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THE
INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

U.K. sugar surcharge reductions.

The Sugar Board surcharge of 4½d per lb (42s 0d per cwt) was reduced to 4¼d per lb (39s 8d) per cwt from the 26th February. Although this decrease occurred at the end of a week during which there had been a fall of £1 5s per ton in the world market price of sugar, the surcharge had been set at a time when the price was even lower, so that the intervening period of rather higher values had resulted in a higher return to the Sugar Board which the reduction in surcharge was intended to offset. Subsequent higher values led to a second reduction from the 19th March, to 4d per lb (37s 4d per cwt).

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U.K. import licensing of sugar.

The Board of Trade recently announced a change in the current licensing arrangements for imports of refined sugar from all sources (i.e. for sugar polarizing at more than 98 degrees). A global import quota is to be re-introduced from the 15th March for refined sugar imported for consumption without further refining. This is being done to safeguard the orderly marketing of Commonwealth and domestic raw sugar supplies from excessive imports of refined sugar.

The quota will be for 65,000 tons for the period 15th March to 15th September, i.e. at an annual rate of 130,000 tons. Governments of the supplying countries mainly affected have been consulted.

The limit on imports was originally set in May 1962 when white sugar from a number of European countries was available at prices lower than those prevailing for raw sugar. Appreciable quantities were entering the U.K. which was committed to buying raw sugar under the Commonwealth Sugar Agreement, as well as to using the sugar produced by the British Sugar Corporation. At that time the quota set for May-December 1962 was 135,000 tons, corresponding to an annual quota of 200,000 tons.

A year later, however, the supply picture was very different and the world market price for sugar was over £100 per ton c.i.f. U.K. Sugar was in short supply so that there was no need for a measure designed to limit imports. Consequently the limit was dropped temporarily and has now been restored now that the conditions of shortage have disappeared and sugar is plentiful again. The new quota has been calculated on an annual rate of 130,000 tons which is the average amount imported in the past four years.

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Barbados sugar commission report[1].

A commission was appointed on 19th December 1962 "to inquire into all aspects of the sugar industry in Barbados with special references to its finances and general economies including the arrangements for the marketing of canes and of sugar and molasses and the provision of a guaranteed weekly wage for all agricultural workers in the sugar industry".

The members of the Commission were: Dr. R. FARLEY, Professor and Chairman, Department of Economics and Business Administration, and Director, Industrial Relations Centre, Inter-American University of Puerto Rico; Mr. M. B. IFILL, an economic and business research consultant; and Mr. J. C. BROWN, a chartered accountant with the Commonwealth Development Corporation.

The Government of Barbados released the report on 22nd December last year. The main conclusions, recommendations and suggestions included the following:

1. A fair minimum over-all return on investment in the Barbados sugar industry (estates and factories) is 11% per annum.

2. Absenteeism should be discouraged and owner-management encouraged, and credit facilities provided to enable paid managers to buy estates. Young Barbadians should also be encouraged to qualify as agricultural technicians at the University of the West Indies and then to enter farming as a career as owner-manager.

3. Smallholdings should be consolidated into 100-acre co-operative farms.

4. Barbados should not allow sugar production to expand beyond present limits during the current decade.

5. One or two "centrals" should be established within the next 10 years, each with a capacity of 40,000 tons of sugar per year.

6. Severe penalties should be imposed on those found guilty of wilful incendiarism.

[1] *Chron. W. India Comm.*, 1965, **80**, 74.

7. The Government should establish a permanent Sugar Industry Commission with wide powers to bring about the fundamental changes required in agriculture.

8. The Agricultural Credit Bank and the Sugar Industry Agricultural Bank should be amalgamated into one statutory body: the Agricultural Bank.

9. The educational system should create a conscientiousness about agriculture.

10. The setting up of a Labour-Management Training and Development Institution should be discussed by the Trade Union, employers and the Government with University authorities in the Area.

11. The Union should employ a full-time economist-accountant as soon as possible.

12. The Government and the industry should enter into discussion for the development of satisfactory housing accommodation and recreation facilities on the sugar estates.

13. There should be intensive week-end courses and in-service training programme for the Extension Service in the Ministry of Agriculture.

14. Administrative decentralization of the Agricultural Extension Service should continue and its operation be better co-ordinated. A co-ordinated Extension Committee representative of the Government, the Barbados Workers' Union, the Barbados Agricultural Society, the Barbados Chamber of Commerce and the Junior Chamber of Commerce should be established.

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Tate & Lyle take-over bid for United Molasses.

A £31,000,000 take-over bid by Tate & Lyle Ltd. for United Molasses Co. Ltd. was announced on the 11th March. Tate & Lyle are offering cash, shares and loan stock to the equivalent of 34s 3d for every United Molasses ordinary share, the stock exchange quotation of which had been 26s 3d. As quoted elsewhere in these pages, the quotation has jumped rapidly, reaching 32s 6d by the close of the 17th March. There is an exchange offer for the United Molasses preference shares, and the United Molasses directors are reported to regard the terms as fair and to be recommending shareholders to accept.

Should the offer be accepted, the take-over will mark a further extension of the Tate & Lyle group interests which now cover sugar machinery manufacture (A. & W. Smith & Co. Ltd.), raw sugar production (West Indies Sugar Co. Ltd., Caroni Ltd., Chirundu Sugar Estates Ltd. and Corozal Sugar Factory Ltd.), raw sugar ocean transport, refining in the U.K., Canada and Africa, refined sugar distribution, rum production and, maybe in the future, bagasse utilization. It is logical for the Group to branch out in molasses operations since both Tate & Lyle and United Molasses have experience and problems allied to each other's, for example in bulk transport, and have been linked for years in a molasses producer-buyer relationship.

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U.S. sugar quotas, 1965.

On the 15th February the U.S. Secretary of Agriculture revised the proration to individual countries of the 1965 sugar quota for foreign countries other than the Republic of the Philippines. The quotas are based on the sugar tonnages actually supplied to the U.S. during 1963 and 1964, double weight being given to the quantities supplied last year. Thus it was not possible to calculate exactly what each country's quota should be at the time the total quota was first set because the final figures for the 1964 deliveries were not available.

To allow for this a 10% reserve was held back from the quota for proration when these 1964 delivery figures were known and, now that they are known, the 10% has been allocated. With minor exceptions the revised prorations are generally somewhat more than 10% greater than the initial quantities. Separate prorations have been provided for South Africa and Swaziland in recognition of the fact that they are not pooling their sugar marketing arrangements in 1965 as they did in 1963 and 1964. In some cases where the 1964 quotas were not filled, the new prorations are less than 10%. Quotas for the U.S. beet and cane sugar industries, Hawaii, Puerto Rico, Virgin Islands and the Philippines are unchanged.

The initial and revised quotas are given below:

	Initial Quotas (*short tons*)	*Revised Quotas*
Domestic beet	2,650,000	2,650,000
Mainland cane	895,000	895,000
Hawaii	1,115,479	1,115,479
Puerto Rico	1,140,000	1,140,000
Virgin Islands	15,232	15,232
Total Domestic Areas	5,815,711	5,815,711
Philippines	1,050,000	1,050,000
Argentina	59,244	65,897
Australia	171,913	193,069
Belgium	1,744	1,867
Brazil	204,057	228,550
British Honduras	3,845	4,342
British West Indies	112,690	126,145
Colombia	27,038	29,015
Costa Rica	32,143	36,041
Dominican Republic	357,566	398,323
Ecuador	45,652	51,121
Fiji	41,954	47,059
France	5,315	5,882
French West Indies	39,706	44,352
Guatemala	36,828	36,276
Haiti	20,168	19,188
India	89,224	100,164
Ireland	7,983	2,311
Madagascar	6,723	7,586
Mauritius	13,866	15,430
Mexico	358,617	403,225
Nicaragua	37,395	41,947
Panama	13,298	14,986
Peru	222,691	248,625
Réunion	2,038	2,288
El Salvador	15,820	17,904
South Africa	98,047	100,108
Southern Rhodesia	8,403	9,197
Swaziland	—	9,300
Taiwan	63,026	69,819
Turkey	1,408	1,517
Venezuela	2,458	2,755
Held in Reserve	233,429	—
	9,200,000	9,200,000

CATION EXCHANGE CAPACITY OF SUGAR CANE ROOTS

By R. L. NARASIMHAM and T. G. PACHECO
(Sugarcane Research Station, Anakapalle, India.)

THE important rôle of cation exchange capacity of plant roots in the mineral nutrition of plants, with particular reference to cationic nutrients and certain anions such as phosphate, has been recognised only recently. Nutrient absorption through cation exchange between plant roots and the external medium is supposed to be "passive", in contrast to "active transport" of nutrients involving expense of metabolic energy[1,2]. It is well known[3] that legumes have a higher root cation exchange capacity (e.g. soybean, 58·9 meq; alfalfa 48·0 meq per 100 g) than cereals (e.g. barley, 12·3 meq; wheat, 9·0 meq per 100 g). The capacity of legumes to absorb phosphorus in greater amounts and from relatively less soluble sources, as compared to cereals, has been attributed by MEHLICH and DRAKE[4] to the higher root cation exchange capacity of the former, which tend to absorb more of calcium thereby increasing the availability of phosphate. While data on the cation-exchange capacity of roots of many cultivated crops are available[3,5] the value (or values) for sugar cane roots has not been found by the authors in available literature. Besides this, certain varietal differences noted in the nutrient composition of two important varieties of cane cultivated in Andhra Pradesh (India) viz. Co 997 and Co 419, in spite of identical soil and fertilizer treatments (such varietal differences in phosphate uptake have also been reported by JAYARAMAN and KRISHNAMURTHY[6]) led the authors to investigate any possible differences in their root cation exchange capacities.

Researches on the rôle of roots in nutrient absorption by sugar cane have been conducted by VENKATARAMAN and THOMAS[7], VENKATARAMAN[8], and later extensively by EVANS[9]. Both VENKATARAMAN and EVANS dealt with differences in the root system of cane varieties as regards their intake of water and nutrients. VENKATARAMAN and THOMAS observed that the functional activity of cane roots in regard to nutrient absorption declined after a time, the place of old roots being taken by freshly formed ones; they considered that normally the shoot roots of cane remained active for about 5 to 6 months. EVANS also reported that hairy roots of cane were most efficient in nutrient intake and that the root hair density in respect of plants studied by him reached a maximum at 6 months age of crop.

EXPERIMENTAL

This study was carried out at the Sugar Cane Research Station, Anakapalle during 1963–1964. Since it is rather difficult to obtain complete samples of roots and also rid them of the sticking soil particles when such samples are to be drawn from cane plants grown normally in soil, cane plants of varieties Co 997 and Co 419 in the present study were grown in washed sand in pots, with periodical addition of HEWITT's nutrient solution[10] in which the amount of potassium was, however, doubled to meet the well-known demand of the crop. Plants of normal growth could be raised by this method. For the study, plants with their roots intact were carefully removed from the sand by projecting a jet of water. The roots were severed and washed first with tap water and finally with distilled water. The roots were immediately dried in an electric oven at 70°C, cut into fine bits and a smaller representative sample drawn. Samples of roots were drawn from varieties Co 997 and Co 419, at ages of $1\frac{1}{2}$ months (both sett-roots and shoot-roots) and (for normal shoot roots) at 3, 6, 9 and 12 months ages of the crop which was harvested at 12 months age. The cation exchange capacity of the dried roots was finally determined by the leaching method recommended by JAIN[11].

RESULTS AND DISCUSSION

Measurements of cation exchange capacity of the sugar cane roots studied are given in table I.

The cation exchange capacity of sett-roots, which are known to function partly in nutrient absorption in very early stages, was lower than that of the shoot-roots of the same age or later ages of crop. The value for Co 997 was somewhat lower than Co 419.

In regard to the cation exchange capacity of shoot roots it can be seen that for both the varieties, there was a rise in the cation exchange capacity from $1\frac{1}{2}$ months age to 6 months age, the rise from 3 to 6 months age being very steep. This remained stationary from six months age right up to harvest at 12 months of age for Co 997, while in the case of Co 419, there was a small decline from 6 to 9 months age whereafter the values remained constant. Thus for both the varieties, the values were nearly similar and also remained constant during the maturity period.

[1] LUNDEGARDH: *Ann. Rev. Plant Physiol.*, 1955, **6**, 1–24.
[2] EPSTEIN: *ibid.*, 1956, **7**, 1–24.
[3] DRAKE *et al.*: *Soil Sci.*, 1951, **72**, 139.
[4] *Amer. Chem. Soc. Monograph*, 1955, (126), 286–324.
[5] NORMAN: *Amer. J. Bot.*, 1957, **44**, 67–73.
[6] *Indian J. Sugar Cane Res. Dev.*, 1964, **8**, 197–205.
[7] *Agric. J. India*, 1922, **17**, 381–388; through van Dillewijn: Botany of Sugar Cane (Chronica Botanica, Waltham, Mass., U.S.A.) 1952.
[8] *Proc. 3rd Congr. I.S.S.C.T.*, 1930, 429–445; through van Dillewijn: Botany of Sugar Cane (Chronica Botanica, Waltham, Mass., U.S.A.) 1952.
[9] *Mauritius Sugar Research Sta. Bull.*, 1935, (6), 44 pp.; *Ann. Bot. (N.S.)*, 1938, **2**, 159–182; *Proc. 6th Congr. I.S.S.C.T.*, 1939, 802–808; *Indian J. Sugar Cane Res. Dev.*, 1964, **8**, 160–171.
[10] *Tech. Comm. Bureau Hort. and Plant Physiol.*, 1952, **35**, (22), 589–598.
[11] *Curr. Sci.*, 1959, **28**, 71.

Table I

Cation Exchange Capacity (C.E.C.) of sugar cane roots (Plant Cane)

(Mean values for 4 replicates; meq per 100 g dry sample)

(a) Sett Roots

Age of crop: 1½ months

(i) Co 997: 12·6 meq

(ii) Co 419: 13·7 meq

(b) Shoot Roots

	Variety	*Age of crop* 1½ *months*	3 *months*	6 *months*	9 *months*	12 *months*
(i)	Co 997	19·0	20·0	29·9	28·3	29·8
(ii)	Co 419	21·0	22·5	34·4	29·6	29·5
Mean for age		20·0	21·3	32·2	29·0	29·7

Mean for variety: Co 997—25·4 meq; Co 419—27·4 meq

For Shoot Roots only

L.S.D. for C.E.C. difference between varieties (5% level) = 0·92 meq

L.S.D. for C.E.C. difference between ages of crop (5% level) = 1·59 meq

Between the two varieties, Co 997 (early maturing variety) and Co 419 (late maturing variety), the latter had significantly higher root cation exchange capacity (mean value for entire life cycle) than the former. This divergence was highest between the two varieties at the age of six months, when the peak value attained by roots of Co 419 was much higher than that of Co 997. Studies in mineral nutrition of the two varieties at this Station during 1961–1964[12] indicated higher levels of calcium, magnesium and phosphorus in elongating sheaths of Co 419 than in Co 997, which, however, had a higher potassium content. This differential uptake of these nutrients appears to be due, at least in part, to the above differences in root cation exchange capacity particularly during the active growth period. This behaviour is similar to that of legumes and cereal crops mentioned earlier[3].

The crop plant with a root cation exchange capacity nearest to sugar cane appears to be corn, with a value of 26·0 meq/100 g.

The study seems to indicate that root cation exchange capacity plays a rôle in mineral nutrition of sugar cane. VENKATARAMAN[8] said that desirable root characteristics might be incorporated if possible in breeding superior cane varieties. Among such characteristics cation exchange capacity seems to be one.

SUMMARY

The cation exchange capacity of the roots of two important varieties of sugar cane, viz. Co 997 and Co 419, was determined. It was found that the cation exchange capacity of sett-roots of cane at 1½ months' age was lower than that of the shoot-roots of the same age or of later ages of crop, and that, for shoot-roots, this value attained its peak level by the age of 6 months in the case of both the varieties. Variety Co 419 was noted to have a significantly higher root cation exchange capacity (27·4 meq/100 g) than Co 997 (25·4 meq/100 g). This appeared to be partly responsible for the differences in the uptake of some mineral nutrients such as calcium, magnesium, and phosphorus by the two varieties. The possibility of a clearer understanding of the differences between the varieties with reference to their performance as related to their mineral uptake was indicated by this study with the varieties in sand culture in pots.

ACKNOWLEDGMENT

Thanks are due to the Sugarcane Specialist, Anakapalle, for affording facilities for work. The authors' thanks are also due to Dr. B. RAMAMOORTHY, Physical Chemist, Division of Chemistry, Indian Agricultural Research Institute, New Delhi, for his constructive suggestions.

[12] *Ann. Rpts. Sugar Cane Research Sta.*, Anakapalle, 1961/62 to 1963/64 (unpublished).

SUGAR BEET CULTIVATION IN CHILE[1]

RECENT sugar beet production in Chile affords a good example of the benefits that may accrue from sound agricultural practice in a developing country. Chile had a rapidly increasing population, an unfavourable balance of payments and an insufficient food supply for the people. Field trials with sugar beet were commenced in 1945.

At the present time the sugar beet industry has a production of almost 100,000 tons from approximately 25,000 hectares and has become an important factor in the country's economy. It has made possible a reduction in purchases from abroad and this success has given a stimulus to other forms of agricultural production.

The Central Valley is the principal region of cultivation for sugar beet. So far there are three sugar beet factories. These encourage the cultivation of sugar beet in various ways, e.g. by the operation of a credit system, cultivation contracts and the supply of seed and fertilizers. This new agricultural enterprise has meant employment for 6000 agricultural workers and 800 workers in the factories. The factories have provided an economic stimulus to the towns. Roads in the regions of the cultivated areas have been improved. In foreign trade 22 million dollars have been saved. When two more factories have been erected it is expected that 60% of the home demand for sugar will have been met.

F.N.H.

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Into the doldrums and out with Puerto Rican sugar. E. F. RICE. *Sugar J.* (La.), 1964, **27**, (1), 21–24. Reasons are given why it is thought production will be restored to former levels. These include new Government incentives, a crash programme to develop new varieties and mechanical harvesting.

[1] *International Fertilizer Correspondent*, 1964, **5**, (12), Item 845.

