and Fertilizers*, 1969, 32, 504.—Twenty-five sugar cane varieties were grown under the conditions of water-logged and saline areas. The varieties CoL 33, CoL 54, CoL 38 and CoL 48 gave the highest yields but these were very low compared with the yields from normal soils.

* * *

Studies on the effect of the application of manganese sulphate on cane yield, cane quality and on levels of different fractions of manganese in Chopan soil. G. K. ZENDE. *J. Indian Soc. Soil Sci.*, 1968, 16, 315-322; through *Soils and Fertilizers*, 1969, 32, 504.—Field trials are reported on a black, saline-alkali soil using five MnSO₄ treatments and controls. Part of the added soluble Mn was adsorbed on the exchange complex and part converted into active or inactive oxides, mainly acid-insoluble oxide. Mn application to the soil or foliage increased K, P and N uptakes.

* * *

Renewed warning on ratoon stunting disease. ANON. *Australian Sugar J.*, 1969, 61, 239.—Recent drought has highlighted the damage that the disease can cause in Queensland where it is the most damaging of all cane diseases. It is favoured by dry conditions. Reference is made to the tours arranged by the Bureau and local Pest Boards aimed at creating an awareness among growers of the extent of the losses which the disease can involve and to remind growers of the proven control measures.

* * *

Chopped cane transport for railway cane growers. ANON. *Australian Sugar J.*, 1969, 61, 254.—Details are given of a loading system devised to give railway

cane growers the advantages of chopper harvesting. This system involves the road-to-rail transfer of bulk "Canetainer" bins, each holding approximately 4½ tons of chopped cane. The transfer operation is carried out in minutes by means of a hydraulic system.

* * *

Herbicides for the control of weeds in sugar cane intercropped with soya beans and groundnuts. S. Y. PENG and W. B. SZE. *Trop. Agric.*, 1969, 46, 333-342. In Taiwan it is common practice to intercrop cane during the early stages of growth with such crops as groundnuts, soya beans, rice, cotton, tobacco or vegetables. This is on account of arable land shortage and population pressure. Eight herbicidal treatments with three frequencies of hand weeding were carried out. The herbicides used were: 2,4-D, "Linuron", "Paraquat", "Dalapon", "Nitrofen", "Amiben", "Fenac", MCPA, "Secone", "Diuron", 2,4-DB and "Atrazine". It was concluded that "Nitrofen" at 3.75 to 5.0 kg a.i. per ha should be used as a pre-emergence herbicide for cane interplanted with soya beans and groundnuts.

* * *

The crop and planting. L. L. LAUDEN. *Sugar Bull.*, 1969, 47, (24), 3.—Cane growers in Louisiana are reminded that the planting operation is the most important job on the farm. The various points that must be watched are discussed and the need for good supervision stressed. Good quality mosaic-free seed cane only should be planted. Great care is needed to ensure that cane setts are not covered with too much soil, which is easily done. Not more than 4 inches of soil is needed and "cultipacking" or rolling is very important.

* * *

White leaf disease of sugar cane. S. C. LIN and C. S. LEE. *Sugarcane Pathologists Newsletter*, 1969, (3), 2-3.—This disease, found in the northern parts of Taiwan in 1958, was at first confused with leaf scald. It is now considered to be due to a new species of *Mycoplasma* and to be spread by a leaf hopper (*Epi-tettix hiroglyphicus*). Successful attempts to culture *Mycoplasma*, found in sieve tubes of infected sugar cane, are described. Experiments to isolate *Mycoplasma* from the insect vector are in progress.

* * *

Leaf scald in South Africa and Swaziland. G. M. THOMSON. *Sugarcane Pathologists Newsletter*, 1969, (3), 4.—This disease was identified for the first time in South Africa and Swaziland in the latter part of 1968. Various other subsequent outbreaks in South Africa are described and the attempts that are being made to contain the disease.

* * *

Yellow wilt in Malawi. M. A. SIDDIQI. *Sugarcane Pathologists Newsletter*, 1969, (3), 13.—During 1967-68 yellow wilt at Nchalo Sugar Estate, Malawi, did not cause much concern. The disease was found sporadically and no losses in yield recorded. The

symptoms of the disease are described. The belief is held that some of the so-called symptoms may be due to unfavourable soil/water relationships.

* * *

Elephant grass (*Pennisetum purpureum*), a natural host of sugar cane mosaic. K. S. BHARGAVE, R. D. JOSHI and N. RISHI. *Sugarcane Pathologists Newsletter*, 1969, (3), 15.—Elephant grass is reported, it is thought for the first time, as a natural host of sugar cane mosaic. This is a serious threat because this grass, also called Napier or Merker grass, is so widely cultivated for fodder.

* * *

Peat pots for cane plants. L. LINDSAY. *Sugarcane Pathologists Newsletter*, 1969, (3), 22.—The advantage of establishing young cane plants in 4-inch square peat pots, instead of conventional 6-inch round plastic or clay pots, as a means of saving greenhouse space is discussed, the saving of space being 185%.

* * *

The cause of leaf galls (pseudo-Fiji disease). F. M. J. L. SHEFFIELD. *Sugarcane Pathologists Newsletter*, 1969, (3), 25.—An experiment (in Kenya) is described in which a single caged insect (a leafhopper) was responsible for some 600 galls subsequently appearing on the leaves of the sugar cane plant on which it fed. Many cane varieties at the temporary Breeding Station at Mtwapa had previously become severely affected by leaf galls.

* * *

Investigations into some agronomic factors affecting the yield, quality and incidence of top-borer of sugar cane at Lyallpur (1950). M. M. I. KHAN and C. K. MUHAMMAD. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 269-271.—A high rate of manuring gave increased yields with both early and late-sown sugar cane, being more pronounced with the early-sown cane. Time of planting had no effect on the incidence of top borer attack. Damage to millable stalks was greater with the early-sown cane and with cane that had been liberally manured. Growers are recommended to practise early sowing and to use ammonium sulphate in addition to their farmyard manure.

* * *

Light growth relationship in sugar cane, 1954. W. MUHAMMAD and N. D. YUSUF. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 271-272.—The findings in general were in close agreement with those of earlier workers. Three different species of *Saccharum* (*S. spontaneum*, *S. barberi* and *S. officinarum*, new variety) were used in the experiments. Shoot length data obtained with the three varieties, under different photoperiods and light intensities, showed a striking resemblance. Maximum growth of different species occurred in different photoperiods. *Saccharum spontaneum* produced the longest shoot in an 18-hour day. *S. barberi* attained maximum length in continuous light. *S. officinarum* produced the best growth in an 18-hr day.

Distinguishing characteristics of some of the newly evolved sugar cane varieties at the Sugar Cane Research Station, Lyallpur (1957). H. AHMAD and N. D. YUSUF. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 274-276.—Stem or culm characteristics or diagnostic features of six new cane varieties are given. These are concerned with the ligule, bud or eye, groove, ivory markings, splits and colour of stem, the last mentioned being somewhat variable according to stage of growth, exposure to sun and light, etc.

* * *

Studies into the effect of seed rate on the growth and yield of the sugar cane crop (1957). A. M. GORSI and N. D. YUSUF. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 276-278.—Three seed rates were used in the experiment, with 25,000, 35,000 and 45,000 two-budded sets per acre. Some sets were soaked before planting. This was found to be distinctly beneficial under prevailing conditions and to give a higher rate of germination (6-9%). The medium seed rate (35,000) gave the best results.

* * *

A study of arrowing in sugar cane with special reference to flowering characteristics and fertility as influenced by light cum irrigation treatments at Lyallpur (1962). A. M. MALUKARA and N. D. YUSUF. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 278-280.—Normally sugar cane does not flower at Lyallpur or, if it produces inflorescences, the flowers are sterile. The effects of the nature of the soil, nutrition, irrigation and light intensity were studied. Application of phosphate increased flowering, as did irrigation in July. With light treatment, developing arrows emerged normally. The application of phosphate combined with light intensity of 4500 W gave the best results and the arrows emerged in the shortest period. Dehiscence of anthers took place only when additional light was supplied.

* * *

Studies into the effect of varying day length on growth and development in three different varieties of sugar cane (1962). A. JABBAR and N. D. YUSUF. *Rpt. Ayub Agric. Res. Inst. (W. Pakistan)*, 1965, 280-282.—Results are reported on the effect of varying the photoperiod on shoot length increment, tiller formation, green leaf intensity, length and thickness of internode, sugar content, etc. Three different varieties of cane were used—CoL 54, B.L. 18 and B.L. 19. The variety B.L. 18 appeared to be the most sensitive to the day length factor and CoL 54 to show the least response. B.L. 19 produced the highest number of green leaves for different photoperiods.

* * *

Yields of sugar cane planted with different amounts of mosaic. R. L. TIPPETT. *Sugar Bull.* 1969, 47, (23), 4-11.—This study included four experiments with the two cane varieties C.P. 52-68 and L. 60-25. They compared germination, July stand counts, plant cane and ratoon yields in plots planted with seed cane

infected with various levels of mosaic. The percentages of mosaic in the growing cane did not remain constant with the specified amounts planted. In all tests there was spread of mosaic into the healthy plots. Plots planted with 100% mosaic-infected seed-cane showed some apparent recovery. Detailed results of the trials are shown in tables.

* * *

Rats seen as No. 1 pest of some northern cane fields. ANON. *Producers' Rev.*, 1969, 59, (8), 37.—Since cane grubs were brought under control in northern Queensland by the use of BHC, rats have been the No. 1 cane pest. They destroy large quantities of cane every year and reduce the sugar content of the stalks which they attack. Baiting is essential if rats are to be controlled and damage kept in check. Two articles that have appeared on the subject in Queensland are reproduced, one dealing with aerial rat baiting.

* * *

Deep tillage in Hawaii. I. Subsoiling. A. C. TROUSE and R. P. HUMBERT. *Sugarland (Philippines)*, 1969, 6, (6), 16-18, 22-23, 26, 32.—The reasons for deep tillage and subsoiling in Hawaiian cane fields are given and the means and equipment used for achieving it described. With modern harvesters and other heavy equipment deep tillage is the only satisfactory answer to the soil compaction that unavoidably takes place. Furthermore it increases the root-run available to the cane plant and increases the moisture-holding capacity of the soil, important where irrigation is concerned.