SUGAR CANE VARIETIES IN BRITISH GUIANA

TWO articles devoted to the subject of sugar cane varieties in British Guiana are contained in Sugar Bulletin No. 32 (1964) of the British Guiana Dept. of Agriculture, the information given referring to the year 1963. The methods of seedling selection and testing employed at the Department's Sugar Experiment Station are described by G. D. WATKINS in some detail, along with a diagram which gives a "bird's eye-view" or précis of the selection and variety selection methods that are employed. The Station was started in 1921 and is at present concerned almost entirely with the breeding, selection and testing of new cane varieties. These may be derived from 4 different sources, viz.—(1) Demerara varieties or the Station's own crosses (prefixed "D") (2) Demerara-Barbados varieties (prefixed "D.B."), from fuzz received from the Central Cane Breeding Station, Barbados, (3) Barbados varieties selected from the first year seedling trial in Barbados, and (4) foreign varieties sometimes imported.

The fuzz or seed is sown in "flats" in a steam sterilized mixture of equal parts of pulverized clay, well rotted filter-press mud and coarse sand, the same medium being used in "potting up" the seedlings later. Some 50,000—70,000 seedlings are handled each year. The method of planting of these seedlings in the field or the "seedling fields" are described, as are the main considerations concerned with the selection.

Ratooning ability in new seedlings or varieties is considered to be specially important in British Guiana for it is now common practice to carry fields up to and over the 10th ratoon. For this reason selections are made in ratoon crops. The Demerara seedlings are not subjected to their first examination until the first ratoon crop and are finally selected as second ratoons. The Demerara-Barbados seedlings, in keeping with the selection policy of the Central Cane Breeding Station, Barbados, are examined as plant canes and the final selection made in the first ratoon crop. It is at this stage that the varieties are given their permanent identification numbers.

In order to ascertain the quality or sugar content of the juice a Brix-assay team examines the shoots. The team consists of 2 men using hand refractometers accompanied by a recorder and several men equipped with cane punches of the type described by SEN[1] which has an easily removable polyethylene juice reservoir. A composite juice sample is collected from the 8 most mature canes in the stool and the Brix reading for a drop of the juice recorded. A well balanced Brix-assay team of this kind (with 8–10 "punchers") has an output of approximately 120 evaluations per hour. The Brix reading and the amount of cane in the stool are naturally all-important in selection.

Any stool showing signs of leaf scald (*Xanthomonas albilineans*) would be automatically discarded. Heavy arrowing might also be a cause for rejection. A visual assessment is made on growth of cane, cane length and cane diameter, and a note made of any other special characteristics.

The soils of the cane growing areas of British Guiana are divided, for variety trial purposes, into Demerara Frontland Clay, Berbice Frontland Clay, Riverside Clay, Pegassy Clay and occasional Sand Reefs. It is only possible for the Experiment Station to test varieties fully on the more important Demerara and Berbice Frontland Clay with occasional trials on other soil types.

The variety and fertilizer position of the sugar industry is depicted in a table giving the values and quantities of fertilizers used on sugar estates in 1961–1963. Separate figures are given for ammonium sulphate, superphosphate, hypophosphate, muriate of potash, limestone and urea. With regard to urea 357 tons for 1961 had increased to 863 tons in 1963.

Other tables give the varietal composition of the 1963 harvest in comparison with that estimated for 1964, and a summary of the estimated acreage of the minor commercial varieties to be reaped during 1964. In 1959 the acreages of the varieties B.37161 and B.41227 contributed equally to provide approximately 80% of the crop. Since that time there has been a gradual increase in the proportion of B.41227 and it is estimated that it will constitute 53% of the 1964 crop, compared with 23% for B.37161.

F.N.H.

Agricultural Abstracts

Drought hits Puerto Rico. ANON. *Sugar J.* (La.), 1964, **27,** (1), 25.—The effects of this drought, the worst since the Weather Bureau began keeping records in 1898, on the island's sugar industry is described. One of the results attributed to the dry weather is widespread outbreaks of aphids in sugar cane and grasslands in the western part of the island.

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Harvesting methods in relation to sugar production. H. W. KERR. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 6 pp. The writer points out that mechanical harvesting was more or less forced on Queensland with a greatly increased cane acreage and failure to recruit sufficient labour for hand harvesting, in spite of immigrants from southern European countries. Trash burning, a universal practice in Queensland, is defended, the one disadvantage being when bagasse is required for pulping and high-grade paper manufacture.

[1] *Proc. 9th Congr. I.S.S.C.T.*, 1956, 389.

Sugar producers' approach to mechanization. H. A. THOMPSON. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 12 pp. Various aspects of sugar cane agronomy are here discussed and analysed. Examples are given why a practice or technique which is successful in one country may not be successful in another. The writer points out that opinion is hardening against the use of harvesting equipment which cuts and lays the cane on the ground, to be picked up or loaded later. It may be relatively successful in Louisiana because of the loose or peaty nature of the soil. Elsewhere it has resulted in much extraneous matter finding its way to the mills mixed with the cane.

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Deployment of mechanization in sugar cane. D. C. P. EVANS. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 9 pp.—The writer stresses the value of this type of conference in assisting planners, producers, engineers and scientists to obtain a better understanding of each other's problems and needs. The high degree of mechanization reached in the sugar beet industry with monogerm seed, precision planters and efficient harvesters, is referred to. Sugar cane is basically a cheaper crop to grow but the development of mechanization has not kept pace with sharply rising labour and other costs.

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Measures in mechanization. D. C. P. EVANS. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 5 pp.—It is pointed out that the skill of the farmer and the scientist have made increased agricultural outputs possible in many spheres but it is only mechanical power that allows this to be achieved economically. Mechanization has now reached the stage when it must be accorded the status of an applied science in its own right.

* * *

Practical experience with the MF 515 sugar cane harvester on a global basis. S. W. D. BAXTER. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 8 pp.—Details are given of the increasing use being made of this harvester in Queensland and in many other cane growing countries of the world and of the methods of cultivation or field layout desirable to enable the machine to give its maximum performance. The machine is claimed to be the first commercially available complete cane harvester in the world and to be made in greater quantity than any other. Its ability to harvest lodged cane is one of its virtues.

Case histories with the MF 515 sugar cane harvester in Africa. D. M. SMITH. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 6 pp.—Initial difficulties in some African cane growing countries, due mainly to unsuitable field conditions or layout, and how these were overcome are described. The writer refutes the idea that labour in Africa is not able to handle the machines efficiently and gives examples of efficient teams operating in Malagasy (Madagascar).

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Factory planning for mechanically harvested cane. T. STORRAR. *Paper presented to the Massey-Ferguson Mech. Sugar Cane Production Conf.*, 1964, 9 pp. The various methods used in different parts of the world in transporting cane or in getting it from the field to the mill in a reasonably clean condition are reviewed. The advantages of handling chopped cane, as delivered by the chopper-type harvester, are pointed out.

* * *

FAO and sugar cane production. L. STENSTRÖM. *Paper presented to the Massey Ferguson Mech. Sugar Cane Production Conf.*, 1964, 7 pp.—The author, who is a farm power and machinery specialist of the Food and Agriculture Organization of the United Nations, gives an account of the work of the Organization where sugar cane is concerned, especially in the underdeveloped countries. The first expert to be sent out by FAO on an assignment was, in fact, a sugar cane agronomy expert (the late C. VAN DILLEWIJN, author of *Botany of Sugar Cane*), who went to Ceylon.

* * *

Diseases of sugar cane observed in Peru in 1961 and 1963. E. H. TODD. *Sugar J.* (La.), 1964, **26,** (12), 10–16.—The writer paid two visits to Peru, at the request of the Comite de Productores de Azúcar de Peru, to conduct field inspections in key sugar producing areas in order to advise on disease problems. This report deals with observations and recommendations. In addition quarantine matters are briefly discussed. Ratoon stunting disease was found to be the most serious and widespread disease. The important variety "Azul" was widely infected. About a dozen other diseases were found, viz.: bacterial mottle, brown spot, chlorotic streak, eye spot, leaf variegation (due to genetic causes), mosaic, Pahala blight (due to Mn deficiency), Pokkah Boeng, red rot and red spot of leaf sheath, rind disease, ring spot, root rot, and sclerophthora.

New cane variety. ANON. *Australian Sugar J.*, 1964, **56,** 187.—Characteristics of the new cane, Q79, are outlined. This tall, medium-thick cane is said to be best suited to the poor class soils of northern Queensland, especially poor wet clays subject to waterlogging. On better land it is inclined to sprawl or lodge. Resistance to wind is good.

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Johnson grass menace. ANON. *Australian Sugar J.*, 1964, **56,** 221.—A warning is given of the potential danger of Johnson grass (*Sorghum halepense*) to cane growers in many parts of the Burdekin district. The need for dealing with the weed in the early stages is stressed. Queensland trials have shown that the use of "Dalapon"-TCA mixture in conjunction with dry cultivation will give very useful control of the weed.

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Puerto Rico starts mechanized sugar harvest. D. SMITH. *Sugar J.* (La.), 1964, **27,** (2), 9–13.—Mechanized harvesting of sugar cane is developing rapidly in Puerto Rico. It is being fostered by two firms. The key machine is the so-called Duncan cut-load harvester of Hawaiian origin. The machine is described. It is designed basically for heavy tonnage recumbent cane (40–100 tons per acre). Its capacity is 40–60 tons per hour. Much of the Puerto Rican cane crop is recumbent. A table gives harvesting costs in U.S. sugar areas.

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Sugar cane breeding in Puerto Rico. E. B. GARCIA. *Sugar J. (La.)*, 1964, **27,** (2), 41–42.—The history of sugar cane breeding in Puerto Rico, which is as old as the Agricultural Station itself (1910), is outlined and present day methods of cane breeding described. The acid solution technique developed in Hawaii and the melting pot technique (poly-cross), together with bunch planting have all been successfully applied.

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Successful new Australian sugar cane harvester. ANON. *Sugar J.*, (La.) 1964, **27,** (9), 49–51.—A detailed description is given of the Massey-Ferguson MF515 cane harvester[1].

* * *

Sloping eroded land converted into profitable sugar cane farm. J. A. BONNET. *Sugar J.* (La.), 1964, **27,** (2), 52–53.—A description is given of how a capable educated farmer in Puerto Rico set about improving his family sugar cane farm of about 800 acres with bulldozing and soilfilling operations, greatly increasing yield.

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An appraisal of sugar varieties grown in Puerto Rico. F. MÉNDEZ ROIG. *Sugar J.* (La.), 1964, **27,** (2), 78–79, 85.—The many changes that have taken place in the Puerto Rican sugar industry in the past 15 years are reviewed with emphasis on the changes in varieties. An objective appraisal of the varieties now grown shows the newer varieties to be definitely superior to those of 15 years ago. A table depicts yields and sucrose content of 15 varieties.

Facts about Co 975. ANON. *Sugar Cane Varieties Quarterly Newsletter* (Coimbatore, India), 1964, **1,** (2), 10–12.—A description is given of this variety and its known performance. It was released from Coimbatore to the State Research Stations in 1953, having been bred from Co 527 and Co 617. It is a heavy yielding mid-season variety.

* * *

Interest in a new Mexican variety of sugar cane. A. GONZALEZ GALLARDO. *Sugar y Azúcar*, 1964, **59,** (8), 35, 46.—A new non-flowering, high-Brix, cold-resistant variety (Mex. 52-29) is said to be causing much interest in Mexico. It is a cross between POJ 2878 (female) and CP 29-203 (male). Favourable experiences with this cane in various parts of Mexico are recounted.

* * *

More sugar from central China. CHI LING. *Bol. Azuc. Mex.*, 1964, (179), 26–27.—Attention is drawn to the increased sugar production in China, that for the last quarter of 1963 having doubled that of 1962. Sugar cane is an important crop in the 5 southern provinces of China. Its cultivation is very ancient and goes back to the Chou dynasty.

* * *

The fertilizing of sugar cane. ANON. *La Industria Azucarera*, 1964, **70,** (848), 239–241.—There is a general discussion on the fertilizing of sugar cane by N, P and K, accompanied by a chart showing the amounts of nitrogen (in kg/ha) recommended in sugar cane cultivation in 18 different sugar cane growing countries. These vary considerably.

* * *

The first hundred years. ANON. *Producers' Rev.*, 1964, **54,** (7), 19.—The year 1964 was the centenary year of the first successful production of sugar on a commercial scale in Australia. This article and several others in the same issue give interesting accounts of the early days of cane cultivation and milling in Australia and of subsequent developments.

* * *

Selection of non-fibrous sugar beet. L. A. SCHLÖSSER. *Ind. Sacc. Ital.*, 1964, **57,** 152–155.—The opinion is expressed that low fibre content in sugar beet is definitely a genetic factor and may be brought about by breeding, as with high yield, bolting resistance, etc.

* * *

Rice varieties and the yield of spring-paddy sugar cane. H. C. FU, T. P. SOO and R. C. LIN. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 25–32.—Results of a 2-year experiment are given. These confirm the belief already held that an early variety of paddy should be used for interplanting with sugar cane in order to reduce sugar loss to a minimum.

[1] See *I.S.J.*, 1964, **66,** 369.

The relationship between morphological characters and internal structure of sugar cane varieties and their resistance to frost injury. M. T. CHEN. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 33–41.—It was found that sugar cane varieties with a thin layer of parenchyma tissue in the leaf blade are more resistant to frost damage than those with a thicker layer of parenchyma tissue and a higher moisture content. External morphological characters could not be correlated with frost resistance.

* * *

Interplanting sweet potato with sugar cane. C. K. TANG. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 43–53.—An experiment designed to obtain information on the varieties of cane best adapted for interplanting with sweet potato (*Ipomaea batatas*) is described. The highest yields of sweet potatoes were with cane varieties characterized by a long tillering period and slow growth in the early stage. The presence of sweet potato reduced tillering and the number of millable cane stalks, also percentage of dead cane.

* * *

Yields of sugar cane interplanted with different varieties of sweet potato. F. Y. SHIA and T. P. PAO. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 55–63.—Little difference was found between the effect of different sweet potato varieties interplanted with N:Co 310 cane. Tainung 53 gave the highest tuber yield, however, and is recommended.

* * *

Investigation of nematode-trapping fungi in Taiwan. H. T. CHU and C. H. HU. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 133–140.—This is a report of a preliminary investigation on nematode-trapping fungi carried out in Taiwan in 1962–63. Four kinds of nematode-trapping fungi were isolated from soil and compost (2 species of *Arthrobotrys*, one of *Dactylella*, and one of *Dactylaria*), also two predacious nematodes from cane and pineapple fields (*Mononchus papillatus* and *Mononchus* sp.nov.).

* * *

Chemical control of sugar cane long horn beetle. H. T. TSENG. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (35), 141–147.—This soil insect (*Dorysthenes hydroponicus*) is a pest of upland sugar cane in Taiwan. It may decrease cane yield by 30–50%. Details are given of fairly successful control with "Dieldrin", "Aldrin" and "Heptachlor".

* * *

Effect of density of planting on the yield of autumn plant cane and its first ratoon. K. H. TANG and F. W. HO. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 17–30. Field experiments on density of planting are recorded. Four spacings were used, viz.: 50, 40, 30, and 20 cm between setts, all in rows 1·30 m apart. There was no appreciable difference in millable cane yield in both plant and ratoon crop.

Sugar cane tops for propagation. T. P. PAO and S. L. HUNG. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 1–16.—Results are given, in tabular form, of 11 experiments, during 1962–64, to test the effect of hot water and hot air treatment (for ratoon stunting disease) on the germinating capacity of tops from harvesting and of "rayungan" (lateral sprouts from blossoming stalks). There was no significant effect of either heat treatment on germination and these materials are recommended for close planted spring nurseries.

* * *

Experiments on cultural methods for spring paddy cum sugar cane. W. T. CHEN and T. P. PAO. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 31–47.—Results are given of 6 field trials (from 1954–60) dealing with planting time and method, spacing, etc. It is concluded that cane should be planted about 5 days after transplanting the rice or paddy seedlings.

* * *

Field experiments on some new early maturing sugar cane varieties in the early milling stages. Y. C. PAN and T. L. LIU. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 49–57.—Eleven field experiments to ascertain the value of the new early varieties F 144, F 148 and F 149 for yield and sugar in the early milling period are described. F 148 and F 149 were markedly superior to the widely grown N:Co 310 used as standard.

* * *

Spacing of the new sugar cane variety F 146. C. C. TSE and J. M. CHU. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 71–80.—This cane is of medium stalk diameter with a large number of millable stalks. Spacing experiments were carried out from 1959 to 1963 and comparisons made with N:Co 310. The recommended spacing, in the area concerned, is 0·3 m between plants with 1·25 m (or more) between rows.

* * *

Relation of the growth of the sugar cane plant to the absorption of K and Na. T. YANG. *Rpt. Taiwan Sugar Exp. Sta.*, 1964, (36), 101–107.—Water culture experiments with sugar cane cuttings are reported, lasting 80 days, the variety N:Co 310 being used. K markedly affected growth and tillering while Na had little effect. K content was high in shoots and low in roots while, strangely, the reverse applied with Na.

* * *

A study of the silicon content in the soils of Taiwan sugar cane fields. J. J. SHIUE. *Rpt. Taiwan Sugar Expt. Sta.*, 1964, (36), 109–115.—Soluble SiO_2 content was low in coarse textured acid soils derived from sandstone and higher in saline and heavy textured soils. It is considered that soluble SiO_2 in soils may be related to productivity. Soils with low soluble SiO_2 content gave low cane yields.

THE USE OF A GRANULAR MINERAL DECOLORIZING CARBON IN A BEET SUGAR FACTORY

by R. M. J. WITHERS and G. CRANE

Paper presented to the 17th Tech. Conference, British Sugar Corporation Ltd., 1964.

PART II

The adsorption columns

Three ways of constraining the juice and carbon flow to a plant have been considered: first to operate similarly to a conventional diffusion battery; second, to operate continuously through a bed of CAL carbon co-currently, i.e. with both juice and carbon entering at the top of the vessel in parallel; and thirdly, to operate through a bed in counter current.

The first method required strong and expensive vessels to stand up to the pressures to force the liquid through. The inherent batch operation requires labour, is expensive to automate and seems out of line with present trends in our factory process. However, this method is commonly practised in America, and Tate & Lyle have installed such a scheme at their Liverpool refinery. The use of a number of vessels with counter-current working should give good adsorption figures.

The main weakness of the second scheme is that it cannot give the same adsorption as counter-current working.

The third technique, which is the one employed at York, may be carried out either in a free bed or in a packed bed.

One of the problems that arise with a packed bed is the question of high pressure drop which can arise owing to packing with fines. Work at our research laboratories showed that the pressure drop is considerably affected by the amount (which may be only of the order of 2½%) which is finer than 60 mesh (U.S. sieve series).

Partly as a result of the high pressure drops that were obtained in the experimental plant at Bramcote the initial system adopted for our York factory was that of a free bed.

Three columns of 9 ft diameter, each 37 ft high, were built and originally the carbon entry had a single central delivery point at the top of each column while the juice enters through pipes fixed in a concentric circle at the bottom. These pipes are fitted with collapsible cowls so that if the juice flow is stopped no carbon can enter the pipe distributor.

At the top of the column were fitted 14 × 88 mesh stainless steel screens, the entering CAL carbon being brought through a screen by means of a central pipe.

Also at the top was a mechanical dipstick and there are a number of 1-inch draw-off cocks fitted down the sides of the vessels.

The juice passing upwards through the body of carbon tends to lift the particles somewhat. If all the particles are of the same size and if there is no chanelling or other non-uniform distribution of juice flow the whole bed would be uniformally extended giving the patented CAP expanded bed.

At York we did not expect to approach this theoretical condition but if it were to obtain at a juice flow of 100 g.p.m. into the three vessels (33 g.p.m. each) at 58°Bx and 80°C we would expect a 15·5% bed expansion (100 g.p.m. represents a juice flow of 0·52 g.p.m./sq.ft. in the 9 ft diameter vessels).

This free bed system was operated during one beet campaign at York and the following refining run. It was then changed to a packed bed system.

The main disadvantage experienced with the free bed was that a large proportion of fines were fluidized at the top of the beds and accumulated beneath the flat screens. The pressure drop across the screens could then reach such a magnitude that at times the screens lifted or burst and this caused an occasional large carry-over of fines into the filter plant.

Tests on the properties of the CAL carbon within the columns did not show a progressive reduction in the adsorption area, suggesting that the bed may have overturned so that the most active carbons were not necessarily always on the top of the bed. If this occurred much of the advantage of counter current flow between the juice and the carbons was lost.

When the bed was fully packed the carbon granules themselves acted as a filtering media and this reduced the amount of carbon fines in the effluent juice. It also tended to hold the fine carbon in the bed so that it did not accumulate on the discharge screens. In fact the large flat screens were replaced by 29 sparge pipes with a total screening area of only 25% of that installed with the free beds. A general arrangement drawing showing the details and distribution of the sparge pipes appears in Fig. 2.

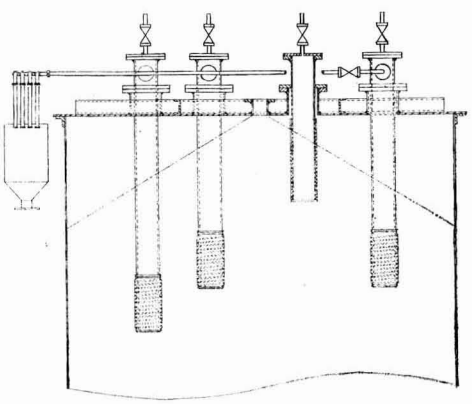


Fig. 2

Originally 118,000 lb of CAL carbon was loaded into the system spread equally between the three columns.

If all this carbon were in the columns and the juice flow was about 100 gallons per minute at 58° Brix, then with the predicted 15% expansion the bed should be about 5–6 ft below the level of the flat screens. This was difficult to confirm in practice owing to the spongy feel of the fluidized top of the bed. Increasing the juice velocity to 130 gallons per minute should only have lifted the bed another foot or so. This arrangement should have given a contact time between carbon and juice of about 2¼ hours. It is not known precisely how much carbon was stored in the rest of the system (transfer chamber, storage bins, scrolls and furnace) but in any case it was negligible compared with 118,000 lb.

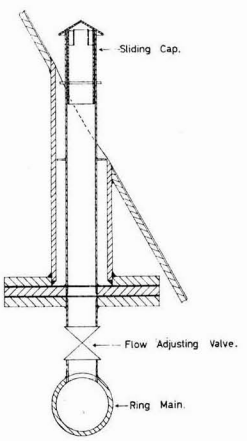


Fig. 3. Details of juice entry into the column

When the system was changed to a packed bed the columns were filled right up to the sparge pipes and the contact time was then approximately 2·8 hours.

Reports had shown that a constant product of contact time and carbon cycle rate gives a constant colour removal. It therefore seemed most likely that initial experiments would be concentrated on the variation of carbon cycle rate.

The maximum cycle rate is fixed by the capacity of the Herreshoff furnace. This was nominally rated at 700 lb of CAL carbon per hour. Its actual performance depends on the moisture content and percentage impurities of the entering carbon. In practice, however, the recycle rate has been governed by the work of sweetening-off, de-watering and handling the carbon and we have never achieved rates substantially in excess of 500 lb per hour. The average re-cycle rate was 300 lb per hour.

The CAL carbon is not removed continuously from the three columns but in slugs. Every four hours a slug is taken from one of the columns so as to fill the transfer chamber. This is effected by opening the motorized Saunders valve at the bottom of one of the three columns and simultaneously venting the transfer chamber. At the same time the motorized Saunders valve at the top of the same column is opened so as to allow a fresh supply of reactivated carbon to enter the top of the column and maintain the packed bed.

No difficulties have been experienced in filling the transfer chamber but certain difficulties were found in feeding the main columns with carbon.

In the free bed system it was never possible to obtain a satisfactory slugging system for feeding the column tops and eventually the carbon was allowed to run in continuously through an open valve for the whole four-hour period. In the case of the packed bed system it was found that the screen aperture size was rather critical since if the screen is too fine there is a restriction on the flow of liquid through the sparge pipes and the carbon tends to settle out in the feed pipes and the column is not properly filled. If, on the other hand, the screen aperture is too large there is a loss of fine carbon from the system. We have found that a screen mesh of 40 with an aperture of 0·0158 in has given satisfactory results in practice. In addition to the Saunders valves, manually-operated ball valves are fitted to the bottoms of the three columns as a safety measure. These valves are probably better than diaphragm valves since they cut through the stream rather than squeeze it. This particularly applies where the carbon slurry is thick or the line is packed full of carbon as occurs at the bottoms of the columns. However, in practice, we have never yet had a failure of any of the rubber diaphragms of the Saunders valves and the ball valves have therefore not had much use. Nevertheless, in a future installation we would probably have motorized ball valves rather than diaphragm valves.

The only other feature of the adsorption columns that need be mentioned is that they are lined internally with an epoxy resin in order to minimize corrosion problems, particularly in view of the long off-season. So far we have not had any of the columns emptied for inspection and are unable to report on this corrosion aspect but we believe the linings are giving satisfactory service.

Transfer chamber

This is illustrated in Fig. 4 and is designed to hold about 12 inches depth of carbon from any one of the columns, or about 1500 lb of carbon in juice. The three columns are connected to the transfer chamber by three 4-inch diameter stainless steel pipes which enter at the bottom of the transfer chamber. At the top of the transfer chamber there is a 4-way valve which either connects the transfer chamber to a supply of compressed air, wash water (which is used

to sweeten-off the carbon), or to atmosphere, through 1-inch air-operated Saunders valves. There is also in the top of the transfer chamber a high level control which automatically closes the automatic Saunders valves from the main adsorption columns. After the

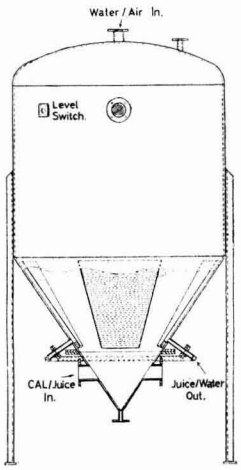


Fig. 4

transfer chamber has been filled and the supply of carbon has been automatically cut off, the vent valve is closed and the juice is blown through the CAL by means of the compressed air supply. At the bottom of the transfer chamber there is a conical screen through which the juice passes and in the delivery line an automatic density meter is fitted. After all the juice has been blown through the carbon the water is admitted to the transfer chamber and when the density instrument shows that the Brix has fallen below about 20° the sweet water is automatically switched from the CAL supply tank back to the beet end of the factory. When the sweet water falls below about 3° Brix there is a further change in the destination of the sweet water which then goes to the diffuser supply.

After the sweetening-off operation, compressed air is again supplied to the top of the transfer chamber and the carbon-water mixture is then transferred to the wet carbon bin (Fig. 5).

Various scheme of sweetening-off and de-watering CAL carbon were tried before the arrangements described above were finally accepted at York.

Initially the sweetening-off was carried out in a separate wash column similar to those employed in the patented CAP process. This was found to be relatively inefficient probably owing to the fact that the sweet water was made to travel upwards rather than downwards and also it was difficult to maintain a constant level.

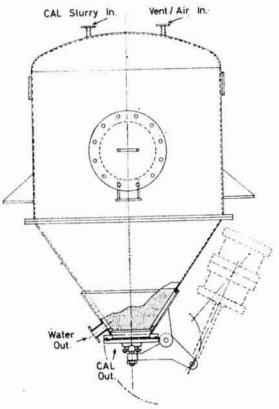


Fig. 5

This wash column was discharged after only six weeks operation, and replaced with a vibrating screen. This was a horizontal screen with a separate compartment for separating juice from low Brix sweet water and fitted with wash sprays.

Great difficulty was experienced with this device in maintaining a clean screen. If the screen aperture was made sufficiently large to prevent blinding and blockage a large quantity of fines entered the wash water lines and drains whereas fine screens created difficulties due to blinding and buckling.

The original system for de-watering the carbon was a top feed rotary vacuum filter. This had a diameter of 36 in with a 24 in face, used a 24 × 110 mesh screen and was driven by a vari-speed gear unit to give drum speeds of $1\frac{1}{2}$–$7\frac{1}{2}$ m.p.r.

Unfortunately CAL carbon/water slurry has no natural stability whatever and great difficulty was experienced in preventing all the water running over the surface of the drum into the dry bin. This top feed filter was therefore replaced by a vibrating horizontal screen but this gave similar problems to those described in connexion with the sweetening-off. However, this vibrating screen was used for most of the first beet campaign.

The results we have achieved with the final system are as follows:

The percentage of sugar left in the carbon averages about 1·2% and to obtain this we need about 10,000 gallons of sweet water per day. Of this about 8000 gallons at about 1°Brix goes back to the diffuser and about 2000 gallons in the range 20°–23°Brix goes back to the thin juice tank. An average day will see 5 transfers being made altogether from the 3 columns and this corresponds to about 7500 loads of dry carbon or about 310 lb per hour.

The present technique for de-watering merely consists of letting the wet carbon drain off in the wet bin for about 3 hours and then dumping it into

the dry bin. The CAL to the furnace usually averages about 36% moisture content, a very satisfactory figure.

The filling of the transfer chamber is very rapid indeed, taking only about 1 minute. The average sweetening-off time is about 1¼ hours; about ¾ hour is spent blowing the thick juice off the carbon and about 50 minutes is required to transfer the washed carbon to the wet bin. The whole operation takes just over 3 hours so that the maximum rate of recycle which can be achieved with satisfactory sweetening-off and de-watering is about 500 lb per hour.

Hydraulic Transport

Hydraulic transport in water or juice is the recommended method of handling CAL carbon. It is clean, and causes minimum abrasion. It can either be circulated by means of an eductor, pumped, or air pressure can be applied to force the slurry through a discharge pipe.

In America eductors are used on a number of plants but they wear out rapidly due to the high local velocities of the carbon impinging on the metal. It is considered that these eductors must also wear out the carbon and contribute to a high cycle loss and so we have chosen the two techniques of air lift and pumping.

The limitations which have to be considered with hydraulic transport are: first, how much power and how much breakage is allowed at high velocities, and second, what the chances are of a blockage at low velocities. There are not many precise data available on the breakage but tests at Bramcote on one type of centrifugal pump gave a breakage rate rather less than 0·3% per cycle when pumping at 10 ft per second around a circuit of 1-inch pipe about 40 ft long.

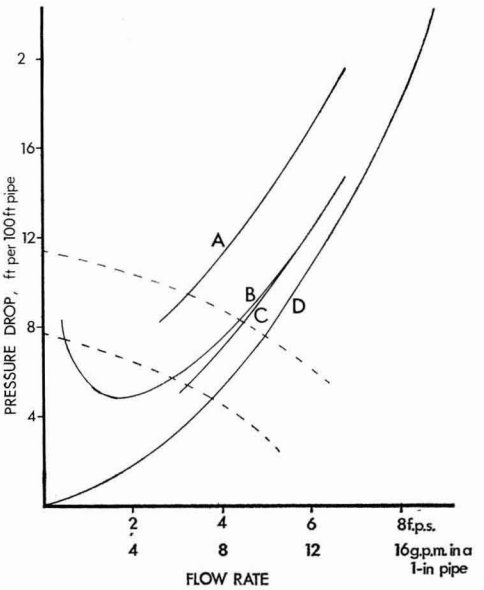
Another test at Bramcote involving the air lift principle along a 10-ft pipe at 2·7 ft per second gave a fines production of less than 0·1% for 5 recycles.

Tests of pumping of CAL carbon by the manufacturers gave figures in the region of 0·1% loss per cycle when pumping at velocities in the range of 2·8–9 ft per second.

Careful tests on pumping of coal (a similar material to CAL carbon) by the British Hydro Mechanics Research Association showed that ½-inch coal particles were found to lose about 0·5% of their weight per mile of 1½-in pipe when pumped over a distance of 10 miles at 2 ft per second.

In general, therefore, at velocities below 10 ft per second we are not likely to be much concerned with breakage although it is reasonable to expect breakage to increase with speed since the related effect of wear of pipes is known to increase at about a cube of the velocity. The pump impeller needs therefore to be kept at the slowest practical speed.

Fig. 6 shows the flow characteristics of ½-inch coal in a 1½-in diameter pipe obtained from the B.H.R.A. and also shows the Pittsburgh data on CAL in a 2-inch diameter pipe.



A=30% CAL in 2-in pipe; B=15% coal in 1½-in pipe;
C=20% CAL in 2-in pipe; D=water

Fig. 6

It can be seen from the superimposed centrifugal pump characteristics that below a velocity of 2 feet per second the system is unstable but there should be no danger of blockage provided the velocity is kept above 2 ft per second. This represents in a 1-in pipe approximately 4 g.p.m. of water and at 20% concentration, 488 lb per hour of CAL carbon.

The maximum concentration of carbon at these low velocities recommended by Pittsburgh is 30%. At 4 g.p.m. of water this represents 732 lb per hour or the maximum capacity of the furnace.

In the original plant where centrifugal pumps were employed after the wash column and again at the quench tank, the speeds of the impellers and the air pressure to the air lift from the transfer chamber were set to give about 9 g.p.m. initially.

In fact, we have never had a blockage with the air lift system even though very low flow rates at very much less than 1 g.p.m. with very high carbon concentrations (greater than 50%) have been employed, whereas a number of blockages were experienced with the centrifugal pumping systems.

The latest arrangement of the plant retains the air lift principle from the transfer chamber but has abandoned altogether the pumping of CAL carbon in water, since the wash column has been abolished and we now transfer the carbon from the quench tank to the supply tank in treated juice. Hydraulic transport up a vertical pipe is very much more stable

than in a horizontal pipe and transport in juice is much more stable than transport in water.

In an attempt to avoid the undesirable effects of centrifugal pumps with their unstable characteristics and high impeller velocities we have tried to use positive displacement diaphragm pumps. These have not been mechanically successful.

(*To be continued*)

1964 TECHNICAL SESSION ON CANE SUGAR REFINING RESEARCH

THE 1964 Technical Session on Cane Sugar Refining Research was held in New Orleans recently with technical representatives from most of the major sugar refiners of the U.S., including Hawaii, and from England, Canada, and Australia present to discuss the latest developments in this field.

The conference was sponsored jointly by U.S.D.A.'s Southern Utilization Research and Development Division and the Cane Sugar Refining Research Project Inc., the organizations cooperating in the research endeavour. The project, formerly located in Washington, D.C., as the Bone Char Research Project, was transferred to New Orleans about a year ago, and is now a part of the Food Crops Laboratory of the Southern Division.

Dr. FRANK G. CARPENTER, project leader, opened the meeting, and introduced Dr. C. H. FISHER, Director of the Southern Division, who welcomed the visitors. E. P. BARRETT (Baugh Chemical Company, Baltimore, Md.), K. R. HANSON (American Sugar Company, Brooklyn, N.Y.) and HENRY G. GERSTNER (Colonial Sugars Company, Gramercy, La.) presided at the three technical sessions.

One of the more perplexing problems facing the sugar industry today is the formation of "floc" in carbonated beverages. Y. YANKELEVITS (of the Sucrest Corporation, Brooklyn, N.Y.) described a quick method, based on polarography, by which the tendency of a sugar to cause flocculation in carbonated beverages can be predicted. He told the group that actual beverage tests have demonstrated a high degree of reliability.

W. W. BINKLEY (The New York Sugar Trade Laboratory, Inc., New York, N.Y.) reviewed the reactions by which colour is formed in sugar. During the manufacturing process, he said, each of the principal constituent sugars of cane juice has a part in the formation of the coloured substances of the final molasses. When sucrose, glucose, and fructose are subjected to simulated mill conditions for juice clarification, in the presence of a simple amino acid and aconitate ions, both glucose and fructose make significant contributions to colour. The colour yield from sucrose becomes significant only when the pH of these systems enters the range of that of final cane molasses.

Since raw sugars vary widely in colour, as well as in the ease with which colorants can be removed with bone char or by crystallization, each lot constitutes a different problem for the refiner. N. H. SMITH (California and Hawaiian Sugar Refining Corporation, Crockett, Calif.) said that his Company have used the sensitivity of colour in raw sugars to changes in pH to indicate the ease with which the colour can be removed by bone char. They found that the more sensitive colour is to pH changes, the easier it is to decolorize the sugar with bone char.

In an entirely different field, the mechanism of growth of calcium phosphate precipitate, used in the clarification of sugar solutions, was discussed by Dr. WALTER E. BROWN (American Dental Association Research Associate, National Bureau of Standards, Washington, D.C.). Dr. Brown, a world authority on the calcium phosphates, told his audience that the relationship between the structures of hydroxyapatite and octacalcium phosphate profoundly influences the properties of the precipitates, including their solubility. The number of calcium phosphates encountered in the clarification, defecation, and decolorization is surprisingly large. This, plus the fact that the crystallites are very small, makes it difficult to determine which salts are involved and how their properties influence efficiency of the removal of impurities, and other factors, such as filtrability.