* * *

Screening for mosaic resistance in *Saccharum spontaneum* at Houma, Louisiana, 1964-68. P. H. DUNCKELMAN and R. D. BREAU. *Sugar y Azúcar*, 1969, 64, (10), 16-18.—During the five-year test period at Houma, 262 clones of *Saccharum spontaneum* were screened for mosaic in a greenhouse, being inoculated with all known strains of the mosaic virus. Degrees of resistance are shown in tabular form. The most resistant wild forms are now being used in the breeding work in progress.

* * *

Care of the soil in Mexican cane lands. D. ONTIVEROS H. *Bol. Azuc. Mex.*, 1969, (233), 10-20.—Various aspects of sugar cane husbandry, concerned with the soil, are discussed in the paper, including fertilizer use, incorporation of organic manure, use of herbicides, elimination of bad practices in the handling or management of the soil, etc. A few notes are included on the more serious pests and diseases of sugar cane in Mexico.

* * *

The variety situation in Tucumán in the light of recent work. R. F. DE ULLIVARRI and G. KENNING V. *La Ind. Azuc.*, 1969, 75, 185-201.—The performance of many locally bred varieties of sugar cane is discussed and illustrated with tables, along with the performance of many imported varieties, some of them of very long standing, in different parts of Argentina.

Sugar beet agriculture



Topping with forage harvesters. S. OIEN. *Sugar J.*, 1969, **32**, (3), 27–30.—Results are given of experimental work in topping and harvesting of sugar beet in Denmark. It is pointed out that in Europe methods of harvesting sugar beet vary remarkably from one country to another. In some countries harvesters with a built-in topper predominate. In other countries (as in Denmark) the work is in two phases, topping being a separate operation. For this forage harvesters are widely used in Denmark, these machines being in common use for other crops. The difficulties that arise, especially with uneven stands or machine-thinned crops, are discussed.

* * *

Preliminary trials of sugar beet cultivation on Godavari farms. V. P. VAIDYA. *Proc. 22nd Conv. Deccan Sugar Tech. Assoc. (India)*, 1967, (Addendum), 1–5.—Three varieties of sugar beet [Ramonskaya, Ero type E (G), Ero type E (I)] were cultivated as a trial, with irrigation. Yields were not high (16–20 tons/ha). There was no serious insect attack but some beets were affected by a rot (identity not indicated).

* * *

Experiments on defoliation and mechanical thinning of sugar beet. G. BARALDI and G. VIROLI. *Ind. Sacc. Ital.*, 1969, **62**, 200–212.—The performance of two different makes of mechanical harvester are discussed. There was little difference in their overall efficiency. Results were less regular than topping by hand.

* * *

Two *Alternaria* diseases of sugar beet in India. A. N. MUKHOPADHYAY. *Indian Phytopathology*, 1969, **22**, (1), 135–138.—As a result of a survey of fungal diseases of sugar beet in India two fungi causing leaf spot, not previously recorded on the Indian Subcontinent, are recorded. These are *Alternaria tenuis* and *A. brassicae*. Details of the diseases and their symptoms are given. Damage may be severe.

* * *

Sugar beet in India. P. S. GILL. *World Crops*, 1969, **21**, 340–343.—Details are given of trials and experimental work with sugar beet in India during the last decade. In the irrigated plains of North India it may be grown as a winter crop without any difficulty. With large scale cultivation and processing the fuel problem becomes acute since beet does not produce its own fuel as does cane. Growing both cane and beet for consecutive processing, a way out of this dilemma, is discussed.

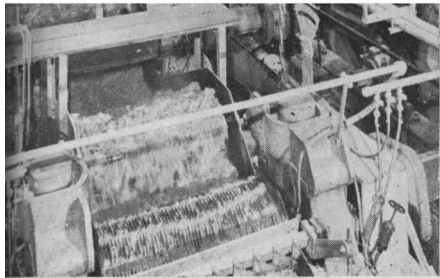
The effects of potassium carriers and levels of potassium and nitrogen fertilization on the yield and quality of sugar beets. G. J. GASCHO, J. F. DAVIS, R. A. FOGG and M. G. FRAKES. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 298–305.—With sugar beet a high level of K in the petiole is regarded as conducive to high yields but a high level in the root at harvest is undesirable as it ranks as a non-sugar contaminant of the juice. The main object of this investigation was to ascertain whether the K carriers—KCl, KNO₃, K₂SO₄ or (K₂SO₄ + MgSO₄)—differentially affect the yield and/or quality of sugar beet. Additional objectives were to determine if rates of K or N fertilization, or their interactions, affect the yield and quality of sugar beet. Yield and quality on three soil types in two successive years were affected similarly by the four carriers. The highest concentration of K in petioles generally occurred when KCl had been applied.

* * *

Selecting sugar beet for yellows resistance on the relative concentration of three amino acids in leaves of infected plants. J. M. FIFE. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 318–323.—It is considered probable that amino-acids (aspartic acid, glutamic acid and glutamine) are to a large extent genetically controlled in the leaves of beet yellows infected plants. This paper summarizes the results of 7 years of field testing of selections which were made on the basis of a combination of the amino-acid ratio and root weight. It reports the correlations of the amino-acid ratios of the selections with root yield and percentage sucrose. The correlation between the amino-acid ratio of the yellow-resistant selections and the percentage sucrose is regarded as positive and highly significant.

* * *

Phosphorus nutrition of sugar beet seedlings. K. M. SIPITANOS and A. ULRICH. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 332–346.—In the USA young sugar beet seedlings frequently require P fertilization for satisfactory growth. The need may be determined by analysis. Recently it has been necessary to estimate the P status of sugar beet seedlings when the petioles are too small for convenient sampling, as at the cotyledon stage of development. To solve this problem a greenhouse study of sugar beet seedlings by a culture solution technique was made to find, if possible, a more convenient part of the seedling to sample. P status could be determined from the soluble or total P values of petioles of the first pair of leaves formed or of their blades or cotyledons.



Cane sugar manufacture

Measuring and control instruments in the new factory, Ingenio Adolfo López Mateos. O. HERNÁNDEZ R. *Bol. Azuc. Mex.*, 1969, (236), 30-32.—The title factory is the newest and one of the most modern in Mexico. A list is given of the various measuring and control instruments installed in the various sections—steam plant, clarification, evaporation, crystallization and centrifugals.

* * *

Evaluation of evaporator scale inhibitors. R. MALONEY. *Sugar J.*, 1969, 32, (6), 21-23.—See *I.S.J.*, 1969, 71, 202-205.

* * *

New concept of reduced boiling house recovery (ESG). R. C. BHANDARI. *Indian Sugar*, 1969, 19, 459-464. Drawbacks in the DEERR and GUNDU RAO formulae for reduced boiling house recovery are discussed and a simplified version of the latter proposed, viz. $R = e + K(J' - J)$, where e is the actual boiling house recovery, K is the ratio of non-sugars in clear juice to non-sugars in mixed juice, J is the mixed juice purity and J' the purity to which the observed boiling house recovery e is reduced.

* * *

Reduction of inversion and repression of micro-organisms in sugar factories. C. K. CLONINGER and F. T. CORRADINI. *Brasil Açuc.*, 1969, 74, 20-23.—A brief account is given of inversion of juices by microbial action where the mills and pipelines are infected, and of the action of "Busan 881" in reducing this loss.

* * *

Sugar in the cocoa land of Ghana. H. J. DELAVIER and H. HIRSCHMÜLLER. *Zeitsch. Zuckerind.*, 1970, 95, 24-26.—A brief survey is presented of the Ghana sugar industry, which consists of two cane sugar factories at Asutsuare and Komenda. These have so far produced only 3000 tons of sugar annually whereas the country's consumption is over 60,000 tons. A target of 35,000 tons/year is hoped for as the combined output of the two factories, which have a crushing capacity of 2000 and 1000 t.c.d., respectively. The total cane area is 2000-2500 ha, and the chief varieties of cane grown are B 41227 and PR 980. Yield is of the order of 28 tons of cane/ha. Much of the sugar is used to produce akpeteshie, a primitive alcoholic drink.

* * *

Burning bagasse. V. J. BAILLET. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, 16, 5-8.—The design and operation of spreader stokers and cell-type incinerators for disposal of excess bagasse are discussed.

Full pan seeding of low-grade strikes—a brief review. T. R. RAY INC. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, 16, 9-22.—The basic essentials of the full pan seeding system¹ and the classification of supersaturation into labile, intermediate and metastable zones, etc. are discussed, with an account of its use at Erath Sugar Company, one of the 10% of Louisiana sugar factories to have adopted the system.

* * *

Handling sugar cane mud with the "Eimcobel" filter. J. R. STEMBRIDGE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, 16, 23-32.—Factors affecting the performance of the "Eimcobel" filter are discussed; these include proper size selection, operation of the preceding clarifier, mud temperature, bagacillo addition, and especially the proper preparation and use of flocculation aids. Aspects of filter operation are discussed which, with proper attention, can achieve the desired goal of a clear filtrate which can go to the evaporator instead of having to be recirculated.

* * *

Suchem "Auto-Diffuser". P. P. STRICH. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, 16, 33-38.—An account is given of the initial operations of an "Auto-Diffuser"² at Louisa Sugar Cooperative in Louisiana in the 1968/69 season. The installation took only 6 months from ordering and is rated at 3000 tons/day although during the first crop the maximum handled was 2552 tons/day. Pol extraction was raised by 6.06 to over 95%, equivalent to 10 lb of 96° raw sugar per ton of cane, but cane preparation was as used when milling and was inadequate to achieve higher extraction which could reach 96-97% under ideal conditions. The bagasse was dewatered by two mills and had the same water content as before the diffuser was installed; because of its temperature and fluffiness, however, it burnt better than before.

* * *

Continuous crystallizer in operation at Lula factory. P. E. CANCEIENNE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1969, 16, 91-94.—The nine crystallizers fed from the low-grade pan at Lula factory were connected in series using gravity overflow from one to the next and providing central baffles in each with a space beneath to prevent channelling from one crystallizer to the next. The first two units are cooled

¹ GILLET: "Low grade sugar crystallization" (California & Hawaiian Sugar Refining Corp. Ltd., Crockett, Calif.) 1948.

² *I.S.J.*, 1968, 70, 203-205.

with cold water and the massecuite reheated to 115–125°F with hot water in the last two. Previously, discharging massecuite to the units farthest from the pan was slow and caused delays of 30–45 minutes before the pan could start another strike; with the new system all strikes are discharged in 4–5 minutes, so that average strike time is reduced. Other advantages include more uniform massecuites, better heating and cooling control, less labour, higher massecuite Brix, greater flexibility, etc.

* * *

Caking of raw sugar. A. P. GUPTA and M. NARAIN. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 1–6.—Samples of raw sugar of 97.4, 98.6 and 99.1 pol were kept in desiccators at various R.H. levels for 10 weeks, the changes in weight and physical condition being noted after 4 weeks and at weekly intervals thereafter. Above 80% R.H. the samples absorbed water and became semi-liquid. At 74 R.H. no change in weight occurred. At 66 R.H. there was loss of moisture which was least in the highest pol sugar and *vice-versa*. Similar behaviour was found at lower R.H. levels, while slight caking began with the lower purity samples at 56 R.H. and more definite caking at 35 R.H. in all three sugars. Thus only high polarization raw sugar should be made where the atmospheric R.H. is below 45 in the summer, and low polarization sugar should only be made near the port or coast where the humidity remains high.

* * *

White sugar without sulphur or hydros. A. C. CHATTERJEE. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 7–16.—See *I.S.J.*, 1969, 71, 211.

* * *

Further studies on the use of phosphate in clear juice. A. C. CHATTERJEE, K. T. PILLAI and S. SRINIVASAN. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 17–22.—See *I.S.J.*, 1969, 71, 211.

* * *

Spontaneous combustion of final molasses—some observations. R. D. JOSHI. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 33–35.—An account is given of the occurrence of a frothing reaction which caused the overflow of massecuite from four crystallizers after striking four “jelly” pans. Escape of the gas was aided by the addition of “Instol” surface-active agent, formaldehyde and oil, and after cooling to room temperature it was found that there had been practically no sucrose loss. Drought-affected cane was being crushed at the time and this may have been the cause. It is recommended that, should such frothing be observed, the massecuite be cooled with adequate circulation and venting, while the molasses resulting should be stored separately and, if the sugar factory has a distillery attached, it should be sent for immediate use for fermentation instead of being stored.

Continuous cooling of final massecuites at Vuyyuru. M. ANAND. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 23–32. The crystallizer station has been converted to continuous operation at Vuyyuru so that the massecuite dropped from the pan passes to a bank of four receiving units in parallel which are air-cooled and reduce the temperature from 61/63°C to about 60°C. The massecuite is discharged to two “Rota” pumps which feed two banks of crystallizers each comprising a Werkspoor air-cooled unit (where the temperature falls from 60° to 50/52°C) feeding in series two water-cooled Fletcher-Blanchard units (50/52° to 47/48°C, and 47/48° to 44/46°C) and an air-cooled unit from which the massecuite passes to a pug mill for reheating before feeding to the centrifugals.

* * *

Cleaning evaporator tubes from outside. R. D. JOSHI. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 36–37.—The outside of the evaporator tubes at Shreepur factory had not been cleaned for five years and oil deposited from the exhaust steam reduced heat transfer to the extent that syrup Brix only reached 45° instead of 60°Bx. Injection of gasoline with the steam was ineffective, but boiling with caustic soda was so successful that the evaporator performed as if it were fitted with new tubes. Boiling with caustic soda has become standard practice and it is planned to make permanent connexions to the juice heaters to treat them in the same way.

* * *

Diffusion-cum-milling and non-sugar extraction. R. RAGBIR. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 38–40.—It is argued that higher sucrose extraction by diffusion must entail higher non-sugar extraction and that better quality juice results from (i) elimination of microbial action under the aseptic conditions applying, and (ii) coagulation and precipitation of non-sugars in the juice from dewatering mills which is returned to the diffuser where the bagasse acts as a filter. Experiments in which juices are heated and filtered over bagacillo support the hypothesis that non-sugars are removed in this way.

* * *

“Sedipur TF2 Solid” as settling aid in cane juice. A. C. CHATTERJEE, S. SRINIVASAN and N. SANTHANAM. *Proc. 23rd Ann. Conv. Deccan Sugar Tech. Assoc. (India)*, 1969, (I—Manufacturing), 67–79.—Rates of settling in cane juice were determined in laboratory experiments on the use of “Sedipur TF2”. They showed that the most suitable amount was 1.5 p.p.m. added in the form of a 0.05% solution, and that boiling the cold defecated juice after adding the flocculant was better than adding it to the juice which had already been boiled. The flocculant gave a faster settling rate and lower mud volume, better colour and clarity of treated juice, while the CaO content and purity were more or less the same and the pH was slightly higher.



Beet sugar manufacture

A method of calculating the thermodynamic features of multiple-effect evaporators. A. M. KOZAK and V. A. SOLOMYKIN. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (5), 128-133.—The method described uses material, heat and energy balances to establish causes of exergy losses at various stages in the evaporation process. It enables the losses to be calculated and means of increasing the thermodynamic efficiency to be found. A worked example is given.

* * *

Freezing and prolonged storage of beet. M. M. VISSARIONOV and K. H. G. TEREGULOV. *Sakhar. Prom.*, 1969, 43, (11), 61-63.—At Karlamanskii sugar factory in the USSR beet were piled and then subjected to forced ventilation until the ambient temperature fell below freezing; the beets were then deep-frozen with cold air from fans until the temperature in the pile fell to -16°C . The daily sugar losses were reduced to 0.005% on beet compared with 0.013% in beet stored in the conventional manner.

* * *

Problems and trends in the Hungarian sugar industry. L. NAGY. *Elelmezési Ipar*, 1968, 22, 327-335; through *S.I.A.*, 1969, 31, Abs. 69-1024.—A general survey of the present state of the Hungarian sugar industry is given, with particular reference to beet cultivation, beet delivery, acceptance according to the sugar content, and the relation between industry and agriculture.

* * *

Determination of the changes caused by micro-organisms in sugar beet stored in a pile. Š. PELCIARIĆ and M. MILIĆ. *Savremena Poljoprivreda*, 1967, 15, 415-421; through *S.I.A.*, 1969, 31, Abs. 69-1027. 639 beets with either their leaves or crowns cut off were stored for 32 days. The numbers infected by moist rot, dry rot or mildew and the part of the root attacked are tabulated. Cutting off the crowns increased the liability to microbial attack, especially moist rot in the upper part of the root.

* * *

Choice of continuous diffusers for Bulgarian sugar factories. D. BABEV. *Khranit. Prom.*, 1967, 16, (8), 34-36; through *S.I.A.*, 1969, 31, Abs. 69-1028.—Technical and economic data are compared for DDS scroll and BMA tower diffusers in Russia and Poland. The DDS unit usually gave higher diffusion juice purity and dry substance at lower draft, but took longer and gave more pulp in the juice; it is said to pay for its installation in 3 years compared with 5-6 years for the BMA type. A disadvantage of the BMA type is

that juice from damaged beet passes through the screen area only with difficulty.

* * *

Sugar factories in Khorassan (Iran). M. MONAZAHIAN. *Zeitsch. Zuckerind.*, 1969, 94, 657-661.—Information is given on the 8 beet sugar factories (of which 5 are privately and 3 state-owned) operated in the province of Khorassan, in the north-east of Iran. At a beet slice in the 1968/69 campaign of 1,130,000 tons of beet, Khorassan is the major sugar-producing area of Iran. Details are given of campaign results from 1948/49 to 1968/69, and methods used in beet agriculture are surveyed.

* * *

Development of evaporation crystallizers—operation at constant level. A. R. GRANDADAM. *Zeitsch. Zuckerind.*, 1969, 94, 665-667.—A new boiling concept is described in which the level of a given volume of massecuite is maintained constant throughout the process, a level being chosen which will ensure maximum evaporation of the massecuite water content. With automatic control, the new type of "evaporation crystallizer" would, it is claimed, have a number of advantages over the conventional vacuum pan, including more rapid crystallization, boiling of higher Brix massecuites, improved sugar quality and yield, and the use of vapour at lower pressure. The design, four variants of which are briefly described and illustrated, is protected by patent.

* * *

Process conditions for low-grade massecuite crystallization system with pre-curing. I. N. AKINDINOV. *Sakhar. Prom.*, 1969, 43, (12), 28-32.—Calculations are given for determining the proportion of the massecuite which must be pre-cured in order that the crystal fraction remaining after return of the separated molasses is such as to give the desired exhaustion and curing characteristics after cooling. Standard molasses composition is used as the starting point.

* * *

Effect of juice level in the carbonatation tank on the coefficient of utilization of CO_2 . L. G. VORONA, A. K. KARTASHOV, V. A. NAGORNAYA, S. L. SHOIKHET and V. Z. SEMENENKO. *Sakhar. Prom.*, 1969, 43, (12), 32-36.—In an experimental carbonatation vessel 10 metres high it was found that raising the juice level to 4-4.5 m increased the degree of CO_2 utilization to 65-70%. A further increase to 75-80% was found possible by using spray jets for the juice, which is recommended in any case where it is impossible to raise the juice level.

Experimental investigations of the extraction capacity of beet cossettes of varying shape. S. M. GREBENYUK, E. V. OSTROVSKII and I. I. LEVIN. *Sakhar. Prom.*, 1969, 43, (12), 40-43.—Laboratory experiments in which laminar cossettes and slices of beet were obtained and subjected to diffusion showed that the degree of sugar extraction was about the same with both types at identical thicknesses.

* * *

Mechanization of lime kiln charging. G. A. MIKULA and E. V. OLEINIK. *Sakhar. Prom.*, 1969, 43, (12), 53-55.—Details are given of the system at the author's sugar factory in the USSR, whereby charging of the lime kiln with limestone and solid fuel requires one operator instead of the twelve employed before the system was modified.

* * *

Complex for mechanical handling of limestone and solid fuel at Gaisinskii sugar factory. A. A. KUKHARSKII and A. N. BOTIN. *Sakhar. Prom.*, 1969, 43, (12), 56-57. The system for preparation and loading of limestone and solid fuel at this Soviet sugar factory is briefly described.