Utilization of molasses for particular fermentation processes is dependent upon the nature of the reducing sugars present, and estimates of the composition of this fraction of the product should be useful in expanding its commercial applications. Effective methods have been sought for the quantitative analysis of the four naturally occurring isomers which constitute the reducing sugar fraction of molasses or raw sugars. Dr. L. F. MARTIN (Southern Utilization Research and Development Division, U.S.D.A., New Orleans, La.) described recently-developed methods which provide independent analytical measurements from which each of these reducing sugars can be calculated.

J. B. STARK (Western Utilization Research and Development Division, U.S.D.A., Albany, California) discussed application of the ion exclusion method for recovery of sugar from molasses. The process, he said, is essentially a chromatographic technique, by

which the components to be separated are loaded on a column and washed through with water. Recovery of sugar from molasses by ion exclusion offers a number of advantages over ion exchange; the cation exchanger used in the exclusion process is cheaper and more stable than the anion exchanger used in the exchange process, operation near pH 7 precludes sucrose inversion, there is no expense for costly regenerants because water removes both the sucrose and the impurities from the column, and fewer resin beds should be required, as only one resin is used.

One of the objectives of sucrose crystallization is to eliminate inclusion of salts from the sucrose crystal. K. ONNA (Experiment Station, Hawaiian Sugar Planters' Association, Honolulu) spoke on salt concentrations in the sucrose gradient around the crystals. Analytical data for sodium, potassium, and calcium chlorides, calcium sulphate, and calcium monobasic phosphate were obtained. He told the group that findings suggest that well circulated systems must be used for crystallization rate and inclusion studies.

A paper by S. E. BORODKIN and P. D. BERGER (Research and Development Division, American Sugar Company, Brooklyn, N.Y.) dealt with the quantitative determination of organic acids in commercial sugars. In the opinion of the authors, the method is reliable, has good resolution, and is sufficiently sensitive to be used for granulated sugar, and also is of sufficient capacity for use with blackstrap molasses. The method involves ion exchange chromatography with coulommetric titration, and thin layer chromatography.

A new anaerobic microorganism, *Clostridium butyricum*, thought to be responsible for the production of significant amounts of butyric acid in sugars, was reported by A. B. RIZZUTO (Research and Development Division, American Sugar Company, Brooklyn, N.Y.). Dr. RIZZUTO and his fellow workers were seeking the source of an objectionable odour, sometimes detectable in sugars and corn starch. This is the first of a proposed series of papers on the subject.

Progress in research on the soluble polysaccharides of sugar cane was reported by E. J. ROBERTS (Southern Utilization Research and Development Division, U.S.D.A., New Orleans, La.). These polysaccharides, or gum, have been isolated from final molasses, syrups, raw sugar, refined granulated sugar, factory juice, and crusher juice from hand-cut cane ground immediately after cutting. Methods have been devised for the quantitative determination of the total soluble polysaccharides of sugar cane products, and considerable information has been accumulated about them. Unlike other high molecular weight carbohydrates such as cellulose, starch and dextrans, these materials always contain fructose units in the polymer chain.

NYSTOSE, A FRUCTOSYL-1-KESTOSE

By W. W. BINKLEY and F. W. ALTENBURG

(New York Sugar Trade Laboratory, 37 Warren Street, New York, N.Y., 10007, U.S.A.)

THE recent discovery of glycosylsucroses in cane final molasses[1] and related products[2] is attributable directly to modern chromatography. Paper chromatography, in particular, revealed the probable utilization of some of these trisaccharides by the sugar cane transglycosylases to form higher oligosaccharides[3]. In the continuation of our researches on cane final molasses, we have undertaken the preparation of some of these oligosaccharides. We wish to report the enzymic synthesis of a crystalline fructosylkestose which we have designated nystose, to record some of the properties of this tetrasaccharide and to elucidate in part its structure.

EXPERIMENTAL

Preparation of Oligosaccharide Concentrate.—Twenty grams of sucrose in 200 ml of water and 100 ml transfructosylase[4] solution were allowed to react for 48 hr at 20–25°C. The reaction mixture was then heated to boiling, cooled to room temperature and assayed for oligosaccharides by paper chromatography[5]. Ninety millilitres of the heated reaction mixture were added at the top of a 30 cm high × 6 cm dia. column of granular carbon[6] followed by 3 litres of distilled water to remove the adsorbed monosaccharides. This process was repeated with successive additions of 80 ml and 70 ml portions, respectively, of the heated reaction mixture. The chromatogram was then developed with 1 litre of 5% aqueous ethanol followed by aqueous ethanol in 500 ml lots of increasing concentration (6% to 11% in 1% steps) to eliminate the bulk of the disaccharide(s). The remaining higher oligosaccharides were eluted from the column with 30% aqueous ethanol, yielding 2·3 g.

Chromatography of Oligosaccharide Concentrate on Carbon.—A 40 cm high × 6·5 cm dia. carbon column

[1] BINKLEY: *I.S.J.*, 1964, **66**, 46.
[2] GROSS *et al.*: *ibid.*, 1962, **64**, 69.
[3] BINKLEY: *ibid.*, 1964, **66**, 185–187.
[4] "Clarase 900", a fungal alpha amylase produced by the Miles Chemical Co., Clifton, N.J., U.S.A. A 2% aqueous solution of the enzyme was dialysed 24 hr against running tap water just prior to use.
[5] ALBON & GROSS: *Analyst*, 1952, **77**, 410.
[6] "Nuchar", C-Ungrouind grade (West Virginia Pulp and Paper Co., New York, N.Y., U.S.A.) See BINKLEY: *I.S.J.*, 1963, **65**, 169 for adsorbent conditioning.

was formed from a slurry of a 1:1 (w/w) mixture of "Darco G-60" (Atlas Chemical Co., Wilmington, Del., U.S.A.) and "Celite 535" (Johns-Manville Co., New York, N.Y., U.S.A.) in water. The column was conditioned with aqueous ethanol as described by GROSS[7]. An amount of 2·87 g of the oligosaccharide concentrate in 145 ml of water was added at the top of this column which was then developed with aqueous ethanol in 1 litre lots of increasing strength (10 to 20% in 1% steps). The column effluent was collected in 100 ml fractions and the yield of recovered adsorbate was determined after partial solvent removal under reduced pressure at 60°C followed by drying in vacuum at 25°C over calcium chloride (Fig. 1). These fractions were assayed by paper chromatography[5] and were grouped as l-kestose, tetrasaccharide(s) and higher oligosaccharides. The yield of tetrasaccharide-containing syrups was 1·7 g. An aqueous methanol solution of this syrup gave 1·5 g of elongated plates.

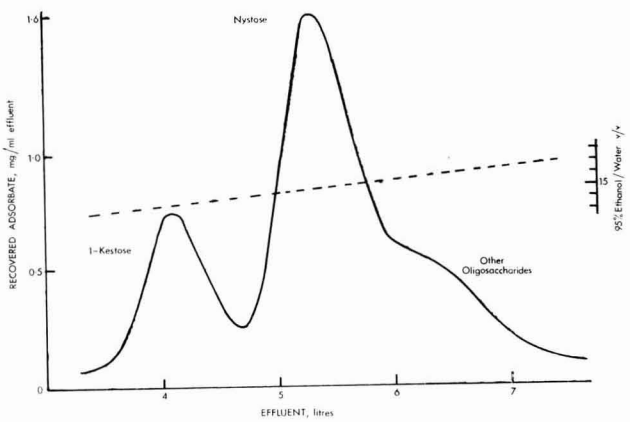


Fig. 1

Nystose.—One lot of crystals from the tetrasaccharide fraction of the preceding chromatogram was recrystallized five times from aqueous methanol.

(A) *Elemental Analysis*.—C, 42·99; H, 6·42; O (by difference), 50·59; mol. wt., 608[8a], 637[8b]; calculated for $C_{24}H_{42}O_{21}$, C, 43·24; H, 6·35; O, 50·51; mol. wt., 666.

(B) *Physical Properties of Nystose*.—Recrystallized nystose melted at 131–132°C, $[\alpha]_D^{20}$ + 10·6° (c 3·9 water), $R_{sucrose}$ 0·37–0·38[5], $M_{sucrose}$ 0·63–0·64 (4 hr at 12°C and 2000 V in a 0·05 M borate buffer at pH 9·2). X-Ray powder diffraction data[9] were as follows: 11·5s, 8·89m, 6·24m, 5·81m, 5·12s, 4·79s, 4·74m, 4·07m, 3·88m, 3·67m, 3·39m, 3·18m, 3·11m, 2·96m, 2·76w, 2·58s, 2·40m, 2·22m, 2·14w, 2·06m, 1·96w. Infra-red spectrum bands[10] between 800 and 950 cm^{-1} were as follows: 947s, 923w, 897m, 876s, 854vw, 835m.

(C) *Qualitative Tests*.—Nystose reacted as follows: Molisch-positive; Benedict, before acid hydrolysis-negative, after acid hydrolysis-positive; invertase-positive; emulsin-negative.

(D) *Hydrolysis of Nystose with Invertase*.—Nystose (50 mg) and invertase (50 mg) in 1·5 ml of distilled water were incubated for 23 hr at 32°C. The reaction mixture was heated at 80°C for a few minutes, cooled to 25°C and deposited at a designated position on a 23 × 45 cm sheet of Whatman No. 17 filter paper. The descending chromatogram was developed at 20°C with 160 ml of 3:3:1 v/v/v acetic acid:ethyl acetate:water. Strips cut from the lengthwise edge of the chromatogram and sprayed with p-anisidine hydrochloride reagent were used as guides in the dissection of the remainder of the chromatogram. Sections of the chromatogram containing adsorbates with the mobilities of fructose and glucose were eluted with distilled water; adsorbate recoveries were 33·2 and 11·7 mg, respectively, fructose/glucose = 2·84/1 (fructosylkestose, 3/1).

A separate lot of nystose at the same concentration was allowed to react with invertase for 23 hr at 20°C. The angular rotation of the resultant solution was —3·93° (D line of sodium). The calculated value for a mixture of 1 mole of D-glucose and 3 moles of D-fructose at the equivalent concentration is —4·02°.

(E) *Controlled Acid Hydrolysis of Nystose and Isolation of* 1-*Kestose from the Hydrolysis Products*.—Nystose (25 mg) in 0·5 ml of 0·005N HCl was heated at 70°C. Aliquots of the reaction mixture were taken at selected intervals and chromatographed at 20°C on Whatman No. 1 filter paper utilizing 2:2:1 v/v/v l-butanol:ethanol:water as the developer and p-anisidine hydrochloride as the spray reagent. In addition to nystose, other detected substances with mobilities identical to l-kestose, fructose, sucrose and glucose appeared in the reaction mixture in the order listed.

A 50 mg lot of nystose in 1·25 ml of 20% aqueous acetic acid was heated for 145 min at 40°C. The reaction mixture, cooled to 25–27°C, was deposited with a streak applicator at a selected position on a 23 × 45 cm sheet of Whatman No. 17 filter paper. The descending chromatogram was developed at 20°C with 410 ml of 7:1:2 v/v/v 1-propanol:ethyl acetate:water, about 90 hr being required. Zone

[7] *Methods in Carbohydrate Chem.*, 1962, **1**, 360.

[8] (a) Ebullioscopic in methanol; (b) Vapour pressure of aqueous solution as determined with a model No. 301A Vapour Pressure Osmometer (Mechrolab Inc., Mountain View, Calif., U.S.A.).

[9] Interplanar spacings expressed in Angstroms; relative intensities estimated visually (s = strong, m = medium, w = weak). CuKα radiation was used for the diffractograms.

[10] These were obtained with a Model B IR Recording Spectrophotometer (Baird Associates Inc., Cambridge, Mass., U.S.A.) using a pellet made from a mixture of 2 mg of sugar and 300 mg of potassium bromide (s = strong, m = medium, w = weak, vw = very weak).

locations were achieved with α-naphthol-phosphoric acid reagent[5] sprayed on guide strips cut from the lengthwise edges of the chromatogram. The yield of residual syrup from the elution with water of the zone with the mobility of l-kestose was 6 mg. Nucleation at 25–27°C with l-kestose of an aqueous methanol solution of several combined lots of this residual syrup yielded crystals with an infra-red spectrum and X-ray powder diffractogram identical to those for l-kestose.

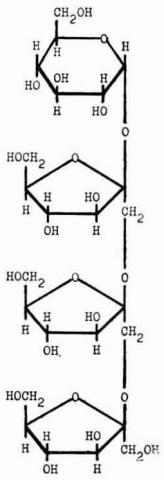


Fig. 2

(F) *Periodate Oxidation of Nystose.*—One half of a millimole of nystose was allowed to react in the dark at 20°C with 5 millimoles of sodium metaperiodate in 100 ml of water. After 24 hr, 4·8 millimoles of oxidant were consumed per millimole of nystose with the concomitant formation of 0·93 millimoles of acid (presumed to be formic acid); 5·0 and 0·96, respectively, after 48 hr. A 1- or 6-fructofuranosylkestose would utilize 5 moles of oxidant while producing 1 mole of formic acid.

(G) *Examination of Higher Oligosaccharide Fraction.* A sample of residual syrup from the higher oligosaccharide fraction of the oligosaccharide concentrate (Fig. 1) was allowed to react at 70°C with 0·005N HCl for 30 min. Paper chromatography as described in the preceding section (E) indicated the probable presence of nystose, l-kestose, sucrose, glucose and fructose among the hydrolysis products.

Discussion

Nystose is a tetrasaccharide composed of one D-glucose and three D-fructose units. Controlled acid hydrolysis revealed that this sugar is a fructosyl-1-kestos, eand periodate oxidation indicated that the fructosyl radical is in the furanose form. The application of Hudson's[11] isorotation rules to nystose strongly suggests that this radical is linked to l-kestose in the beta configuration, the expected linkage from the enzymic synthesis[12] used to prepare this sugar. The structure of nystose is deduced from these data to be *O*-α-D-glucopyranosyl-(1↽⇀2)-*O*-β-D-fructofuranosyl-(1↽2)-*O*-β-D-fructofuranosyl-(1↽2) β-D-fructofuranoside (Fig. 2).

Hudson's[11] isorotation rules provide independent evidence that the anomeric linkage of the fructofuranosyl unit to the sucrose moiety in l-kestose[13] is beta.

Calculations

Molecular Rotation (M) = Specific Rotation × Molecular Weight. Let M_s, $M_{1\text{-}k}$ and M_n = Molecular Rotations for sucrose, l-kestose and nystose, respectively. Since the values for the α- and β-D-fructofuranosyl moieties, $[F + B]$ and $[F - B]$, are + 18,000 and — 8000, respectively[14], then M_n is given by either $M_{1\text{-}k} + [F + B]$ = + 14,400 + 18,000 = + 32,400 or $M_{1\text{-}k} + [F - B]$ = + 14,400 — 8000 = + 6,400. The value found for M_n is + 10·6 × 666 = + 7,100.

Similarly the value of $M_{1\text{-}k}$ is given by either $M_s + [F + B]$ = + 22,700 + 18,000 = + 40,700 or $M_s + [F - B]$ = + 22,600 — 8000 = + 14,700. The value found for $M_{1\text{-}k}$ is + 28·5 × 504 = + 14,400.

Summary

A crystalline fructosyl-1-kestose, designated nystose, was isolated from the products of the action of a fungal alpha amylase on sucrose. Structural studies strongly suggested that this tetrasaccharide is *O*-α-D-glucopyranosyl-(1↽⇀2)-*O*-β-D-fructofuranosyl-(1↽2)-*O*-β-D-fructofuranosyl-(1↽2) β-D-fructofuranoside.

Acknowledgment

Thanks are due Mr. E. J. Roberts, Sugar Investigations, United States Department of Agriculture, for his assistance with the paper electrophoresis and Mr. H. Chanzy, State University College of Forestry at Syracuse University, for his assistance with the X-ray diffractograms.

[11] *J. Amer. Chem. Soc.*, 1909, **31**, 66; 1916, **38**, 1566.
[12] Gross *et al.*: *J. Chem. Soc.*, 1954, 1727.
[13] Bacon & Bell: *J. Chem. Soc.*, 1953, 2528.
[14] Wolfrom & Shafizadeh: *J. Org. Chem.*, 1956, **21**, 88.

SIMPLE METHOD OF MORE ACCURATE MEASUREMENT OF FILTRATION COEFFICIENT F_k

by Dr. JAN DOBRZYCKI
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THE method developed by Brieghel-Müller[1] for measuring the filtration coefficient F_k consists of filtration of the juice through a micro-filter (of 2 sq.cm. filter surface) at constant pressure difference (40 cm Hg). The filtrate is collected in a burette calibrated in ml, and the time when the juice level reaches the 1, 4 and 5 ml marks is noted.

The F_k value is then calculated using the following formula:

$$F_k = \frac{S^2}{(V_2 - V_1)\,(V_3 - V_1)}\,[(t_4 - t_3) - (t_2 - t_1)] \quad (1)$$

where, in this case, S = 2 sq.cm., V_1 = 0 and t_1 = 0, V_2 = 1 ml, V_3 = 4 ml and V_4 = 5 ml.

[1] *Kolloidz.*, 1940, **92**, 285; 1940, **93**, 306; 1941, **95**, 82.

Thus, the original equation reduces to

$$F_k = (t_4 - t_3) - (t_2 - t_1) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

If a number of F_k determinations are made in the same juice, scattering of the results occurs which in practice often reaches $\pm$ 10%. (This also happens when the mud structure does not alter with time.) A single measurement of F_k thus carries with it a degree of uncertainty.

For scientific experiments, several parallel measurements should be made and a mean value calculated. However, with precipitates exhibiting rapid changes (recrystallization) this does not help.

To reduce the error without prolonging the test time, a method of series measurement was developed in which the times of the juice level at several marks on the burette were noted. This necessitates using two ordinary stop watches or a double-hand stop watch.

Generalization of the F_k Measurement

Let us assume that the filtration times of the successive n ml of the filtrate were measured as:

Filtrate volume, v	0	1	2	3	..	n ml
Time (from start of measurement), t	0	t_1	t_2	t_3	..	t_n sec
Filtration time of single ml, T ($T_n = t_n - t_{n-1}$)		T_1	T_2	T_3	..	T_n sec

Ideally, the filtration time of a single ml T is a linear function of volume v. From the definition of the coefficient F_k we can derive

$$S^2 T = F_k \cdot v + b \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

If the measured results are plotted as points in a graph of T *vs.* v, they lie close to the ideal straight line (see, for instance, Fig. 1). The least squares method permits us to find an equation for the straight line which best describes the measured results.