* * *

Course of a normal crystallization with regard to the effect of non-sugar and colorant contents and the number of crystals in the massecuite. S. ZAGRODZKI. *Gaz. Cukr.*, 1969, 77, 265-270.—Mathematical examination of the boiling process showed that while the boiling time from nucleation could be predicted quite accurately for pure sugar solutions up to about 15 minutes, after which there was a gradual increase in the difference between theoretical and actual times (above a theoretical time of 50 min the actual times were about 60% greater), in the case of impure solutions the non-sugars and colorants had such a pronounced inhibiting effect on crystallization, even in 1st massecuite boiling, that the total boiling time was considerably longer than that of pure solutions and than was shown by laboratory determination of the rate of growth of single crystals in pure solution.

* * *

The occurrence of micro-organisms at the sugar end and their control. I. JANUSZEWICZ and K. MOSSAKOWSKA. *Gaz. Cukr.*, 1969, 77, 270-275.—After a survey of standards in various countries for bacterial counts in sugar, details are given of tests carried out in Poland since 1965 on sugar from warehouses at various sugar factories during the campaign and in the inter-campaign period. These show generally that the use of various named disinfectants in floor washing has reduced the bacterial populations so that in 1967/68 about 70% of the sugar samples conformed to the standards of the American Bottlers of Carbonated Beverages.

* * *

Tests on storage of washed beets in piles with forced ventilation. W. TRZCINSKI and J. MALEC. *Gaz. Cukr.*, 1969, 77, 278-280.—While washing of beets with fresh water before piling reduced daily sugar and weight losses compared with beets stored unwashed, washing

with fresh water plus lime solution reduced the losses still further in tests carried out during the 1966/67 campaign.

* * *

Effect of main liming temperature on increase in juice colour during concentration in evaporators. H. ZAORSKA and S. ZAGRODZKI. *Zucker*, 1970, 23, 6-12.—Investigations showed that while liming at 72°C caused a considerable increase (about 200%) in juice colour during evaporation to 65°Bx, a liming temperature of 85°C led to a much lower increase in juice colour during evaporation (generally less than 100%), although in both cases the increase was smaller at a normal juice level, i.e. at which the percentage of tube length filled with juice was numerically equivalent to the juice Brix. At the higher liming temperature the juice colour increased by less than 70% at normal evaporator level.

* * *

Accidents with packaging machines in the sugar industry. R. KRÖCHER. *Zucker*, 1970, 23, 15-23.—A detailed survey is presented of accidents involving packaging machine operators in West Germany during 1962-68. Causes of the accidents and the circumstances surrounding them are discussed.

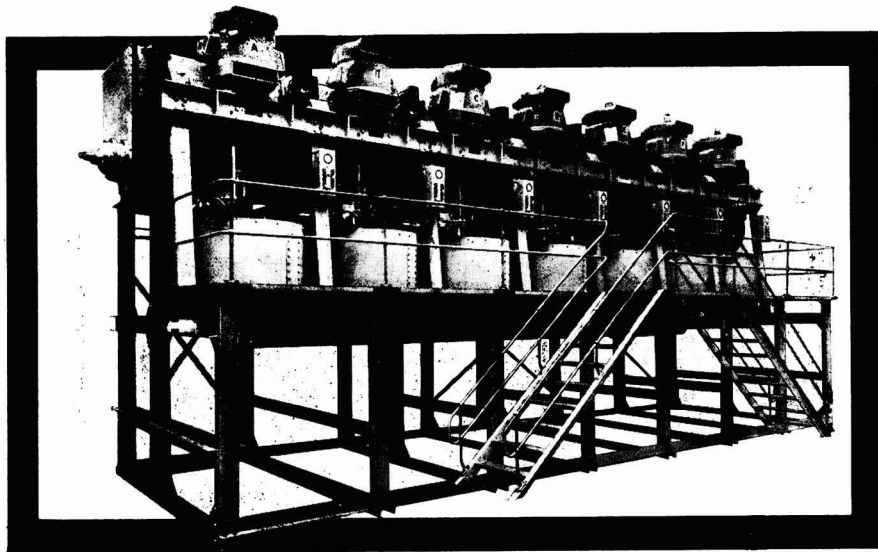
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Complements of the automation of boiling apparatus with high evaporative potential. J. DE CREMOUX. *Hautes Etudes Betterav. Agric.*, 1969, 1, (3), 7.—Objects to be achieved in automation of pan boiling are the adjustment of evaporation to crystallization and control of graining so that it is reproducible. The first may be achieved by controlling the steam flow in relation to the massecuite level in accordance with a simple programme, while the second may be achieved by ensuring that seed is introduced into the super-saturated syrup when its conductivity reaches a pre-set value, and for feed to begin again when the conductivity has fallen to a second pre-set value.

* * *

Spiral heat exchangers in the sugar factory. M. DUMIS. *Hautes Etudes Betterav. Agric.*, 1969, 1, (3), 11-12. The Rosenblad spiral heat exchanger made by the Alfa-Laval Group provides very high heat transfer coefficients but, because of the small diameter of the channels, is liable to blockage by e.g. pulp particles or mud from juice being heated. To avoid this, the heat exchangers should be set horizontal to prevent sedimentation and the fluid flow should be as high as possible, e.g. 1.5 m/sec. Such a heat exchanger is then very suitable for press water, diffusion juice, limed juice, etc. With diffusion juice, solid deposition on the heating surface may be minimized by using a heating fluid which will give a small temperature difference, e.g. hot water or last effect vapour at 70°C, to heat the juice to 60°C. Stainless steel construction also resists deposition since it presents a better surface to the juice than mild steel, can be made with thinner sections giving higher heat exchange and lower weight, and also is cleaned more easily. The two types of spiral exchanger offered by Alfa-Laval are briefly described and other types of heat exchanger mentioned.

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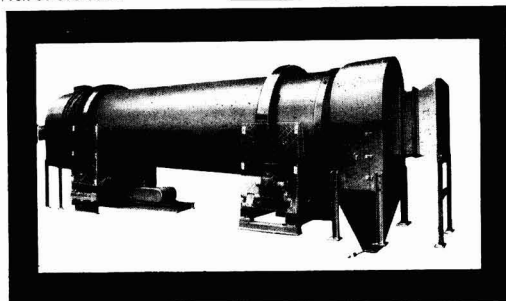
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ASSISTANT MANAGER

SUGAR SALES DIVISION

The demand for the Company's Sugar
Centrifugals continues to expand and we
wish to strengthen our sales team to increase
personal contact in the many sugar producing
areas.

For the new post of Assistant Manager,
Sugar Sales Division, we are seeking an
engineer who already has experience of
management, who is accustomed to negoti-
ating contracts, both technically and com-
mercially, with senior engineers and managers
and who, preferably, has first hand knowledge
of the sugar industry and its equipment.

It is expected that the successful applicant
is unlikely to be less than 27 years old, but
for a man of real ability who enjoys some
world-wide travelling there will be good
prospects.

Starting salary will depend on his experience
and ability, but will also be commensurate
with the importance we attach to his potential
for later promotion.

The Company has a Life Assurance and
Pension Scheme and would be willing to
assist with removal expenses.

Please write, with full details of education,
qualifications and experience to:—

**The Secretary,
Thomas Broadbent & Sons, Limited
Central Ironworks,
Huddersfield.**



Sugar refining

"Koblit", a forgotten active carbon. W. VON PROSKOWETZ. *Zucker*, 1970, 23, 12-14.—Reference is made to the production of an active carbon from carbonation mud and sawdust. Named "Koblit" after its inventor, KOBLIHA, this was found in the 1930's to have the same decolorizing properties as "Carboraffin" while being considerably cheaper. The process for preparation of "Koblit" was patented and was used in at least two Czechoslovakian refineries. Some details are given of the test procedure used by IVANČENKO to evaluate active carbon performance and the effect of pH on carbon. It is suggested that the same technique could be used to test modern carbons.

* * *

Sankey safeguards sugar supplies. ANON. *Food Trade Rev.*, 1969, 39, (10), 75; through *S.I.A.*, 1969, 31, Abs. 69-1150.—To cope with emergencies, e.g. dock strikes, a new raw sugar warehouse has been built at Sankey's Earlstown refinery. It is 160 ft long by 85 ft wide, 21 ft high at the eaves and 45 ft high at the apex; the brick walls are clad with aluminium above a height of 12 ft. The working capacity is 6000 tons, utilizing >50% of the volume available.

* * *

Complementary refining with pulverulent mixtures of polar resinous adsorbents, activated carbon and inorganic adsorbents. B. N. DICKINSON and H. E. BARRETT. *Ind. Eng. Chem., Prod. Res. Dev.*, 1969, 8, 199-204.—The decolorizing effect of mixtures of polar resinous adsorbents and activated carbons or inorganic adsorbents was determined by equilibrating sugar solutions and corn syrups with various mixtures, of 1-100 μ particle size for 30 minutes at 60°C. The concentration of soluble chromophores, expressed as the difference between absorption at 450 and 600 nm, is recorded in tabular form for the adsorbents alone and mixed, and the complementary effects determined, i.e. the ratio of the amounts of adsorbent alone and in a mixture giving the same decolorizing effect, as well as the carbon equivalents. Advantages of the treatments are discussed.

* * *

Removal of colour from sugar solutions by adsorbent resins. I. M. ABRAMS. *Abs. Papers presented to 157th Nat. Meeting, Amer. Chem. Soc.*, 1969, (CARB 33). Experiences with three types of granular adsorbent resin (nonionic, weakly basic and strongly basic) are summarized. Examples of the different purposes for which the resins are suitable were shown in laboratory tests on sugar solutions. A macroporous phenol-

formaldehyde resin gave better clarification of a very dark-coloured, 70% inverted high-test molasses with a high colloidal content than did defecation with lime and phosphoric acid. Weakly basic phenolic resins removed 50-80% of the colour from solutions of washed raw cane sugar. Highly porous, strongly basic resins in the chloride form removed >90% of the colour from partly decolorized, 50-66°Bx cane syrups. Resin life is discussed, and comparisons are made with bone char and granular activated carbon.

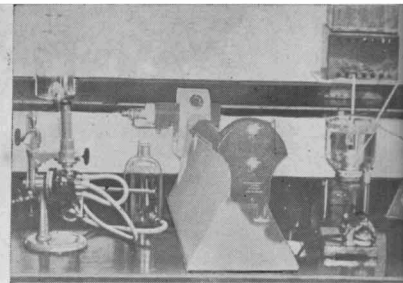
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Examination of the dynamics of colorant adsorption by active carbons of different porous structure and granulometric composition. A. N. KISELEV and V. N. GOLUBEV. *Sakhar. Prom.*, 1969, 43, (11), 12-18. Tests with a synthetic syrup of 3-5°St colour content, using Soviet granular carbons as well as Pittsburgh "CAL" granular carbon, showed that for maximum utilization of the adsorbent surface the optimum flow rate of the syrup was 2.6 cm/min (compared with velocities in the range 2-5 cm/min used in Soviet refineries). The difficulties encountered with adsorbents of small cross-section area and having a large adsorbent bed are discussed; these include channelling, occurrence of a wall effect, drop in decolorizing efficiency and reduced utilization. A fixed-bed scheme is described which consists of five columns (three of which are in use per cycle) and in which the treated syrup is filtered through kieselguhr before going to process. The costs of the system are discussed.

* * *

Decolorization of liquors with active chlorine, liming and carbonation. Comparison with conventional decolorizing methods. J. BUREŠ and M. FRIML. *Listy Cukr.*, 1969, 85, 274-284.—Beet sugar remelt liquor was used in tests to determine the decolorizing effect of adding chloride-of-lime together with lime and then gassing with CO₂. With 0.23% CaO plus 0.08% chloride-of-lime a decolorizing efficiency of 45% was achieved compared with 23-30% using only milk-of-lime (about 0.1% CaO). The effect of the chloride-of-lime was greater the lower was the lime dose. On the other hand, at a milk-of-lime dose greater than 0.30% CaO the chloride-of-lime effect on decolorization was negligible. To obtain removal of one-third of the colouring matter, which is normally the case when bone char or active carbon is used, only 0.06% chloride-of-lime and 0.12% CaO is required. The method is cheaper than the use of bone char or active carbon and is considered particularly suitable for liquors of high colour content.

Laboratory methods & Chemical reports



Central tare laboratory operation. C. L. SCHMALZ, R. B. PARK, N. E. CARVER and J. SILVER. *J. Amer. Soc. Sugar Beet Tech.*, 1969, **15**, 306-311.—Details are given of the equipment and operation of two semi-automatic central tare laboratories established by the Utah-Idaho Sugar Co. to process samples from four of the company's five sugar factory districts.

* * *

Separation of colouring substances in sugar production according to their adsorptive capacity. I. F. BUGAENKO, I. P. BULGAKOVA and I. I. PAVLOV. *Sakhar. Prom.*, 1969, **43**, (10), 6-9.—In a method described for quantitative determination of colouring matter fractions in raw sugar and molasses solutions and thick juice, the fractions are obtained by passing the product through a column of AV-16gs anion exchanger and successively eluting with water and solutions of NaCl, HCl and NaOH. The optical density is then read at 540 nm and compared with standard curves.

* * *

Effect of temperature on sugar solution pH. A. R. SAPRONOV and T. S. ZVEREVA. *Sakhar. Prom.*, 1969, **43**, (10), 33-35.—In view of the linear relationship between pH and temperature, it is recommended that for purposes of maintaining an optimum pH in processing (so as to reduce sucrose decomposition) it is advisable to use a formula which is given, in which the required pH at any given temperature is calculated in terms of the pH at 20°C.

* * *

Formation and composition of beet molasses. X. Alteration of the optical rotation of sucrose by halides of bivalent cations. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1969, **94**, 607-610.—Alkaline earth halides were found, with one exception, to have a reducing effect on the optical rotation of sucrose, so that WIKLUND's equation¹ is valid. The exception was CaCl₂ when in considerable excess of sucrose, in which case it increased the sucrose optical rotation. Although an empirical formula has been derived to describe the reaction, no explanation for the behaviour has yet been found.

* * *

Trace elements in white and refined sugar. A. A. GERASIMENKO, E. A. GRIVTSEVA and L. A. ORLOVA. *Izv. Vuzov, Pishch. Tekhnol.*, 1969, (5), 39-41.—Quantitative and qualitative analyses of white sugar from various regions of the Ukraine in 1963/64 and 1964/65 revealed up to 19 trace elements, of which iron was quantitatively the most common and silver the least.

Refined sugar contained the same trace elements as did the white sugar, but in smaller quantities; some in the 1963/64 campaign also contained an extremely small quantity of beryllium. The data are tabulated.

* * *

Sugar quality requirements in the present and future. W. JÄSCHKE. *Die Lebensmittelind.*, 1969, **16**, 414-418. The author wonders whether the present East German standard of sugar quality will meet the requirements imposed by the official policy directed at regulating the economics of high-class production (in all fields). The sugar quality requirements are compared with standards in other countries, particularly the Braunschweig and EEC points systems. The future prospects with regard to sugar standards are also briefly considered.

* * *

Infra-red and ultra-violet absorption spectra for invert sugar alkaline decomposition products and melanoidins. A. R. SAPRONOV and K. N. DUNAEVA. *Sakhar. Prom.*, 1969, **43**, (11), 8-11.—The spectra, obtained at pH 7.0-7.5 and covering a frequency range of approximately 700-3700 cm/sec in the infra-red region and a wavelength range of about 200-400 nm in the ultra-violet region, are discussed and conclusions drawn from them are presented.

* * *

Dependence of the pH of beet sugar products on temperature. V. A. MAKSYUTOV and V. A. KOLESNIKOV. *Sakhar. Prom.*, 1969, **43**, (11), 23-26.—The pH-temperature relationship has been studied for beet sugar factory products, including juices and boiling house intermediate products, with the aim of permitting optimum values to be found for a given process so as to avoid losses in subsequent processes when the product is heated, e.g. sulphitation followed by evaporation.

* * *

Examination of the temperature coefficients of pH and pOH for beet sugar products. V. A. PRONINA and S. Z. IVANOV. *Sakhar. Prom.*, 1969, **43**, (11), 27-30. Since it has been found that the pH and pOH of products at a given temperature will cover a fairly wide range of values, the range being greater at 20°C than at higher temperatures such as are used in factory processing, it is considered more practical to control the pH and pOH on the basis of the values at the process temperature. The question of pH and pOH

¹ *I.S.J.*, 1946, **48**, 304.

change with temperature is discussed with the aid of graphs and tabulated data (see also preceding abstract).

* * *

Apparatus for the determination of filtration curves of sugar solutions. O. ARGUDÍN and J. CABA. *Bol. Ofic. A.T.A.C.*, 1969, **24**, 133-137.—A device is described for automatic measurement of filtration curves of sugar juices which may be used for comparative evaluation of filter aids, active carbon, raw sugars, filter cloths, etc. It consists of an instrument for recording the time taken for the volume of filtrate collected in a receiving vessel to reach five preset levels, the sensing device being in the form of platinum electrodes located at these levels, and the times being recorded by clocks driven by synchronous motors which are stopped when the filtrate, which is a good conductor, completes the circuit with the appropriate electrode.

* * *

Sucrose decomposition by the action of lime. F. SCHNEIDER, A. EMMERICH, D. HADJANTONIOU and O. OZBEK. *Zucker*, 1969, **22**, 683-691.—Detailed experiments have shown that losses attributed in the literature to the effect of lime in the treatment of juice from beet of normal quality are in fact due to experimental error in the ANDRLÍK & STANĚK method used by various authors. The technique involves clarification of the raw juice with lead acetate, followed by 15 minutes heating at 90°C after addition of NaOH; but it has been found that the concentration of hydroxyl ions after addition of 0.73 g NaOH per 100 ml is 183 meq/litre compared with 30-40 meq/litre in normal liming, resulting in an apparent pol loss. Tests in which the hydroxyl ion concentration was reduced to the level found in liming showed no loss. While sucrose decomposition in milk-of-lime prepared with sweet-water or thin juice was found to be negligible, it is pointed out that considerable losses could occur if the same milk-of-lime were held for a prolonged period (e.g. 24 hr at 80°C).

* * *

Effect of reaction medium on carbon dioxide hydration. J. VAŠÁTKO, G. KOVÁČOVÁ and A. DANDÁR. *Zucker*, 1969, **22**, 692-700.—Studies at 20°C in pure solutions of various sugars showed that the effects of the media on CO₂ hydration and solubility and on pH differed according to the sugar concentration, the hydration rate reaching a minimum at a given concentration. At all concentrations, KCl, albumin and beet proteins reduced the rate, while beet and apple pectin increased it. While addition of sucrose (15 g/100 ml solution) to any of the solutions increased the rate of hydration, when accompanied by albumin and pectin the effect of the sucrose was modified, the albumin and pectin causing a lower and a higher increase, respectively. When all three were present, the inhibiting effect of the albumin was nullified by the accelerating effects of the sucrose and the pectin. The hydration rate rose or fell if the CO₂ solubility was raised or decreased, respectively, by adding any of the test media.

pH change was inversely proportional to the change in CO₂ hydration.

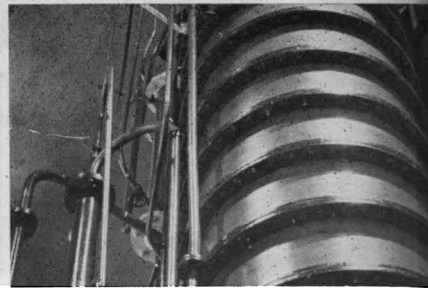
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The formation of kestoses and other saccharides during sucrose acid hydrolysis. H. BOURZUTSCHKY and W. MAUCH. *Zeitsch. Zuckerind.*, 1969, **94**, 545-550, 611-620, 661-664.—The chemical structure and physical properties of 1-, 6- and neo-kestose are described and their discovery in various natural products discussed. More particular attention is paid to the enzymatic production of kestoses and to the hypothesis that only three exist. This supposition is restricted to the system sucrose + β -D-fructofuranosidase, since there are bacteria which also combine fructosyl residues with secondary hydroxyl groups. Tests are reported in which kestoses were found chromatographically in sucrose solution inoculated with three strains of *Bacillus subtilis*. The formation of kestoses by sucrose pyrolysis is discussed, and from analogy between pyrolysis and acid hydrolysis, the suggestion put forward that kestoses could also be formed by the latter mechanism. Conformation formulae are given for β -D-glucopyranose in an approach to the analysis of the saccharide molecule from the energy viewpoint. The mechanism of cleavage by acid hydrolysis and the formation of condensation and hydrolysis intermediates are considered. During hydrolysis a secondary reaction takes place in which a hydroxyl group in the sucrose molecule participates instead of the hydroxyl group in the solvent. A sucrose radical is formed and further cleavage produces kestoses which are also subjected to cleavage at the end of the reaction. The intermediates are cleavable by the enzyme β -D-fructofuranosidase. Details are given of an experiment in which the kestoses were isolated and 6-kestose identified. The various paper, column and thin-layer chromatographic techniques used in the experiments are described, and details given of an enzymatic method for determining glucose and fructose in di- and oligosaccharides. The article includes 287 references to the literature.