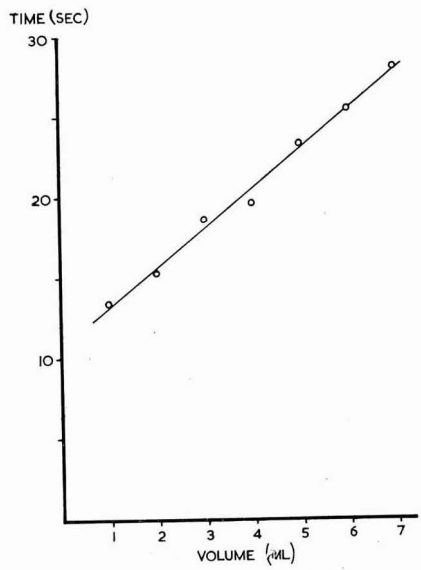


Fig. 1

We denote the error, i.e. the deviation of the measured values of T from the values calculated from the linear equation, by e

$$e = v \frac{F_k}{S^2} + B - T \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where $B = \frac{b}{S^2}$.

Deviations of the individual points from the straight line and the squares of these deviations then equal

$$e_n = n\frac{F_k}{S^2} + B - T_n \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$\text{and } e_n^2 = (n \text{ and } \frac{F_k}{S^2} + B - T_n)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The sum of the squares

$$\Sigma e_n^2 = \Sigma (n\frac{F_k}{S^2} + B - T_n)^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

For this sum to be at a minimum, its partial derivatives with respect to F_k and B must equal zero:

$$\frac{\mathrm{d}\,\Sigma e_n^2}{\mathrm{d}F_k} = \Sigma\, 2\,(n\,\frac{F_k}{S^2} + B - T_n)\,\frac{u}{S^2} = 0 \quad \ldots\ldots (8)$$

$$\frac{\mathrm{d}\,\Sigma e_n^2}{\mathrm{d}B} = \Sigma\, 2\,(n\,\frac{F_k}{S^2} + B - T_n) = 0 \quad \ldots\ldots\ldots (9)$$

After separating these sums into their components and placing the constants before the sum symbols, a system of two equations is obtained:

$$\frac{F_k}{S^2}\,\Sigma\, n^2 + B\,\Sigma\, n = \Sigma\, n.\, T_n \quad \ldots\ldots\ldots\ldots (10)$$

$$\frac{F_k}{S^2}\,\Sigma\, n + B.\, n = \Sigma\, T_n \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Hence

$$\frac{F_k}{S^2} = \frac{n\,\Sigma\, n\, T_n - \Sigma\, T_n\, \Sigma n}{n\,\Sigma\, n^2 - (\Sigma\, n)^2} \quad \ldots\ldots\ldots\ldots (12)$$

Now we can insert

$$\Sigma\, T_n = t_n$$
$$\Sigma\, nT_n = nt_n - (t_{n-1} + \ldots + t_2 + t_1)$$
$$\Sigma\, n = \tfrac{1}{2}n\,(n+1)$$
$$\Sigma\, n^2 = \tfrac{1}{6}n\,(n+1)\,(2n+1)$$

and $S^2 = 4$.

The final formula takes the form

$$F_k = \frac{24}{n\,(n^2-1)}\left[\,(n-1)\,t_n - 2(t_1 + t_2 + \ldots \right.$$
$$\left. \ldots\ldots\ldots\ldots\ldots\ldots + t_{n-1})\right] \ldots\ldots\ldots (13)$$

According to the number of times t noted, this formula takes the following very simple forms:

$$n = 4,\ F_k = \frac{6}{15}\left[\,3t_4 - 2\,(t_1 + t_2 + t_3)\,\right]$$

$$n = 5,\ F_k = \frac{2}{5}\left[\,2t_5 - (t_1 + t_2 + t_3 + t_4)\,\right]$$

$$n = 6,\ F_k = \frac{4}{35}\left[\,5t_6 - 2(t_1 + t_2 + t_3 + t_4 + t_5)\right]$$

$$n = 7,\ F_k = \frac{1}{7}\left[\,3\,t_7 - (t_1 + t_2 + t_3 + t_4 + t_5 + t_6)\right]$$

Example:

$v = 0$	1	2	3	4	5	6	7	ml
$t = 0$	31·4	28·6	47·2	67·0	90·4	116·0	144·1	sec

$$F_k = \frac{1}{7}\left[\, 3 \times 144{\cdot}1 - (13{\cdot}4 + 28{\cdot}6 + 47{\cdot}2 + 67{\cdot}0 + 90{\cdot}4 + 116{\cdot}0)\right] = 69{\cdot}7 \div 7 = 9{\cdot}96.$$

Thus a greater accuracy is obtained with only a slight increase in the time involved.

SUMMARY

Determination of the filtration coefficient F_k according to BRIEGHEL-MÜLLER is based on the filtration time measurement of two definite filtrate volumes in a laboratory apparatus at constant pressure. From analysis of experimental data one can conclude that the filtration time recording is subject to random errors; their magnitude has an important effect on the result of a calculation if this is done by a standard method.

To increase the accuracy of a single F_k determination, a new modified method has been developed and tested. At the moment when the filtrate level reaches the zero mark on the burette, a stop watch is set in motion which then records moments at which the filtrate reaches successive levels of 1,2,3 . . . n ml. A formula has been derived for calculation of F_k from such measurements.

SUGAR IN NIGERIA

The Nigerian Sugar Co. Ltd., the first commercial sugar producer in Nigeria, commenced production at its Bacita factory on the 24th December 1964. The illustrations are of some of the initial supplies of cane brought to the factory in tractor-drawn cane carts, shown leaving the weighbridges in Fig. 1, and being transferred to the cane feeder table in Fig. 2.

Fig. 3 shows the cane on one of the intermediate carriers between mills. This season the Company, whose Managing Agents are Bookers (Nigeria) Ltd., expects to produce at least 10,000 tons of sugar, and next season the target is 30,000 tons. Development of the estate is being actively planned to enable it to produce up to 60,000 tons annually.

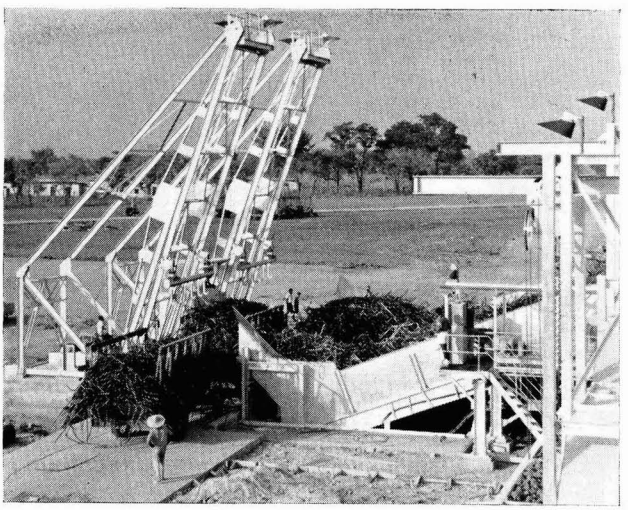


Fig. 2

Fig. 1

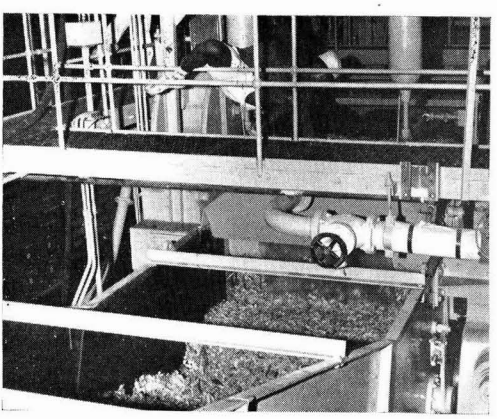
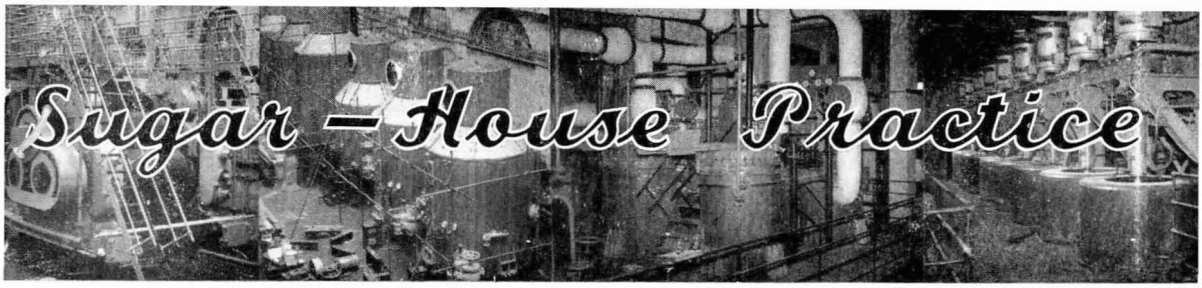


Fig. 3



Recent advances in sugar technology in India. G. R. ATHAVALE. *Indian Sugar*, 1964, **14**, 129–132.—The contributions of Indian authors to the literature of sugar technology in 1962/63 are surveyed.

* * *

Thoughts on (the) vacuum pan boiling station. T. S. RAO. *Indian Sugar*, 1964, **14**, 133–135.—Various aspects of boiling and pan design are considered.

* * *

The process that gave higher boiling house efficiency and better quality sugar with increased crushing rate. B. L. MITTAL. *Indian Sugar*, 1964, **14**, 137–143. More than 50% of the cane received at the author's factory was stale and the equipment available was of small capacity to deal with the tonnage crushed. The clarification technique introduced was devised to avoid destruction of reducing sugars, the juice being heated only to 140°F, pre-sulphited, limed in 2 or 3 doses and sulphited to pH 7·2. The treated juice was heated to 205°F (212°F was aimed for but was not possible). By maintaining the Brix constant at a value below 16°Bx the juice behaves uniformly in the clarifier and settling is better, giving a clearer juice and thicker mud. The 8 filter-presses had been operated in a rather haphazard way, but by operating a two-batch system with 4 presses starting and finishing at a time, over set periods, good filtration was achieved together with lower (2·8–3·5%) pol % mud. The press-juice was returned to the clarifier to prevent any muddy juice leakage entering the evaporator. The *A*-massecuite (of 85–63 average purity) was boiled with syrup, *A* light molasses and remelted double-cured *C*-sugar, using single-cured *B*-sugar as seed. The *B*-massecuite was grained on syrup and *A* heavy molasses, mingled with syrup or water and used as seed for further *B* strikes as well as the *A* strikes. A double amount of the *C*-massecuite was grained as with the *B*-massecuite and built up on *A* molasses after which it was split, each half being fed with *B* heavy molasses and *C* light molasses. This scheme avoided overloading of the pans and centrifugals, gave better and more uniform sugar and eliminated difficulty in drying of the sugar. Care and judicious cooling and dilution of massecuites in the crystallizers were necessary to reduce the sugar loss in final molasses. Further points are made regarding undetermined loss in the clarifier, by entrainment, etc.

* * *

Steam economy measures. I. S. L. PHANSALKAR, M. SINGH and L. SANYAL. *Indian Sugar*, 1964, **14**, 215–220.—Various means of improving heat economy are mentioned, and factors involved in one method—vapour bleeding—are discussed. Calculations are presented for systems to be applied in carbonatation and sulphitation factories where a vapour cell is used in conjunction with a quadruple-effect evaporator. In the carbonatation factory, juice heating using 1st and 2nd vapour, as well as steam, reduces total steam consumption from 81,060 to 62,524 lb/hr for a 1500-ton crushing capacity, while for a sulphitation plant the figure is reduced from 79,076 to 60,886 lb/hr.

* * *

Low-grade and affination work with continuous centrifugals. M. ATHENSTEDT. *Zeitsch. Zuckerind.*, 1964, **89**, 460–462.—In low-grade curing using BMA K 1000 continuous centrifugals, throughput was considerably affected by massecuite viscosity, the maximum being 3–3·5 tons/hr. The minimum temperature at curing should be 50°C and the Brix not allowed to exceed 90–91°. The colour and conductimetric ash content of the sugar were better than when the same massecuite was treated in other continuous centrifugals with smaller baskets and operated at a considerably higher speed (2600 r.p.m.). While reduction in the throughput of the latter machines led to an improvement in the sugar quality, crystal abrasion and molasses purity also increased. The K 1000 machine operated at 1400 or 1800 r.p.m. and had a nickel screen, hard chromed on the working side, with 0·06 mm slits. In affination trials, capacity of the K 1000 centrifugals reached 6–8 tons/hr using a speed of 1450 r.p.m. and basket screen slits measuring 0·12 mm. Capacity could be varied from 4 to 12 tons/hr without adverse effect on the affination sugar quality.

* * *

Economic and other advantages of increasing mill capacity. M. J. MCNULTY. *Sugar J.* (La.), 1964, **27**, (3), 20–22.—To meet expanding cane production in Louisiana, two new factories are under construction and most existing mills have expansion plans. It is pointed out that many mills operated at lower than their potential capacity and that more cane could be crushed with little expense if a number of recommendations were followed, such as delivery of a constant supply of fresh, clean cane to the mill, good preparation, even feed to the crusher or shredder, adequate mill settings, free-moving hydraulic rams, etc.

* * *

Automatic mill feeding at St. Antoine sugar factory. F. DUMONT. *Rev. Agric. Sucr.* (Mauritius), 1964, **13**, 128–130.—To ensure even feeding to the mill, there is a photo-electric cell mounted in the feed chute at such a point that the thickness of the blanket is at an optimum when the cell is not completely covered. The photo-cell receives light from a lamp on the other side of the chute and controls the magnetic

coupling of the cane carrier drive; when the cell is covered the carrier slows and when it is uncovered the carrier speeds up, thereby achieving an even supply to the mill.

* * *

Burning bagasse and wet wood refuse. J. E. NEILSON. *Sugar News* (Philippines), 1964, **40,** 319–323.—A Foster Wheeler (Canada) Ltd. design of furnace, suitable equally for wet wood refuse and bagasse, is described with an account of applications with both fuels. The bagasse furnace at Ingenio San Carlos, in Colombia, uses an SA-type boiler with tubular air heater, forced and induced draught fans, and does not require a dust collector. It has produced up to 40,000 lb of steam per hr, and design conditions are 220°F feed temperature, 275 p.s.i. steam pressure and 520°F steam temperature. Efficiency is 65% when burning bagasse of 50% moisture and 3½% maximum ash content. Its principal characteristic is an inclined water-cooled grate. Advantages of the design are listed.

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Relation between compressive force, peripheral force and (hydraulic) pressure (in a cane mill). T. SUMOHANDOJO. *Balai Penjelidikan Perusahaan*[2] *Gula, Warta Bulanan,* 1963, 499–506; through *S.I.A.*, 1964, **26,** Abs. 566.—Equations are derived from a consideration of the static forces acting on the bagasse or cane blanket entering or leaving the mill. Values for the peripheral force P_w and the compressive force P of a two-roll unit, in kg, are given by $P_w = h(D + h)\, p_c L/2D(1 + 2\mu_o)$ and $P = hp_cL/2\mu_o$, where h = work opening, D = roll diameter, L = roll width, μ_o = coefficient of friction at entry, and p_c = pressure (kg/sq.cm.) between rolls. The value of p_c may be found from the dynamic equation of JENKINS[1], $p_c = 88/(10C_o)^6$, where C_o = compression ratio $h/[h + D(1-\cos\gamma)]$, γ being the angle between the point of contact of the blanket with the roll and the work opening. Values of μ_o vary from 0·30 for the crusher to 0·34 for the 1st mill and 0·37 for the 4th mill, and from 0·395 for the 1st mill to 0·410 for the 4th mill in the case of bagasse rolls. Values of the top roll load for a 3-roll mill are found from the P values for both compressions. The indicated power for driving the mill (in i.h.p.) is given by the formula $Akd^2pDn \times 10^{-8}$, where A,k are constants (in the range 1·30–1·65 and 4·15–4·75, respectively) depending on the type of unit, d = diameter of hydraulic cylinder, p = hydraulic gauge pressure, and n = revolutions/hour.

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Modern system of washing and drying of high grade massecuite sugars by superheated water. S. K. SINGHAL. *Indian Sugar,* 1964, **14,** 283–286.—Washing in centrifugals is discussed, with an account of the advantages of superheated water—condensates raised to 110–115°C under pressure. This has been adopted at Bagpat Coop. Sugar Mills Ltd. and experience there is described. Washing with superheated water was found to be more efficient than washing with water followed by drying with saturated steam; less water was necessary, resulting in reduced dissolving of sugar, and sugar quality was adequate after single curing so that double curing could be dispensed with. The sugar produced was cooler, thus reducing the likelihood of hardening in the sacks.

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Chromising of (a) worn-out turbine shaft. Y. C. YEN. *Taiwan Sugar Quarterly,* 1964, **11,** (2), 33–35.—A replacement for a broken pinion was found to have a gap of 0·3–0·5 mm between its bore and the turbine shaft which it should have fitted. With only two weeks before the start of the campaign, various measures were attempted to fill the gap and a solution found in electroplating the shaft with chromium followed by grinding to the correct diameter.

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Capacity of milling tandems consisting of mills of heterogeneous sizes. A. VAN HENGEL. *S. African Sugar J.*, 1964, **48,** 669–671.—Unit load on a cane milling tandem, expressed in terms of lb of fibre per hr per cu.ft. of total roller volume, is an adequate way of assessing cane crushing capacity of a mill with rollers of the same size. For mills with rollers of different size, a corrected formula is recommended. This was developed by the Java Experiment Station before the war and is expressed as

$$R_o \text{ (overall rating)} = \frac{(n-1)R_1 + R_2 + R_3 \ldots . R_n}{2(n-1)},$$

where n is the number of mills, R_o is the overall rating and R_1–R_n are individual ratings for mills 1 to n, this rating R being the value of $\frac{D^2L}{33^2 \times 66}$, where D = roller diameter (in) and L is the roller length (in), the figures 33 and 66 referring to these dimensions for the commonest size found in Natal.