* * *

Colour of sugars. Attempt at absolute measurement. P. DEVILLERS, A. LEMAITRE, J. P. LESCURE and J. ROGER. *Sucr. Franç.*, 1969, **110**, 469-473, 517-523; 1970, **111**, 35-43.—The subjective nature of sugar colour measurement by visual comparison with standard is discussed and preference for an objective absolute measurement technique explained. The meaning of colour, as observed visually, is indicated in terms of sensitivity to different wavelengths and definitions given of various terms used. Representation of colour by the Maxwell colour triangle is briefly discussed and different trichromatic colour measurement systems described. The Brunswick Institute and C.I.E. methods (the former a comparison method using standards and the latter in the form of a "Trilac" integrating sphere spectrophotometer) are described in more detail and compared using a range of sugars.

By-products



Cane and/or high-test molasses for sake production in Japan. H. OLBRICH. *Zeitsch. Zuckerind.*, 1969, **94**, 512-513.—Mention is made of the fact that more and more molasses is being used to replace some or all of the rice used in the production of sake (the Japanese national drink). The sources of the molasses and the quantities being used for sake production are discussed.

* * *

High grade dissolving pulp from bagasse by the kraft process. M. A. ISLAM. *Sci. Ind.* (Karachi), 1967, **5**, 442-446; through *S.I.A.*, 1969, **31**, Abs. 69-623. Pulp was prepared from bagasse on a laboratory scale; the processes used are described. They consisted of depithing the bagasse, digestion with a mixture of NaOH and Na₂S, multi-stage bleaching of the pulp with Cl₂ and ClO₂, and cold alkali extraction. The yield was 36% on bagasse; the pulp contained 95.4% of α -cellulose and 4.7% of pentosans, and had a very high brightness and colour stability.

* * *

Intensive beef production from sugar cane. VII. The performance of bulls given high levels of molasses/urea at different dilutions. T. R. PRESTON, A. ELIAS and M. B. WILLIS. *Rev. Cubana Cienc. Agric.*, 1968, **2**, 263-268.—Brahman bulls fed on a molasses/urea diet of varying dilution plus napier grass and a protein concentrate showed a daily gain in live weight with increase in the molasses concentration, a reduction in the metabolizable energy required per unit weight gain, and a greater deposition of excess fat on the carcass. Some effects on rumen fermentation were also noted. A molasses concentration of 15-35°Bx is recommended for the first 6 weeks and 75°Bx thereafter.

* * *

High-grade paper from bagasse. ANON. *Sugar y Azúcar Yearbook*, 1968, **36**, 90-91.—The process used at Motril, Spain, in the production of bagasse paper of various grades are described. The bagasse is dried by stacking small bales in open-air stacks. Bleached and unbleached pulps are produced in two separate pulping lines, each of which has an annual capacity of 50,000 tons. The physical properties of two of the products (corrugated paper and Kraft liner) are tabulated and compare well with those of papers from wood pulp.

* * *

Bagasse tissue plant scores production success. ANON. *Sugar y Azúcar Yearbook*, 1968, **36**, 76, 78.—Details are given of a machine for producing tissue paper

from bagasse at San Cristóbal sugar factory, Mexico, which is claimed to be the fastest of its type in the world, producing 45 tons of various grades of tissue paper per day at a rate exceeding 2,200 ft/min. Equipment for pulp preparation and mixing, pressing, drying and winding is also described.

* * *

Dry process bagasse treatment developed by Tablopán board plant. ANON. *Sugar y Azúcar Yearbook*, 1968, **36**, 86-87.—Details are given of the processes used at the bagasse board plant of Tablopán de Venezuela S.A. at San Mateo, Aragua, Venezuela¹. Phenolic resin and wax are added to the bagasse after depithing, milling and drying. From an intake of 130,000 tons of raw bagasse, 33,000 tons of usable dry fibre are obtained, unsuitable material being mixed with molasses for use as cattle fodder. High- and medium-density construction board is produced.

* * *

Fusel oil: phenomena determining its production. E. DAVID P. *CubaAzúcar*, 1968, (March/April), 10-18, 41-47.—Of recent years fusel oil has become of increasing economic importance as a source of amyl alcohol and its derivatives, but little work has been done to determine the factors governing the proportion of fusel oil in the products of fermentation. These have been investigated and it is concluded that the most important factor is the amount of nitrogen which is easily assimilable by yeast; in the absence of sufficient nitrogen as urea or ammonium sulphate or phosphate, the yeast obtains nitrogen for its development by metabolism of albumen and the fusel oil is a product of this metabolism. Consequently the rate of application of nitrogen fertilizer may affect the molasses nitrogen content and hence the fusel oil produced from it.

* * *

Sugar cane as an energy source for the production of meat. T. R. PRESTON and M. B. WILLIS. *Outlook on Agric.*, 1969, **6**, (1), 29-35.—Results are given of extensive experiments in Cuba on feeding molasses to cattle. Experiments with pigs and poultry are also reported. The object of the article is to draw attention to the potential animal productivity of the tropics, believed to be superior to that of temperate regions. It is considered that whatever solutions may eventually be found for present production and distribution problems with protein, meat will be the preferred form for the foreseeable future.

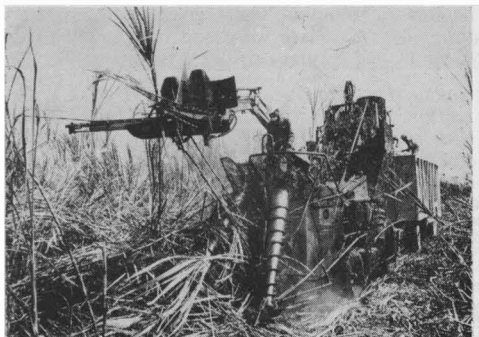
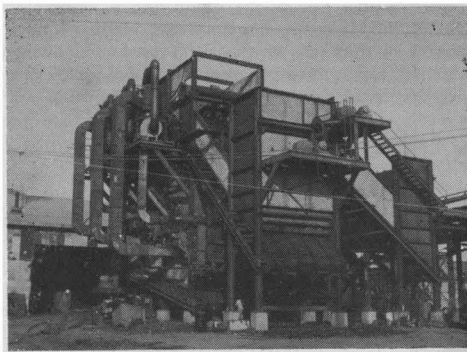
¹ *J.S.J.*, 1966, **68**, 61.

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.

"MF 201 Cane Commander". Massey-Ferguson (Export) Ltd., Coventry, England.

The illustration shows a Massey Ferguson "201 Cane Commander" at the Frome estate of the West Indies Sugar Co. in Jamaica opening a new block of fallen and lodged cane. It is pulling its own 10-ton trailer behind and is completing the second of two break rows before reverting to side delivery operation. This Australian-built self-propelled chopper harvester



can open its own break rows and cut on any face in any direction. It has hydrostatic transmission and a 6-stage cleaning system including two extractor fans and has already harvested almost 1 million tons of cane in its first season in Australia and 4 other countries. Designed to cut, chop and load cane continuously into transport vehicles, the harvester has achieved excellent results in Jamaica and Mexico, handling rows containing up to 80% tangled cane.

* * *

Cane dry-cleaner. Agro Industrial Associates Inc., P.O. Box 3230, 745 Fort St., Honolulu, Hawaii, 96801 USA.

The dry-cleaner shown in the illustration is the first of the type to be commercially produced and is in operation at Central Aguirre in Puerto Rico. It has a capacity of 5000 tons of cane per day and is said to

show no measurable cane loss in the dry-cleaning process. Although its designer agrees that wet-cleaners are preferable where the cane is heavily coated with mud and there is ample water available for disposal of the effluent from the cleaner, he considers that a dry-cleaner is the better solution where water supply is insufficient or effluent disposal is costly. A dry-cleaner is usually not as expensive as a wet-cleaner. Agro Industrial Associates have already proposed two more cleaners.

* * *

Starch removal with "Nervanase". A.B.M. Industrial Products Ltd., Woodley, Stockport, Cheshire, England.

"Nervanase" bacterial alpha-amylase is an enzyme produced by *Bacillus subtilis* which has been successfully applied in experimental and full-scale tests to the removal of starch from cane factory or refinery products by hydrolysis. The enzyme can be added to juice after crushing, clarification, in the 3rd or 4th evaporator effect or in the melter, the exact point depending on the processing system used and conditions obtaining in the factory. The optimum quantity lies in the range 50-100 g/ton of sugar, while optimum pH and temperature are 6.5 and 75-85°C, respectively. According to the amount of enzyme used, 5-60 min is sufficient time for complete conversion of the starch. "Nervanase" is available as "Nervanase MT", containing calcium and sodium salts plus <2 p.p.m. lead and <1 p.p.m. arsenic, and "Nervanase 50X", containing the same quantities of lead and arsenic but also varying quantities of sodium chloride and sodium sulphate.

Remote temperature measuring instrument. Anacon Inc., 62 Union St., Ashland, Mass., 01721 USA.

The new Anacon "Endotherm" telemetered temperature indicator, which allows measurement of temperature in the centre of a vessel or a moving container, consists of three components: a transmitter passing through the process with the product or container; a coupling loop which receives a signal from the transmitter; and a receiver. The transmitter incorporates a thermistor inserted in the container or allowed to float free in the liquid and is completely self-contained in a capsule measuring 4 inches long \times 3 inches in diameter, so that it is protected against ambient temperature and pressure (up to 2.5 atm). Power is provided by rechargeable battery cells.

* * *

The "Fluicon" water purification system. Effluent Control International Ltd., 1075 Warwick Rd., Acocks Green, Birmingham 27, England.

In this new continuous ion exchange system for water purification, the raw water enters at the bottom of the exchange column and passes upwards against a gentle counter-current of ion exchange resin beads. The treated water is discharged at the top of the column while the resin arriving at the bottom is fed to the top of a second column for regeneration, where it moves down at a gentle rate, initially against an upward flowing stream of regenerant and then against a stream of wash water, finally passing out from the bottom of the column to return to the top of the exchange column. Only one control valve is used and the number of mechanically moving parts is minimal. The system is fully automatic and only requires about 15 minutes of operator time per day. Maintenance, chemicals consumption, water wastage and floor space required are all lower than with conventional ion exchange systems used for water treatment. Standard units for water softening and for simultaneous alkalinity removal if required are available for flow rates in the range 2000–20,000 gal/hr, although larger units can be supplied. A full deionization system is expected to be available later in 1970.

* * *

Conveyor chains. Rex Chainbelt Inc., P.O. Box 2022, Milwaukee, Wisconsin, 53201 USA.

A new chain in the D880 series of acetal "FlexTop" conveyor chains manufactured by Rex Chainbelt Inc. is announced. It has a top plate width of 4½ in and can side-flex around a corner of 24 inches minimum radius, thus obviating the need for turntables, dead plates or other transfer devices. Sprocket guide rings are not required, and tapered sides prevent the chain from lifting out of the corners when applied with matching curved wear strips.

* * *

Industrial thermostat. Actuated Controls Ltd., Vale Lane, Hartcliffe Way, Bristol BS3 5RU, England.

The models TC and TC/A non-indicating thermostats recently introduced by Actuated Controls Ltd.

are produced in 9 standard temperature ranges covering -80°C to $+350^{\circ}\text{C}$. The model TC is of the close-differential type, while the TC/A is of the high/low temperature differential type, being effectively two thermostats in one instrument incorporating two micro-switches. It can be pre-set to operate at any two pre-determined points over practically the entire temperature range. The temperature responsive system is of the vapour pressure type and consists of a precision capsule connected to the sensing probe with a length of capillary tubing. A pressure setting dial calibrated to within 2% of the full scale is provided. Judicious use of stainless steel for certain close-tolerance components permits an average repetition accuracy of $\pm 0.5\%$ to be achieved. The thermostats can operate in an ambient temperature of up to 60°C with a variation in operational accuracy over the ambient temperature range of -20°C to $+60^{\circ}\text{C}$ of less than 1%.

* * *

"Spinflo" flowmeter. G. A. Platon Ltd., Wella Rd., Basingstoke, Hants., England.

The "Spinflo" flowmeter is basically a rotor made of PTFE (polytetrafluoroethylene), mounted in a sealed tube and having a speed which varies in accordance with the amount of fluid passing through. The sine wave output signal given by the meter is converted to a square wave and transmitted to the indicator. An accuracy of $\pm 1\%$ is obtainable.

* * *

PUBLICATIONS RECEIVED

STAINLESS STEEL FABRICATORS. Stainless Steel Fabricators' Association of Great Britain, Chamber of Commerce House, P.O. Box 360, 75 Harborne Rd., Edgbaston, Birmingham 15, England.

The latest edition of the list of members of the Association and classified list of their products is available; among the members are a number of manufacturers of equipment applicable in the sugar industry, some of whom are listed in the Buyers' Guide of the ISJ.

* * *

BMA sugar factory in Chile.—Rapaco beet sugar factory (about 900 km south of Santiago, Chile) started operations in May of this year. The fifth sugar factory to be erected by BMA in Chile, it is owned by Industria Azucarera Nacional S.A. Designed to process 1000 tons of beet per day, it has already been operating at a throughput of 1250 tons/day for several weeks and is expected to process about 130,000 tons of beet in its first campaign. Among the equipment installed is a counter-current cossette mixer, in which the cossettes are heated by raw juice drawn from the tower diffuser at 25°C and heated by pan vapour in pre-heaters connected in series. The high-raw sugar is dissolved in thick juice instead of thin juice or condensate, as is generally used. The resultant standard liquor is filtered at 68°Bx on candle filters. These measures permit a low steam consumption.

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Corrigendum: On p. 221 of our July issue it is stated in the Trade Notice concerning the SWS-Dinteloord continuous crystallization system that "Small conglomerates sometimes formed." This is incorrect, and the word "conglomerates" should read "lumps of crystals".

ISJ Panel of Referees

This Journal is happy to announce that Dr. W. R. CRAWFORD, B.Sc., M.Sc., Ph.D., D.Sc., a Whitworth Senior Scholar, has kindly agreed to join our Panel of Referees and to examine submitted manuscripts on our behalf, in order to judge their suitability for publication in the *I.S.J.*



Dr. CRAWFORD served an engineering apprenticeship with Harland & Wolff Ltd., of Belfast, Northern Ireland, and studied mechanical engineering as an undergraduate at Queen's University. He spent some years before and during the last world war with the Department of Scientific & Industrial Research but during the latter part of the war returned to industry as Technical Assistant to the Managing Director of Markham & Co. Ltd., of Chesterfield.

In 1950 Dr. CRAWFORD joined the foundation staff of the newly-formed Sugar Research Institute in Mackay, Queensland, as Chief Engineer and was appointed Deputy Director in 1954. He joined the staff of Walkers Ltd., of Maryborough, Queensland, early in 1963, where he is currently Research and Development Engineer. Here he is chiefly concerned with the Company's sugar machinery activities and in acting as a consultant for factories when and where required.

During his years with the Sugar Research Institute, Dr. CRAWFORD was responsible for all engineering aspects of research on cane milling and the processing of juice into raw sugar. In 1954 he spent some three months studying milling practices in Jamaica, Puerto Rico and Cuba; this led to the design and construction of an experimental three-roll mill, of pilot-plant dimensions, which was put into operation at Pleystowe factory in the Mackay district at the start of the 1956 season.

The results of research on numerous aspects of milling with this experimental plant have had considerable influence on milling practices in Australia and elsewhere. Dr. CRAWFORD has also examined milling practices in Hawaii, Florida, Trinidad, India, Mauritius, South Africa and Taiwan. He has contributed 17 papers to the Queensland Society of Sugar Cane Technologists and three to the I.S.S.C.T., as well as a number of papers published in this Journal. His paper "Cane extraction by Milling—The Modern Approach" received the C. W. Murray Award for 1970 and is to be published shortly in this Journal.

Our thanks are due to Dr. CRAWFORD, as to all our Panel of Referees, whose scrutiny of manuscripts ensures the maintenance of the highest standards for original articles published in the *International Sugar Journal*, to the benefit of the sugar industry and its technologists.

Brevities

Cuban cane harvesting mechanization¹.—A Cuban engineer, ROBERTO HENDERSON, is responsible for the design of a harvester for cane and for the cane conditioning equipment which combine to provide an "integral mechanization system for sugar cane cutting". The harvester is mounted on the front of a bulldozer and is of simple design, with two rotating discs which revolve in opposite directions and cut the cane into lengths of about 30 cm; these are transferred by an intermediate conveyor to a main conveyor and so to the cane carts. The cane conditioner receives the cane, cleans it and delivers it to the mill free of trash².

* * *

Ghana sugar imports, 1969³.—Imports of sugar into Ghana in 1969 totalled 66,844 long tons, *tel quel*, compared with 86,364 tons in 1968. Supplies included 2487 tons from Finland (*nil* in 1968), 21,085 tons from France (13,604 tons in 1968), 32 tons from East Germany (2409), 6022 tons from Hungary (3136), 3285 tons from Poland (3520), 23,273 tons from the USSR (49,812), 4133 tons from the UK (11,470), 5300 tons from Yugoslavia (1661) and 1227 tons from other countries (752).

Chile beet sugar crop, 1969/70⁴.—During the 1969/70 campaign the Chile sugar industry produced 175,658 metric tons of sugar from 1,237,566 tons of beets. In addition, 38,706 tons of molasses, 22,524 tons of dried pulp, 30,177 tons of dried molassed pulp and 40,304 hectolitres of pure alcohol were produced. The beet was grown by 7030 farmers on a cultivated area of 27,329 hectares, and the crop yield was 45.3 tons of beet per hectare.

* * *

Czechoslovakia beet campaign results, 1969/70⁵.—The Czechoslovakian Statistical Office has now published final figures from the 1969/70 beet campaign. According to this report, 180,000 hectares were cultivated and the beet crop amounted to 6,160,000 metric tons, the yield being 33.7 tons per hectare.

¹ *Cuba Economic News*, 1969, 5, (43), 2.

² BETANCOURT: *I.S.J.*, 1970, 72, 114.

³ C. Czarnikow Ltd., *Sugar Review*, 1970, (975), 109.

⁴ *IANSAs*, April 1970; through *B.I.E.S. Extracts*, 1970, (77).

⁵ F. O. Licht, *International Sugar Rpt.*, 1970, 102, (16), 5.

Brevities

Sugar and tooth decay.—Research on dental caries is conducted on a broad scale by the National Institute of Dental Research of the US Public Health Service. In 1969 the Institute set up a Dental Caries Task Force to work "toward the goal of virtually eliminating tooth decay in the United States", a project which would be of benefit to the rest of the world. The Chairman of the Task Force, Dr. H. W. SCHERP, believes this goal can be reached within this decade if the public co-operates. The International Sugar Research Foundation Inc. has provided information on the Task Force and its work. In the light of what is known, three probable means would be employed to eliminate caries: the use of plastic tooth paint, use of chemicals to eliminate certain bacteria from the mouth, and improved use of fluorides. The tooth paint acts by sealing the pits and fissures in the grinding surfaces of teeth which are the sites of most decay even in fluoride-treated teeth. It is a liquid plastic applied with a fine brush after cleaning and a brief conditioning with dilute phosphoric acid; the paint is then hardened by brief exposure to u.v. light. In one recent test, of 200 painted teeth none had cavities while only one had partially lost the coating. There were cavities in 42% of the untreated teeth on the other side of the same mouths as the treated teeth. The second line of attack is based on the identification of *Streptococcus mutans* as the organism mainly responsible for tooth decay; it thrives in a medium rich in sugar such as provided by saliva in the mouths of a high sugar-consuming community. Selection of an anti-bacterial agent which would selectively eliminate this and which could then be incorporated in a toothpaste or mouthwash could reduce caries significantly, and a screening programme is under way. The presence of fluoride in water supplies has been known for some time to reduce tooth decay and striking reductions in caries incidence have been reported where municipal authorities have supplemented low natural fluoride contents. Anti-fluoridation lobbies have been successful in some parts of the US and UK in preventing such supplementation but it has been hinted in the UK Parliament¹ that it might be necessary to introduce legislation to permit fluoridation in such areas of the UK. While it is apparent that a combination of high sucrose diets and lack of dental hygiene can lead to tooth decay, it is encouraging that the research reported gives hope of eliminating this valid criticism of sugar in the diet.