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Application of clarifying aids at Illovo. J. BRUIJN. *S. African Sugar J.*, 1964, **48,** 673–677.—"Viscalin" was compared with "Separan AP-30" as a flocculant additive in clarification. Results of laboratory tests varied with the nature of the juice. No influence was found on starch removal or phosphate removal. Both aids improved mud compactness—the "Viscalin" to a little greater extent—so giving a slight increase in clarifier capacity. There was no indication of improvement in clear juice quality.

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Parallel flow condensers. C. G. M. PERK. *S. African Sugar J.*, 1964, **48,** 679.—Conflow or parallel-flow condensers are simpler and cheaper than counter-flow designs; however, they have certain disadvantages which are discussed.

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Juice clarification experiments on two commercial flocculants—1963 Louisiana crop. E. E. COLL, W. F. GUILBEAU, J. T. JACKSON and S. J. CANGEMI. *Sugar Bull.*, 1964, **48,** 3¼–317.—"Separan AP-30" and "Nalco D-1782" were found to be equal in their

[1] *I.S.J.*, 1957, **59,** 48.

ability to improve settling of insolubles during juice clarification while processing clean, fresh cane and commercial cane very high in trash and soil. Increasing the flocculant rate from 2 to 6 p.p.m. did not further improve settling of juice from clean cane but similar tests were not made on juice from trashy and dirty cane to establish the best addition rate for varying amounts of soil.

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Cane sugar engineering: a survey. G. H. JENKINS. *Sugar y Azúcar*, 1964, **59,** (9), 85–87.—A review is provided on progress in various departments of the cane sugar factory since 1914.

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Progress in sugar technology. P. HONIG. *Sugar y Azúcar*, 1964, **59,** (9), 91–93.—Criteria for judging progress in the sugar industry are discussed and developments over the past 50 years surveyed.

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Refining: a progress report. TECHNICAL STAFF, C. & H. SUGAR REFINING CORP. *Sugar y Azúcar*, 1964, **59,** (9), 94–97.—Changes which have occurred in the conditions applying and methods used in the U.S. sugar refining industry since 1914 are discussed.

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Experimental determination of the physico-mechanical properties of pressed refined sugar. V. Z. SHAPRAN. *Sakhar. Prom.*, 1964, **38,** 736–743.—The properties were determined as a contribution to the design of automatic feeders for pressed sugar packeting machines. They included: (1) the coefficient of friction along various materials at different speeds; (2) impact resistance, measured at various moisture contents; (3) the coefficient of "speed recovery" after impact (i.e. the height of rebound after dropping onto a plate, found to be almost non-existent); and (4) wear—again found to be negligible in the case of sugar fed by centrifugal or vibratory feeders. Graphs of the results are given.

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Bulk storage of raw sugar. O. N. RIDIN. *Sakhar. Prom.*, 1964, **38,** 764–767.—Information is given on the first bulk sugar storage installation to be erected in the U.S.S.R. It consists of three concrete silos each having a capacity of 10,000 tons of sugar. Details are given of the loading and reclaiming equipment and of the air-conditioning plant. Advantages of bulk storage are discussed.

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Study of working processes in the continuous crystallization of sugar. V. D. POPOV. *Izv. Vysshikh Ucheb. Zaved., Pisch. Tekhnol.*, 1964, (2), 122–125, 146.—A brief survey (with 16 references) is given of crystallization studies in the Soviet Union and development of dimensionless equations concerning heat transfer and massecuite circulation in vacuum pans as a guide for the design of continuous pans and crystallizers.

Effect of sugar juice flow rate on the thermal resistance of scale and on heat transfer during boiling. N. YU. TOBILEVICH, I. I. SAGAN', V. G. GARYAZHA, S. I. TKACHENKO, V. S. VOVCHENKO and V. V. IVASHKEVICH. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 106–109.—The effect of juice flow rate on the thermal resistance due to scale with time was studied in a vertical tube heater. The steam pressure was adjusted to maintain constant heat transfer rates. In all cases the amount of scale deposited was inversely proportional to juice flow rate. After 7 days the coefficient of heat resistance due to scale rose almost linearly from zero to 2200, 750, 400 and 270 sq.m./hr/°C/kcal respectively at 0·5, 1·0, 1·5 and 2·0 m/sec juice flow rate.

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Refinement of a criterial equation for heat transfer in massecuite boiling. E. A. NEDUZKHO. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 125–126, 146.—The dimensionless equation developed by POPOV[1], relating to heat transfer in boiling, has been slightly modified to take account of new data concerning thermal conductivity and rates of bubble formation. The modified equation takes the form:

$$Nu\ Pr^{0\cdot1}{}_{e}{}^{0\cdot25}\left(\frac{Kp}{100-Kp}\right)^{2} = 21\ K_x{}^{0\cdot6}$$

where Nu = Nusselt number, Pr = Prandtl number, Kp = crystal content (%) and K_x = Tolubinskii number, which is given by $\frac{q}{r\rho'' d_o u}$, where q = specific heat flow (joules/sq.m./sec), r = heat of evaporation (joules/kg), ρ'' = vapour density (kg/cu.m.) and $d_o u$ = rate of growth of vapour bubbles (m/sec). It has been found that the bubble growth rate depends essentially on the vacuum, and experimental values range from 0·306 m/sec at $1{\cdot}96 \times 10^9$ dynes/sq.m. to 0·153 m/sec at $9{\cdot}81 \times 10^9$ dynes/sq.m. Boiling tests with 2nd refinery and 1st beet massecuites showed the equation to be accurate to within ±15%.

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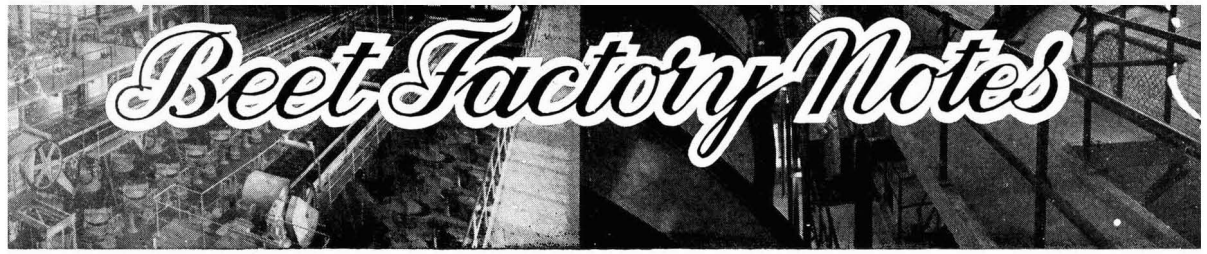
Calculation of technological characteristics of sugar crystallization in vacuum pans. I. S. SKRIPKO. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 130–133, 146.—Simple equations derived from the basic equation for calculation of crystal content[2] are used to explain a method for calculating massecuite weight, purity, Brix and sugar content, the amount of syrup added and the quantity of water evaporated at any given time from graining to dropping. The values are expressed as percentages of the graining charge (weight or volume) per sq.m. of h.s. Graphs are presented showing the changes in the calculated absolute and relative values with time.

[1] *Trudy Kiev. Tekhnol. Inst. Pisch. Prom.*, 1955, **15,** 197–201.
[2] *I.S.J.*, 1964, **66,** 230.



Curing of sugar. I. N. KAGANOV. *Sakhar. Prom.*, 1964, **38**, 578–579.—A massecuite curing balance is demonstrated, starting with the composition of raw syrup and raw washings; all the quantities are expressed on 100 kg beet, except the wash water, which is given as % massecuite or % sugar.

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Arrangement of the vacuum filtration station at sugar factories. L. S. TVERDOKHLEBOV. *Sakhar. Prom.*, 1964, **38**, 589–591.—The relative positions of clarifiers, vacuum filters and juice receivers are discussed. They should be so arranged that the thickened clarifier muds flow under gravity to the vacuum filters on the 2nd storey and the filtrate allowed to flow to the receivers at a gradient no less than 1:200.

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Quality of lime. L. P. SOFRONYUK. *Sakhar. Prom.*, 1964, **38**, 591–594.—The effect of lime quality on slaking efficiency is discussed. Results of tests on building and sugar factory lime from bulk stores and from kilns are tabulated. Further tests with building lime stored in bulk in the open were intended to show the effect of lime quality on sugar solutions. The lime was crushed and added dry to solutions of white and brown sugar and molasses (2 g lime/100 c.c. solution) previously heated to 70°C. After 30 minutes' heating at room temperature, the solutions were filtered and 10 c.c. of the filtrate titrated with N/10 sulphuric acid. The results show that the higher the quality of the lime, the greater was the mud volume and the higher was the alkalinity of the sugar solution. Lime exposed to atmospheric dampness was generally ineffective in non-sugar removal.

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Increasing the throughput of a chemical water purification plant. L. A. BABICH. *Sakhar. Prom.*, 1964, **38**, 599.—Information is given on the water treatment at No. 1 Petrovsk sugar factory. The plant consists of two sand filters and two single-stage cation exchange vessels; the total throughput is 30 cu.m./hr at a true steam consumption of 120 tons/hr. For three years sweet condensate has been used as boiler feed water. The adverse effects of organic compounds and sugar in the feed water are discussed and preventive measures briefly mentioned.

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Some results of processing mechanically-harvested beet at Zhashkovskii factory. A. P. PARKHOD'KO and K. I. BARBASHINA. *Sakhar. Prom.*, 1964, **38**, 614–619. Storage tests were conducted over 45–50 days on mechanically-harvested and manually-lifted beet. Ventilation through concrete ducts was not as successful as expected. The daily losses in manually-lifted beet were 0·008% by weight compared with 0·014% with the mechanically-harvested beet. Details are given of the new beet handling equipment. Processing of mechanically-harvested beet was started without any adjustment after normal beet processings. All factors were adversely affected. Measures adopted to counter the difficulties are listed and further planned alterations to equipment and processes are discussed.

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Changes in the weight of beet during fluming and washing. L. SCHMIDT and J. ZAHRADNÍČEK. *Listy Cukr.*, 1964, **80**, 169–171.—Beet, after placing in a water bath for 30 min and draining for 2 min, showed a weight increase proportionately greater the smaller was the beet. The weight of healthy beet, e.g. in the range 400–600 g, increased by 1·18–1·28%. The proportions of surface and absorbed water making up the total weight increase are tabulated. Beet previously dried at 20°C before fluming and washing exhibited greater weight increase than undried beet, a weight loss by drying of 0·1% causing an ultimate further weight increase of 0·13%. Half-rotten and mouldy beet also showed greater weight increase. Increase in temperature of the flume water by 1°C caused a weight increase of approximately 0·01%. The weight increase was greater the longer was the time of contact between beet and water.

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Flocculating agents in the sugar industry. III. Full-scale application of "Akrynax 2" synthetic copolymer. R. OSVALD and H. KRATOCHVILOVÁ. *Listy Cukr.*, 1964, **80**, 175–182.—Details are given of factory tests using "Akrynax 2" flocculant of Czechoslovak origin. When added to 1st carbonatation muddy juice as a 0·5–1·0% aqueous alkaline solution (2 parts "Akrynax 2" to 1 part NaOH) in an amount equivalent to 1–2 mg % dry flocculant on weight of juice, the polyelectrolyte increased the settling rate by 257% and reduced the filtration coefficient by 35% and the mud volume by 18%. The supernatant was clear and sparkling, even when deteriorated beet were being processed. The flocculant should preferably be mixed with the juice before the clarifiers.

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Fluidization of crystal sugar. L. NEUŽIL, J. TURCAJ and V. VALTER. *Listy Cukr.*, 1964, **80**, 182–191. Fourteen samples of sugar of 0·2–2·5 mm grain size and of varying granulometry were used in studies of the dynamics of fluidization. Electrically heated air was blown up through a column in which the sugar was piled on an interchangeable grid. The threshold fluidization rate was not significantly affected by bed height or type of grid. Spacing within

the bed was largely independent of grain size, type of grid and temperature, but was lower with a higher bed. For uniform fluidization the grid should have a voids area of less than 10%, the grain size and grid openings being approximately identical, the bed no higher than the column diameter, the sugar moisture no more than 0·1% and care taken to ensure good earthing of the heating equipment to eliminate the effect of static electricity. A number of equations are given relating the various parameters involved.

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Air-cooling of low-grade massecuite. G. VAVRINECZ. *Cukoripar*, 1964, **17**, 209–211.—At Szolnok sugar factory air-cooling of low-grade massecuite[1] enabled factory throughput to be increased by 10% without any adverse effect on massecuite quality and molasses exhaustion. The advantages of the method include easy control, elimination of false grain and efficient massecuite curing. A higher molasses purity was attributed to a high ash content in the beet resulting from dry weather.

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Further observations on the Quentin process at the Franken sugar factory, Ochsenfurt, in the 1963/64 campaign. H. NEUMANN. *Zucker*, 1964, **17**, 451–457. Details are given of the Quentin plant for purification of B-molasses[2]. The plant has been enlarged to handle all the B-molasses produced compared with only 50–60% previously. The system includes three filters; filter I contained "Nekrolith MM" resin, the contents of filter II were one-third "Nekrolith MM" and two-thirds a new form of this resin, while filter III contained "Nekrolith RPP" resin. The respective efficiencies of these filters in replacement of K by Mg were 34%, 44% and 61%, and in replacement of Na by Mg 32%, 39% and 54%. The "Nekrolith RPP" resin is not only more efficient but also has a better structure and suffered only 3% leakage throughout a whole campaign. The treated molasses analyses and yields are given in graph form by weeks, as are their viscosities and Brix. An additional sugar yield of 0·40% on beet was obtained.

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Development work in juice purification at De Danske Sukkerfabrikker (Danish Sugar Corporation). H. BRÜNICHE-OLSEN. *Zeitsch. Zuckerind.*, 1964, **89**, 445–448.—A survey is presented of work carried out on juice purification in Denmark starting with the batch system used up to 1950 and ending with the system used at present in most Danish sugar factories and in many factories outside Denmark. In this, raw juice at 35–40°C is pre-limed to 0·15–0·20% CaO alkalinity, a set quantity of concentrated 1st carbonatation mud being added. The juice is limed at 40–45°C to 0·4–0·5% CaO alkalinity during 30–60 min, heated to 85°C and the alkalinity raised to 0·9–1·0% CaO alkalinity in 1st carbonatation. After 30–40 minutes' retention in a Dorr clarifier, 75% of the muddy juice is recovered as clear juice; one-third of the mud is sent to the vacuum filters and the remainder either returned to pre-liming or concentrated in other filters. The filter-cake is returned, without sweetening-off, to pre-liming. A description is given of the Brieghel-Müller pre-liming trough.

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Effective protection against corrosion for practical purposes. W. DRÖGE. *Zucker*, 1964, **17**, 482–487. The advantages of rubber as an anti-corrosion material are discussed and an illustrated account is given of the processes involved in rubberizing and vulcanizing. Other protective agents are briefly mentioned, including paints, plastics and metals.

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Distribution of airborne mesophilic bacteria, yeasts and moulds in beet sugar factories. P. S. NICHOLES. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **12**, 666–671. Air sampling showed the mould content to be usually high in air carrying large amounts of sugar dust, as in the bulk silo tunnels. This is especially true where air is rapidly circulated by large fans and dust "swept" off the top of the sugar. The circulation also tends to keep dust stirred up throughout the bulk store. Spun glass filters placed in the air circulation path remove a fairly large proportion of miro-organisms but their efficiency could and should be increased. The "Precipitron", in conjunction with such filters, removes most bacteria, yeasts and moulds from air forced through the granulator. Yeasts and moulds were found most often in sugar dust-laden air, while high mesophilic bacteria counts in granulated sugar were reflected in high counts in the air passing over it.

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Filtration and settling. I. G. CHUGUNOV. *Sakhar. Prom.*, 1964, **38**, 656–658.—Disadvantages of disc pressure filters for 1st carbonatation juice treatment are discussed. The most suitable equipment is considered to be vacuum filters in conjunction with either settlers or filter-thickeners. The argument that settling has an adverse effect on sugar is refuted.

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The effect of beet slicer operation on the smooth performance of diffusers. A. A. ROKITSKII and M. I. KULIK. *Sakhar. Prom.*, 1964, **38**, 658–661.—For smooth operation of continuous diffusers it is necessary that the beet slicers operate at a speed in step with that of the diffusers while producing optimum quality cossettes. Possible means of governing speed changes over an optimum range are discussed. The present widely-used generator-to-motor system is adequate but has a number of snags. Hydraulic clutches and induction friction clutches suffer high power losses and generate much heat over a long period at low output speeds; other defects are also mentioned. To reduce the speed range and hence obviate the need (with a wide speed range) to cut the number of knife frames, the present reduction gears should be replaced by new ones.

[1] *See* GYORY: *I.S.J.*, 1964, **66**, 363.
[2] *See I.S.J.*, 1960, **62**, 47.

Changes in some physico-chemical properties of syrup during filtration through kieselguhr. T. F. GORB, M. M. POLYACHENKO, E. T. USKOVA and M. V. ARTEMENKO. *Izv. Vysshikh Ucheb. Zaved., Pishch. Tekhnol.*, 1964, (2), 60–61.—A 60°Bx, 90 purity beet thick juice at 80°C was filtered through kieselguhr (1 g/400 ml juice); the turbidity was reduced by 20–25%, while the viscosity and surface tension did not alter significantly, although the latter did tend to increase after filtration. The greatest turbidity reduction was achieved with kieselguhr roasted at 900°C. Elutriation of the crushed raw kieselguhr and/or addition of NaCl or $CaCl_2$ before roasting did not improve its performance.

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System of nomograms for standardizing the work of diffuser stations. A. K. BURYMA. *Sakhar. Prom.*, 1964, **38**, 661–669.—A system of four nomograms is presented for calculating sugar loss (% weight of sugar in beet) from a large number of factors involved in a rather complex diffusion equation. The value given by the last nomogram may be converted by a simple equation to the sugar lost in pulp % weight of beet. Values of the two constants of the diffusion equation (one for the type of diffuser and the other relating the actual cossette retention time and the calculated diffusion period) are tabulated. A worked example using data for a KDA-58 continuous tower diffuser is given and close agreement found between calculated and measured loss. Cossette length, beet sugar content and average diffusion temperature are shown to have greatest effect on losses, while retention time and juice draught have least effect on sugar extraction.