US mainland cane area, 1971².—The US Secretary of Agriculture has announced a 15% increase in the maximum mainland cane area for 1971. The new limits are 205,988 acres for Florida and 330,061 acres for Louisiana compared with the previous limits of 179,120 and 287,010 acres, respectively. With the steadily rising pattern of the Supply Quota each year it is not surprising that the domestic producing areas should be allowed to grow in order to cope with this extra demand.

Indian quota under the International Sugar Agreement³. India is planning to seek an increase in its sugar export quota under the International Sugar Agreement, a Government spokesman said in New Delhi on 3rd August. However, no decision has yet been reached as to what quantity will be asked for; India's present quota is 230,000 metric tons but 75,000 tons are also sold to the UK under the Commonwealth Sugar Agreement and 25,000 tons to the US.

Bagasse-cement building material⁴.—A new light-weight construction material has been developed by the Experimental Research Plant of the Cuban Ministry of Public Works. Based on bagasse and cement, the material is non-inflammable and highly resistant to weather and biochemical action. It can be used for both interior and exterior surfaces and it can be made into hollow sections, so reducing the weight even further.

Japan sugar imports⁵

	1969	1968	1967
	(metric tons, <i>tei quel</i>)		
Australia	577,925	501,422	597,219
Brazil	37,714	—	12,915
Colombia	59,419	50,479	22,554
Cuba	829,132	564,995	506,070
Fiji	24,118	11,468	41,436
Mexico	—	28,326	—
Réunion	—	10,456	12,416
Ryukyu Is.	223,996	231,652	204,534
Salvador	10,038	—	—
South Africa	346,544	486,987	339,814
Taiwan	118,780	167,340	79,113
Other countries	—	198	88
	<u>2,227,666</u>	<u>2,053,323</u>	<u>1,816,159</u>

ICUMSA 15th Session.—The list of recommendations adopted for Subject 29, "Starch hydrolysis products", as reported on page 263 of this issue, is unfortunately incomplete. The full list of recommendations will, however, appear in the *Proceedings* of the 15th Session which is to be published in the near future.

Tate & Lyle Research Centre move.—It has been announced⁶ that the Tate & Lyle Research Centre, established for many years at Keston, in Kent, is to move to Reading University, Berkshire, probably some time in 1972. The new site will provide the opportunity of improving research facilities and certain equipment, a library, etc., will be shared with the University. Planning restrictions have prevented the extension and modernization necessary to improve the present building, Ravensbourne, to the standard required. Nevertheless, the Keston name will continue to be remembered in respect of the kestoses, first identified there by the Tate & Lyle research team under H. C. S. DE WHALLEY.

New Indian sugar factories⁷.—Two cooperative sugar factories with a crushing capacity of 1250 t.c.d. each are likely to be set up in the Cuddapah and Krishna districts of Andhra Pradesh.

Uganda sugar production and exports, 1969⁸.—Total sugar production in 1969 by the three Uganda sugar factories was 137,652 tons, while exports amounted to 52,000 tons of which shipments to Canada were 23,590 tons. It was the first time that Uganda sugar had been shipped in bulk. Other destinations for export sugar included Rwanda, Burundi, the Congo and Kenya.

Cane variety selection in Pakistan⁹.—A new sugar cane research station is being established at Thatta to conduct variety experiments for selection of those varieties suitable for general cultivation in the area. The Government has sanctioned the erection of a sugar mill in this area and some preliminary steps have already been taken towards its establishment.

Hungary sugar exports, 1969¹⁰.—A total of 51,081 metric tons of sugar, raw value, was exported by Hungary in 1969, compared with 18,057 tons in 1968 and 45,631 tons in 1967. The principal outlet was Iran with 12,595 tons but other important markets included Italy (6831 tons), Switzerland (6704 tons), West Germany (5618 tons), the UK (5485 tons), Finland (4780 tons) and Ghana (4085 tons).

¹ *The Times*, 10th March, 1970.

² C. Czarnikow Ltd., *Sugar Review*, 1970, (980), 128.

³ *Public Ledger*, 8th August 1970.

⁴ *Cuba Economic News*, 1969, 5, (43), 5.

⁵ C. Czarnikow Ltd., *Sugar Review*, 1970, (963), 60.

⁶ *Tate & Lyle News*, August 1970.

⁷ *Sugar News (India)*, 1970, 1, (11), 6.

⁸ *Barclays Overseas Survey*, 1970, 77.

⁹ *Sugar y Azúcar*, 1970, 65, (5), 42.

¹⁰ F. O. Licht, *International Sugar Rpt.*, 1970, 102, (12), iv.



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DETERMINATION
OF
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CANE SHREDDING FOR HIGHER EXTRACTION
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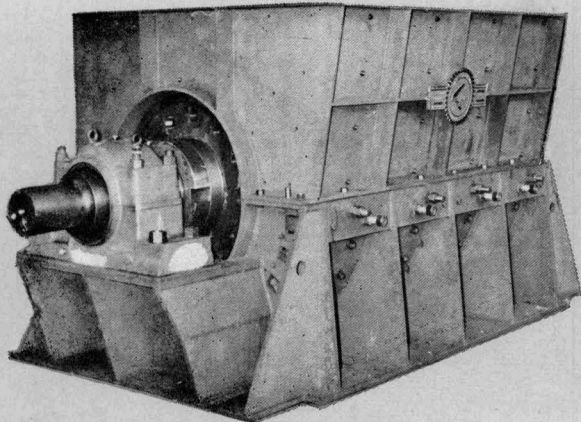
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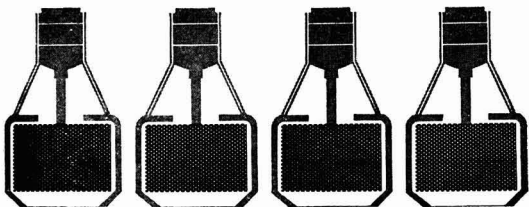
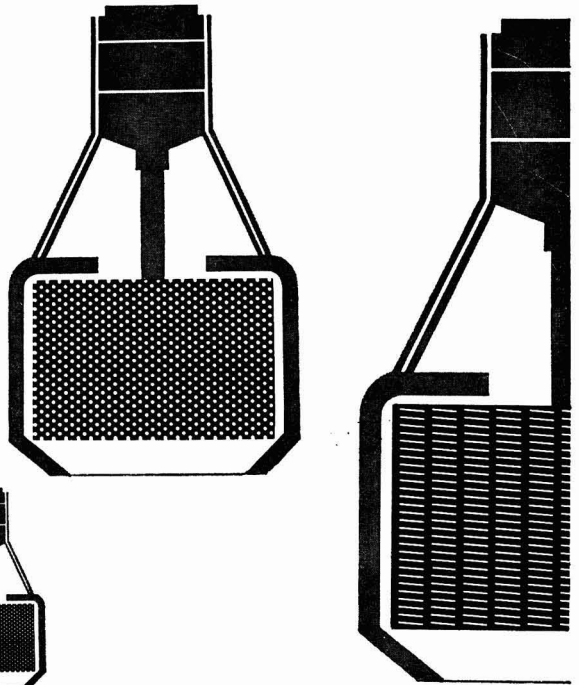
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The moisture balance type D illustrated is essentially the same as the type CB excepting that it can take samples from 100 to 1000 gm depending on the density of the product. In the case of bagasse the weight of sample possible is 100 gm contained in a dish 250 mm long \times 200 mm wide \times 22 mm deep.

The scale range is graduated 0/100%, moisture and the maximum temperature of determination is 200 C controllable by a resistance knob.

The accuracy of the scale for 100 gm is $\pm 0.5\%$ or 0.05% on 1000 gm samples of material. The power required for operation is 1 kW. A timer 0/60 minutes is fitted as standard.

Additional extras which can be fitted if required are:

1. Pyrometer.
2. Voltage stabiliser.

Please state single phase voltage and frequency when ordering.

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Work carried out in South Africa using this type of dryer gave excellent results in drying bagasse. Experiments revealed that 100 g of bagasse could be dried in 20 minutes at a temperature of 266°F, which agreed very closely with laboratory oven determinations at 225 F for 20 hours. Such rapidity of determination is a great benefit to the engineer.

The equipment consists essentially of a fan which draws in air, passes it over heating elements and then through the bagasse. A time switch and thermostat are provided so that any temperature between 90° and 150 C can be maintained with a time of operation between 0 and 60 minutes.

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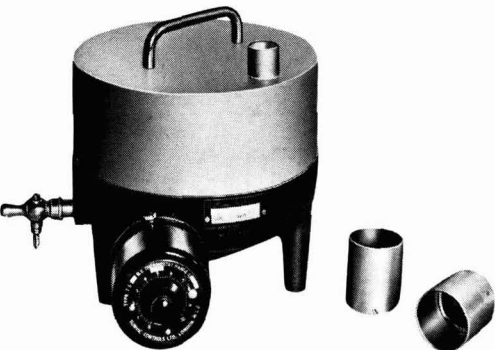


LABORATORY SUGAR DRYER

For the rapid estimation of moisture in sugars, a comparatively large volume of heated air should be passed over and through the sample. Care should be taken in these estimations, however, as it is essential to know the conditions of temperature and time of drying during which period no decomposition takes place. Once these conditions have been established for a particular type of sugar estimations become routine thereafter and results can be obtained in about 10 to 15 min.

This oven is fitted with a thermostat type TS 2, which gives temperature control of ± 0.25 C over a range of ± 60 from a central adjusted temperature.

Four sample containers are provided to fit into recesses in the body of the oven, and two additional containers are provided as spares.



This type of oven must be used in conjunction with a vacuum pump or the factory vacuum line, if available, for drawing the air over the heating element, through the sample and into the vacuum line or pump trap. A time device can also be supplied as an extra with a re-set push-button so that, simply by pushing the button for making contact, a whole series of rapid determinations can be made under the predetermined conditions of time, temperature and air volume, the whole process being automatic once the cycle is set in operation.

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