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Results of tests with an MBO-5M beet piler. A. V. BAIKO, B. I. KUSHCHEV and L. D. TURAEV. *Sakhar. Prom.*, 1964, **38**, 669–674.—The piler described has a tipping platform to raise and unload lorries up to a gross weight of 7 tons, a conveyor for soil removal, a beet sampler, a unit for spraying piled beet with disinfectant, and an adjustable piling conveyor. The advantages and disadvantages of the machine are noted.

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Some physico-chemical properties of beet as a mass bulk load. N. M. KICHIGIN. *Sakhar. Prom.*, 1964, **38**, 675–678.—From the range of bulk weights found, it is deduced that beet occupy only 45–70% of the total available space in a pile, the bulk weight being greatly increased by soil and beet fragments. The angle of repose of piled beet varies considerably (38–39° is taken as basis for the designing of equipment) and factors affecting it and the angle of friction are discussed. Beet tensile strength is considerably affected by the beet mass. During transference to hoppers, the degree of damage is affected by the height of drop, size of beet and the condition of the beet. The effect of pressure in tall piles is considered. The effects of moisture and of freezing on beet movement in hoppers and conveyors and the question of angles of slope involved are also discussed.

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Measurement of temperature differences in heat transfer equipment. I. A. TRUB and T. YA FEDORUK. *Sakhar. Prom.*, 1964, **38**, 678–681.—The advantages and disadvantages are discussed of resistance thermometers and of differential thermo-columns (comprising a number of thermo-couples in two groups with an equal number of junctions and a galvanometer) for measuring the effective temperature difference between saturated heating steam and the contents of evaporators and vacuum pans.

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Heater calculations. M. L. VAISMAN. *Sakhar. Prom.*, 1964, **38**, 681–683.—The contention that juice heaters in many Soviet sugar factories fall short of requirements[1] is refuted. It is pointed out that the coefficient of heat surface utilization depends not only on the length of time before the heater needs cleaning, as shown by the present authors, but also on the temperature difference and particularly on the juice flow rate in the tubes. Hence, most of the heaters in question are considered to have sufficient heating surface.

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Some rational suggestions. L. P. SOFRONYUK. *Sakhar Prom.*, 1964, **38**, 689–691.—The suggestions include the installation of special magnets for tramp iron removal from beet, a method of preventing stoppage of beet elevators caused by beet caught underneath when tipped out, a system for washing F-1 filters, schemes for cooling massecuite with purified water in crystallizers, discharging sugar pieces from a drum dryer to a remelt tank and for remelting reject sugar, and a drive system for beet pile ventilators.

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Counter-current mud washing in disc filters. E. A. KHODURSKII and K. I. BARBASHINA. *Sakhar. Prom.*, 1964, **38**, 692–694.—Filtered juice at 0·2 atm pressure is fed into the hollow section of each disc, thus causing the bags to swell and permitting easy separation of mud from the cloths. The mud is then sweetened-off in vacuum filters. Some simple disc filter modications are necessary.

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Operation of centrifugals. M. KRETOV. *Sakhar. Prom.*, 1964, **38**, 695–696.—For 2nd product raw sugar massecuite it is recommended that Sangerhausen batch centrifugals operate at a maximum speed of 725 r.p.m. instead of 1450 r.p.m. The throughput has been increased and power consumption decreased without any adverse effect on curing. A guide is given to the installation of a "home-made" screen in a BMA fully-automatic centrifugal.

[1] TOBILEVICH *et al.*: *I.S.J.* 1964, **66**, 158.

LABORATORY METHODS AND CHEMICAL REPORTS

Assessment of the nitrite level in diffusion juices as a tool for measurement of microbial activity. L. Cox and M. Tveit. *Socker Handl. II*, 1964, **19,** 47–50. Samples of raw and predefecation juice were decolorized with 1 ml basic lead acetate and 0·1 g active carbon per 10 ml of juice, filtered, and aliquots of the filtrate made up to 20 ml in flasks with distilled water. The colour formed 45 min after the addition of 1 ml each of two reagents was measured photometrically and the nitrite content calculated by a simple equation. The first reagent was prepared by combining a solution of 0·1 g α-naphthylamine in 95 ml water + 5 ml acetic acid with a solution of 1 g sulphanilic acid and 50 g sodium acetate dissolved in 100 ml water. The second reagent was conc. acetic acid. Correlation was found between nitrite concentration and bacterial activity as found earlier[1] and estimation of the nitrite content is considered to give more reliable results than measurement of diffusion juice pH.

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The purity of Natal final molasses. L. Clendinning and W. S. Graham. *S. African Sugar J.*, 1964, **48,** 661–667.—Application of the Douwes Dekker formula to Natal molasses showed it to be a useful gauge of comparative performance of the factories. Some of these were shown to have scope for improvement of exhaustion, but this may require installation of further equipment—pans, crystallizers and centrifugals—in the low-product department.

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Variations in pre-freeze juice acidity in sugar cane. J. E. Irvine. *Sugar Bull.*, 1964, **42,** 317–320.—Total acidity in juice following a freeze is used widely in Louisiana as an index of cane quality. Following suggestions that variations in acidity occur normally, without freezes, was investigated and existence of large variations confirmed. Many related to moisture stress or content and increases may be simply a concentration effect. A colorimetric method for gum determination is being developed and may give a more realistic guide to cane quality after freezing.

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Effect of potassium and sodium salts on molasses sugar content. N. P. Silina. *Sakhar. Prom.*, 1964, **38,** 728–731.—Molasses samples from seven different factories were saturated with sucrose using a vibration technique[2]. The potassium and sodium contents were determined by flame photometry, the sucrose content polarimetrically and iodometrically, the invert sugar by Müller's method and the calcium salts complexometrically. Approximately linear relationships were found between the (K + Na) content and (i) molasses standard purity at 53–64·5 standard purity and (ii) standard molasses saturation coefficient. A linear relationship was also established between K and molasses standard purity, but in the case of sodium the scattering was too great because the Na content in molasses is so low (approximately one-tenth of the K content). The amount of excess sucrose dissolved in a standard molasses was compared with the amount of sucrose in a pure saturated solution. The excess molar quantity of sucrose held by 100 g of non-sugar was related to the g.-atoms of (K + Na) in 100 g of molasses non-sugar. From the resultant straight-line graph, the molar quantity of sucrose held by 1 g.-atom of (K + Na) was found to be 0·435, which compares favourably with the value of 0·43 obtained as the average of the melassigenic coefficients of K and Na salts (except acetate and nitrate, which do not occur in molasses) found by Z. A. Silina[3] and converted in the present article to the number of sucrose moles held by 1 g.-atom of non-sugar cation. Values of melassigenic coefficients found by Dedek for K and Na salts are considered too high.

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The application of activated granular carbons in the beet sugar industry. A. K. Kartashov, L. G. Vorona, A. P. Kozyavkin and G. P. Pustokhod. *Sakhar. Prom.*, 1964, **38,** 731–736.—Tests were carried out using AG-5 granular carbon to decolorize juice and artificial liquors (mostly made by dissolving *A*-massecuite). The effects of Na_2SO_3 on juice coloration on heating were also examined.

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Determination of polysaccharides in sucrose crystal. C. C. Tu and R. H. Okamoto. *J. Agric. Food Chem.*, 1963, **11,** 330–331.—See *I.S.J.*, 1962, **64,** 23.

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Ion-exchange separation and determination of cations in sucrose crystal. K. M. Onna, G. Akatsuka and C. C Tu. *J. Agric. Food Chem.*, 1963, **11,** 332–334. The method reported previously[4] has been somewhat modified. After elution with HCl, the sodium, potassium, magnesium and calcium were determined by a Mohr titration of the eluates evaporated to dryness at 120°C; Fe^{+++} and Al^{+++} were determined with aluminon and the ferric iron with thiocyanate.

* * *

The effect of varying temperatures, concentrations, etc., on the exhaustion of molasses. R. Carolan. *Irish Sugar Co. Ltd. Research & Devel. Dept. Rpt.*, 1964, (49), 11 pp.—Identical molasses samples maintained in the presence of crystalline sucrose under various conditions fell in purity as sucrose was deposited; however, the final products were of similar purity, indicating that there was little to choose between 1 and 4 days' duration, 40° and 50°C, non-sugars:water ratios of 2·5 and 3·1, and granulated and sieved special sugar seed. It is suggested that

[1] Carruthers *et al.*: *I.S.J.*, 1958, **60,** 335.
[2] Silin & Chen': *I.S.J.*, 1963, **65,** 342.
[3] *I.S.J.*, 1963, **65,** 255–258.
[4] Akatsuka *et al.*: *I.S.J.*, 1962, **64,** 23.

experiments be made on a factory scale whereby the factory molasses would be seeded with 20% by weight of granulated sugar (0·8% on beet), cooled to 50°C and slowly stirred for 1 day, when an additional recovery of 0·4% on beet should be possible.

* * *

Molasses exhaustion tests for beet campaign 1963/64. R. CAROLAN. *Irish Sugar Co. Ltd. Research & Devel. Dept. Rpt.*, 1964, (85), 9 pp.—The results of laboratory exhaustion of fortnightly molasses samples are reported. The average purity of the original samples was 63·0 compared with 60·0 in 1959/60. After one day the average purity decrease was 4·8 units (5·6 in 1959/60), after 4 days it was 5·4 units (6·8 after 7 days in 1959/60), and it is concluded that it was easier to obtain low purities with the 1959/60 molasses. Examination of the K + Na + Ca values indicates, however, that the higher amount in the 1963/64 molasses would result in a higher purity than the 1959/60 molasses when exhausted, and that the lower purity of the latter after crystallization treatment did not, in fact, indicate better exhaustion.

* * *

A rapid method for the routine factory analysis of lactic acid. R. F. OLSON. *J. Amer. Soc. Sugar Beet Tech.*, 1964, **13,** 59–61.—A chromatographic technique is described in which samples are spotted, with standard spots containing known amounts of calcium lactate pentahydrate, on Whatman No. 4 paper and the chromatogram obtained by downward development using a solvent containing the colour reagent. This is made up by adding 200 ml of distilled water containing 50 ml of glacial acetic acid, 0·3 g bromocresol green and 0·1 g bromophenol blue, to 800 ml of a stock solution which comprises 70 parts of *iso*-propyl alcohol, 25 parts of benzene and 10 parts of *n*-butyl alcohol. After development for 1–1½ hr the papers are alowed to dry in a cabinet either between sheets of wet canvas or on a frame over a sink containing hot water. The solvent removal is thereby facilitated and the chromatogram produced with lactic acid showing as a yellow spot on a bluish-green background. The sensitivity of the method is 1 γ of lactic acid per 15 λ of volume. The method is rapid and adaptable to routine factory analysis.

* * *

Non-sugars in brown sugar crystals. A. R. SAPRONOV and V. G. CHERNIKINA. *Sakhar. Prom.*, 1964, **38,** 817–821.—Laboratory affination of a brown sugar sample using a chemically pure sucrose solution was found to remove the major part of non-sugars on the sugar crystals. The brown sugar crystals were then subjected to fractional dissolution by washing six times with a 75% aqueous ethyl alcohol solution, the washings being collected separately. Brix and optical density measurements of the six fractions showed that coloured non-sugars are distributed throughout the crystal, even the nuclei remaining after washing being coloured. Absorbency curves for the six fractions differed from one another and were considerably different from the non-sugars in the molasses film on the crystals, indicating the occurrence of syncrystallization. Solutions of melanoidins, alkaline degradation products of invert sugar, caramelan, caramelen and caramelin were saturated with pure sucrose and the optical density measured; 15 g crystal sucrose was added to 30-ml samples of each solution in stoppered flasks which were then agitated for 24 hr at pH 7 and room temperature. The sucrose crystals were then separated under vacuum and washed with syrup followed by 75% aqueous alcohol solution. The crystals were dissolved in water and the colour intensity measured. Differences were found in the extent to which the various colouring substances were absorbed by the sucrose crystals, the greatest relative adsorption occurring in the solution of lowest concentration. Absorbency curves for sucrose in contact with the various colouring substances exhibited a configuration similar to that of the original colour body solutions, except caramelan.

* * *

Determination of invert sugar with Ofner's and Müller's solutions and comparison of the results obtained. S. BAYSAL. *Seker*, 1964, **13,** (50), 7–8.—Results obtained at Ankara beet factory using both methods on press, raw, thin and thick juices and molasses gave similar results, although MÜLLER's method is preferred since it is simpler. The techniques applicable to the various juices and molasses are described.

* * *

Raffinose determination by paper chromatography in the laboratory of Eskisehir sugar factory. P. GÜRAY. *Seker*, 1964, **13,** (50), 16–18.—Details are given of a method, recently adopted at this beet factory, in which 7:1:2 *n*-propanol:ethyl acetate:water is used as solvent. Some results with juices and molasses from the 1962 campaign are presented.

* * *

Results of systematic quality control of Peruvian raw sugars. P. HONIG and J. C. P. CHEN. *Proc. 23rd Meeting Sugar Ind. Tech.*, 1964, 130–145.—Composite weekly samples of Peruvian affined raw sugar were subjected to a standardized examination, in which sulphated ash, reducing sugars, conductivity, CaO, sulphate and colour were determined. The behaviour of different types of non-sugars in the raw sugars from different factories is exemplified by tabulated data. It is considered that determination of total ash in washed sugar is an inadequate guide and that the ash content of the liquors should also be determined. Hence, a raw sugar should not be condemned because of high ash content alone, other factors such as the purification system used and behaviour of the inorganic non-sugars in precipitation, absorption and syncoagulation with the purifying agent being highly significant. Details are given of a proposed standard laboratory phosphatation test for washed raw sugars.

BY-PRODUCTS

Bagasse briquettes solve storage problems, spur new industry. B. PULIDO R. *Sugar y Azúcar*, 1964, **59,** (7), 40.—Advantages of briquetted bagasse as regards moisture content, ease of storage and handling, and convenience of use as a raw material for board and such products, are discussed with brief mention of the briquetting plant at Central Igualdad, Puerto Rico, and the manufacture of bagasse board at Dominico Suiza C. por A., Dominican Republic.

* * *

Utilization of molasses—Stock-feed plant to produce 24,000 tons per year. ANON. *S. African Sugar J.*, 1964, **48,** 541, 543.—Tongaat Sugar Co. Ltd. has formed a subsidiary, Moreland Molasses Co. Ltd., which is to produce an animal feed, "Morea", consisting basically of molasses, urea and other chemicals, including 6% alcohol. A further product is "Voermol", a mixture of molasses and cane flour. A new R400,000 (£200,000) plant to produce 2000 tons of meal per month was scheduled to start operations in September 1964; one section is for milling of maize and the other for producing feeds to any formula in either meal or pellet form. A second plant is under erection near the Triangle Ltd. mill in Southern Rhodesia to supply feeds to the Rhodesian market.

* * *

Recent progress in "sucrochemistry". W. SCHWEISHEIMER. *Chim. & Ind.*, 1964, **92,** 135–136.—A brief and not very up-to-date review is provided of reported applications for sugar and its derivatives in varnishes, detergents, etc.

* * *

Latest development of the yeast industry in Taiwan. W. F. TUNG. *Taiwan Sugar Quarterly*, 1964, **11,** (2), 26–32.—Improved results have been attained at Hsinying yeast factory by use of the "Han-shi" propagator (a modification of the Waldhof-type propagator) and molasses clarification by centrifuging, diluting the sludge, re-centrifuging, diluting the sludge and repeating the process, after which the sludge can be filtered in a press. Other factors include the method of feeding balanced nutrients, high efficiency of sugar recovery and the sterilization procedures adopted.

* * *

Esters of sucrose with bicarboxylic acids. S. FUMASONI. *Ind. Sacc. Ital.*, 1964, **57,** 147–151.—Transesterification with dimethyl esters of the three phthalic acids and malonic acid, and diethyl esters of oxalic, malonic, glutaric, adipic, and pimelic acids, was carried out in dimethyl formamide solvent at 95°C using K_2O as catalyst[1]. The products are briefly described, most attention being given to a solid product from the terephthalate which contained a 2:1 molar proportion of acid : sucrose, had a M.W. of about 12,000 and behaved similarly to sucrose on the Stanton thermo-balance, which records weight loss with increasing temperature.

* * *

New applications for bagasse. J. E. ATCHISON. *Sugar y Azúcar*, 1964, **59,** (9), 100–103.—Progress in bagasse collection, storage, depithing, pulping and utilization of pulp, especially since 1950, is surveyed.

* * *

Esters of sucrose and derivatives. H. PASSEDOUET. *Ind. Alim. Agric.*, 1964, **81,** 705–712.—The fatty acid esterification of sucrose is briefly reviewed up to the HASS & SNELL process of 1956–7, which is discussed in greater detail, as is the LEDOGA-BEZONS process (in which sucrose is transesterified with natural glyceride instead of methyl esters of the fatty acids; this produces mixed sucrose-glycerol esters the proportions of which may be varied to give the product the required emulsifying and detergent properties). The important property of complete biodegradability is mentioned. Hydroxyethylation of sucroglycerides confers on them a more hydrophilic nature and even greater detergent power than had been anticipated, while they show a marked resistance to alkaline hydrolysis, which is a disadvantage of the unsubstituted sucroglycerides. They remain easily biodegradable, however, and are economically attractive as well as non-toxic, and are able to play a useful rôle as degreasing agents in cosmetic and hygienic products.

* * *

Use of molasses as a pasture supplement. H. L. CHAPMAN, R. W. KIDDER and J. R. CROCKETT. *Sugar J.* (La.), 1964, **27,** (4), 10–12.—Experiments were carried out in 1962–3 in which beef cows were fed during the cane season or, alternatively, throughout the year with 5 lb per day of mill-run blackstrap molasses of 86–88°Bx, a control group receiving no molasses. Both groups had higher conception rate and produced calves having higher weaning weights and grades than the control group. The importance of proper evaluation of the available pasture forage is emphasized, with supplemental protein addition where the level is below 10%, and an ample supply of roughage. When properly used, the blackstrap molasses is considered an excellent pasture supplement for beef cattle.

* * *

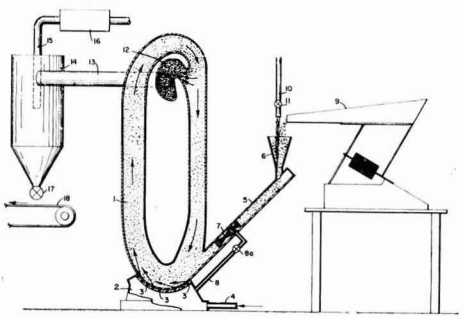
The feeding value of molasses. T. G. CLEASBY. *Sugar J.* (La.), 1964, **27,** (4), 14–19.—Increased interest in molasses as animal fodder in South Africa is reported, and a review presented of the advantages of molasses as a feed constituent and in making silage. Studies in molasses feeding to cattle, sheep and pigs are quoted from the literature, with results obtained in South Africa.

[1] OSIPOW *et al.*: *Ind. Eng. Chem.*, 1956, **48,** 1459, 1462.

UNITED STATES

Dry pulverulent sugar products and their production. F. E. REIMERS, M. D. MILLER and F. BUSH, *assrs.* AMERICAN SUGAR COMPANY, of New York, N.Y., U.S.A. **3,140,201.** 9th January 1962; 7th July 1964.

Sugar/invert mixtures in a dry powdery form, suitable for use in cake icings, fondants, etc., are prepared by mixing granulated sugar and invert syrups, the latter at a suitable water content, and both at a suitable temperature, followed by subjecting them to the action of a "fluid energy" mill, which provides both attrition and drying to give a homogeneous dry powder product. The sugar is delivered by conveyor 9 to hopper 6, invert syrup being added



from pipe 10 through a proportioning valve 11. The mixture enters the upright elongated torus chamber 1 to the bottom of which air at ambient temperature and under pressure is admitted from chamber 2 through orifices 3, attaining sonic or supersonic speed. A conduit 8 with a control valve 8a admits the compressed air to an injector 7 in the conduit 5 leading from hopper 6 to chamber 1. The sugar and invert syrup are entrained in the air stream and carried round the chamber, being subjected to violent impact between particles. Heavier particles remain near the outer wall of the chamber while the lighter, dry powdery particles are carried into the classifying section 12 by the energizing air which is withdrawn through conduit 13. This leads to the cyclone separator 14 from which the air is exhausted through outlet 15 and dust collector 16 while the solids are discharged through the star valve 17 to conveyor 18.

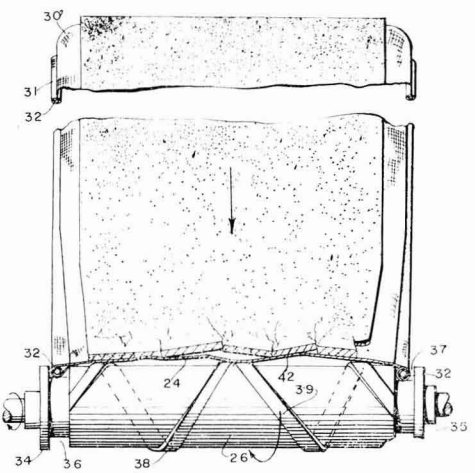
* * *

Dry pulverulent brown sugar and its production. E. NABORNEY, of Fanwood, N.J., *assr.* AMERICAN SUGAR COMPANY. **3,140,202.** 9th January 1962; 7th July, 1964.—Brown sugar in a dry powder form, suitable for making fudge or confectionery, cake mixes, etc. is prepared analogously to the products of the preceding patent, in similar equipment, except that no invert syrup is added to the ordinary brown sugar used as raw material.

* * *

Filter. L. A. JAUHOLA, of Moline, Ill., U.S.A., *assr.* AMETEK INC. **3,144,409.** 4th October 1960; 11th August 1964.

The endless cloth belt of a rotary vacuum filter carries the cake formed over a discharge roller 26, so removing it before the belt returns to the filter drum by way of two idler rollers. In order to ensure complete removal of the cake, the roller 26 is provided with spiral grooves 38, 39 and an air jet is blown into the angle between the roller and the belt coming on to it. The air is trapped by the grooves as the roller revolves, causing the belt to balloon and ensuring complete discharge of the cake. If the air jet is pulsating, the belt balloons intermittently and the grooves on the roller can be omitted.



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UNITED KINGDOM

Preparing L-glutamic acid. AJINOMOTO CO. INC. and SANRAKU OCEAN CO. INC., of Tokyo, Japan. **961,491.** 24th August 1962; 24th June 1964.—See U.S.P. 3,138,540[1].

[1] *I.S.J.*, 1965, **67**, 28.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 4s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

TRADE NOTICES

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

Continuous centrifugal for the sugar industry. Techno-export, Václavské nam. 56, Praha 1, P.O.B. 457, Czechoslovakia.

The new Škoda type KO 1000–6 continuous centrifugal is primarily intended for applications in the sugar industry and is designed for treatment of all raw sugar factory products, middle- and low-grade products in mixed factories, and middle-products, affination raws and low-grade products in refineries. The main advantages of this type of centrifugal are: continuous operation, high throughput and low power consumption, and the high degree of sugar drying.

The KO 1000–6 centrifugal is a horizontal, six-stage machine with a reciprocating piston and a novel type of hydraulic drive which has been patented. The cylindrical rotor operates at 800-1000 r.p.m. and is in six stages, with dia. increasing to 1000 mm at the sixth stage. The main hollow shaft is arranged in two amply dimensioned roller bearings. The reliable hydraulic system provides a sliding movement of the piston with the first, third and fifth stages of the basket to which it is connected. The system includes a 28/16 kW, 2850/1450 r.p.m. electric motor, a driving pump and a hydraulic cylinder with two pistons and a distribution slide valve. Another 28 kW, 1450 r.p.m. motor drives the centrifugal through V-belt pulleys and interchangeable pulleys. The stator is a massive box casting, the interior of which is an oil bath. The rotor is located in a welded cover with compartments for separating syrups of different purities and operating as a sugar hopper. The washing and steaming arrangements form an integral part.

Capacity of the machine is 13 tons/hr of first and middle product or 12 tons/hr of affination magma or 6 tons/hr of low-grade massecuite.

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Metering pumps. Milton Roy (G.B.) Ltd., Burnfield Rd., Giffnock, Glasgow.

The "Milroyal" controlled-volume pumps are available in six plunger sizes for pressures up to 7500 p.s.i. and capacities to 655 g.p.h. The stroke length, which is controlled by micrometer screw adjustment, can be changed even when the pump is running. The pumps are available with exclusive step valve liquid ends with double ball checks on suction and discharge to provide reliable metering accuracies of $\pm 1\%$ or better. The main castings are of cast iron with internal parts of steel and bronze for long service. The pumps have the minimum number of working parts while a special feature is the patented totally-enclosed polar crank drive running in oil and self lubricating.

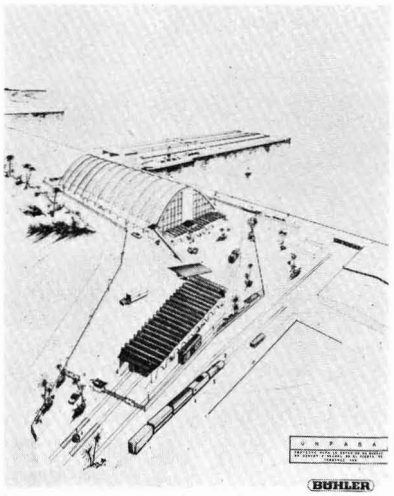
The smaller "mRoy" pump is designed as a low-cost utility metering pump to handle fluids and light slurries with viscosities up to 200 s.s.u. The pump uses a plunger operation at a fixed stroke to develop hydraulic pressure which actuates a flexible hydraulically-balanced "Teflon" diaphragm transmitting energy to the pumped fluid. Double-ball check valves are also used here on the suction and discharge, while discharge flow control is established by adjusting the hydraulic volume which by-passes the diaphragm cavity. This can be done while the pump is running. The standard $\frac{1}{4}$ h.p. models are constructed for maximum flow capacities of 1·3–10·5 g.p.h.

* * *

Bulk raw sugar loading terminal in Mexico. Buhler Brothers, Uzwil, Switzerland.

The Swiss engineering firm, Buhler Brothers, is to install a large plant for storing raw sugar and loading ships at the port of Veracruz. A silo is to be built for the Unión Nacional de Productores de Azúcar S.A. (UNPASA), with a capacity of 40,000 metric tons of raw sugar, as well as the necessary wharves for loading ships. Sugar will be received in rail cars and trucks at the rate of 400 metric tons per hour, while ship loading capacity is scheduled at 800 tons/hr.

In addition to the project engineering, Buhler will supply 17 chain conveyors having a total length of 850 m (2800 ft) and capacities of 400–800 tons/hr,



6 conveying belts with a total length of 400 m (1310 ft) and a capacity of 400 tons/hr each, and a travelling loading tower with a mobile outrigger and a trimmer with telescopic tube. The tower is to have a loading capacity of up to 800 tons/hr and a second tower is to be provided later.

The plant will start operations in 1965, and can then be added to the series of similar installations already erected by Buhler in Latin America.

W-type compressor. Belliss & Morcom Ltd., Icknield Square, Birmingham 16.

The new W-type compressor is a natural successor to the well-known Belliss V-compressor, providing higher outputs up to 3000 c.f.m. A unit exhibited recently delivered 2000 c.f.m. of free air at 100 p.s.i.g.; it is designed for 750 r.p.m. and features the latest developments in adaptable equipment for continuous economical supply of compressed air or gas. It is a compact, heavy-duty, water-cooled, double-acting crosshead type, having 3 cylinders set at 60° between each pair of cylinders, and is available for one-, two- or three-stage operation.

The "WH" type for two-stage operation has two identical low-pressure cylinders; the air or gas passes from each cylinder into its independent intercooler and thence in a combined single flow to the high-pressure cylinder for final compression. Cylinder size changes on rationalized lower parts make available outputs of from 1500 to 2000 c.f.m. at pressures of 60–150 p.s.i.g.

For low-pressure air or gas the "WL" type has three identical cylinders, an additional low-pressure cylinder being substituted for the high-pressure cylinder, and again cylinder size changes make available outputs of 2250–3000 c.f.m. at pressures up to 50 p.s.i.g.

Both compressors can be driven by a flange-mounted motor, V-belt drive, or by a direct coupled motor, diesel engine, steam engine, or geared turbine.

The construction of the compressor is extremely robust with the use of high quality materials; it is designed to reduce maintenance to a minimum and many components are standard and interchangeable with the V-type compressor, which greatly assists spares availability.

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PUBLICATIONS RECEIVED

1864—1964. BROADBENT COMPLETE ONE HUNDRED YEARS. Thomas Broadbent & Sons Ltd., Central Ironworks, Huddersfield, Yorkshire.

In 1864, Thomas Broadbent commenced business as an engineer and millwright in the textile manufacturing area of Huddersfield. In 1870 he made his first centrifugal extractor for separation of water from washed wool and cloth, a machine which proved highly successful. On his death in 1880, his widow ran the business until the two eldest sons were able to take some of the responsibility, and since then the Company has continued a family business with 3 of the present directors grandsons of the founder and 3 more great-grandsons. This well printed and interesting booklet describes the history of the Company and its manifold activities during the 100 years, only the last 30 of which have been devoted exclusively to centrifugal machines, including those which are so well-known in the sugar industry.

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"FREE SPACE" HYDRAULIC COUPLINGS AND DRIVES. Crofts (Engineers) Ltd., Thornbury, Bradford 3, Yorkshire.

A new folder illustrates applications of these drives which are ideal for high inertia machines, providing economies in installation and running costs with protection from overload, and which are available in sizes up to 225 h.p.

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

A new set of data sheets has been issued, giving full dimensional details of the stock range of Renold conveyor chains, wheels and attachments in breaking loads up to 30,000 lb, as well as a chain selection chart.

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TURBINES FOR INDUSTRY. Stal-Laval Turbin AB., Finspong, Sweden.

This is a very attractive multicolour booklet produced by Stal-Laval Turbin AB., a member of the ASEA group, and is available in English with editions to come in German, French, Spanish and Finnish, as well as Swedish. It starts with a 10-page section giving a theoretical background to the design and operation of turbines in industry, under such headings as: back pressure power, selection of steam conditions, specification and evaluation, output obtainable, condensing turbo-alternators and balancing heat and power demand. The second part is concerned with the Company's own turbines—De Laval axial-flow machines in the range 200–2500 kW and Stal radial flow machines for outputs larger than 2000 kW. These are illustrated by a number of clear coloured diagrams and photographs, with tables of dimensions and outputs. Detailed descriptions are given of important design features, including blading, the blade ring, labyrinth glands, steam inlet, control system, bearings and lubrication, as well as frame size, erection, starting and operation. A number of applications are described and illustrated, while the world-wide availability of spares and service engineers is emphasized.

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THE MANBRE & GARTON GROUP. Manbré & Garton Ltd., Winslow Road, Hammersmith, London W.6.

This new brochure provides an outline of the numerous products of the Group, together with particulars of the factories where they are made. There are eleven Companies mentioned, including Manbré Sugars Ltd., Sankey Sugar Co. Ltd. and Martineau's Ltd., who produce refined cane sugar, and other companies producing invert sugars, brewing sugars, primings and caramels, maize starches, dextrins, gums, etc., in the U.K. and South Africa.

* * *

Kent-Evershed take-over.—George Kent Ltd., of Luton, Beds., has, by a proposed exchange of shares, offered to take-over Evershed & Vignoles Ltd., of London, W.4, together with Evershed's subsidiaries. The Directors of Evershed & Vignoles have recommended acceptance of the offer and it has been accepted in respect of the controlling interest.

* * *

New sugar mill in British Honduras.—A contract valued at £1·6m approximately has been awarded to Taylor Woodrow (Overseas) Ltd. for the civil engineering design and construction of a sugar mill project at Tower Hill near the township of Orange Walk, British Honduras, for the Corozal Sugar Factory Ltd., part of the Tate & Lyle Group. Taylor Woodrow will also be responsible for the installation of the extensive mechanical services, including the processing equipment and electricity and water supplies to make the factory independent of external services. Work is due for completion by the end of 1966. The Tower Hill sugar factory, part of a large scheme to extend the cultivation and processing of sugar cane in British Honduras, will have a capacity, when fully extended, of some 135,000 tons of sugar in the season. Main buildings include the mill house, boiling house, bulk sugar store, power house and pump house. Most of the buildings will be steel framed structures, of single- and multi-storey construction. A 200-ft high reinforced concrete boiler chimney is also being built. A half-million gallon capacity molasses storage tank, a 200,000-gallon condensate water storage tank and storage facilities for fuel oil and diesel oil are to be provided, together with ancillary buildings. Orange Walk is on the New River, about 60 miles to the north of Belize, the capital of British Honduras. Cane will be delivered by road, mechanically unloaded, and after processing and storage, the raw cane sugar will be discharged into barges for transport to Belize and subsequent export and refining. A wharf will be constructed on the river bank. The river will also provide water for cooling, to be extracted through weirs and pumped to vacuum pans and evaporators, later being discharged by gravity into open culverts and passed back into the river.

JAPANESE SUGAR IMPORTS 1964[1]

(*Metric tons, tel quel*)

	Raws	*Refined*	*Non-Centrifugal*	*Total*	*Total* 1963	*Total* 1962
			1964			
Argentina	—	—	—	—	—	8,627
Australia	430,239	15	—	430,254	327,866	274,319
Brazil	—	—	—	—	5,053	20,970
China	130	—	403	533	—	—
Cuba	335,695	—	—	335,695	163,664	522,716
Dominican Republic	—	—	—	—	—	8,660
Hong Kong	—	124	—	124	—	46
India	60,810	—	—	60,810	91,233	—
Indonesia	10,197	—	—	10,197	10,830	—
Mauritius	—	—	—	—	9,855	—
Peru	—	—	—	—	5,732	6
Poland	—	—	—	—	—	10,576
Ryukyu Islands	105,389	26,093	11,100	142,582	164,853	111,457
South Africa	215,989	—	100	216,089	179,052	82,582
Taiwan	337,687	—	3,785	341,472	477,391	428,498
Thailand	2,962	—	—	2,962	34,949	24,880
United Kingdom	—	130	—	130	—	—
U.S.A.	—	159	—	159	—	—
Other Countries	18	—	49	67	818	519
	1,499,116	26,521	15,437	1,541,074	1,471,296	1,493,856

BREVITIES

Trinidad sugar strike[2].—On the 9th March the Trinidad Government declared a state of emergency in the sugar belt. It is to introduce legislation designed to settle industrial disputes and maintain public order. On the same day Caroni Ltd. announced a complete shut-down of all their operations as the strike of sugar workers spread to two more of the Company's estates. The announcement came in the midst of growing reports of violence in the sugar belt. The strike, called by a dissident group of sugar workers, is in protest against the present system of union representation. The strikers have stressed that they have no quarrel with the sugar manufacturers. The state of emergency was ended on the 24th March 1965[3].

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U.K. beet campaign, 1964/65.—The 1964/65 campaign ended on the 7th February 1965 with a total quantity of beet delivered of 6,218,000 tons compared with 5,245,000 tons in the previous year and with the record of 7,215,000 tons in 1960/61.

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Explosion at U.S. refinery[4].—An explosion rocked the American Sugar Co. refinery at Chalmette, La., on the 15th February, killing one employee and injuring others. All operations were stopped but quickly resumed on a reduced basis. It was estimated that production rate would be increased substantially within a month and full production resumed in about three months.

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Indian sugar production, 1963/64[5].—The sugar season 1963/64 ended on the 31st October, 2,570,000 metric tons of sugar having been produced, as compared with 2,156,000 tons in the 1962/63 season.

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Libya sugar refinery[6].—International bids are expected to be called-for soon for the building of a £L2,500,000 sugar refinery. Specifications for tenders are being prepared by Polish experts. The plant is expected to be built in the Azizia area and should be in production by late 1966.

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New co-operative sugar factories for India[7].—Three more co-operative sugar factories are proposed for Uttar Pradesh, to start operation in three or four years. The Government of Bihar has also asked for immediate sanction of a loan of Rs. 9,000,000 (£675,000) from the Industrial Finance Corporation of India for setting up a co-operative sugar factory at Banmankhi in Purnea district.

South African sugar factory expansions[8].—The Gledhow Sugar Co. Ltd. is to spend R. 2·1 million (£1,050,000) on a two-stage expansion programme which is designed to increase the crushing capacity of its factory in Natal from 200 to 250 tons of cane per hour. The first stage, due to be completed at the beginning of the 1965/66 season, entails the installation of a new boiler with a capacity of 100,000 lb of steam per hour at 400 p.s.i. and 740°F, extensive alterations to the evaporator plant, and installation of 4 fully automatic 48 × 30 in Broadbent centrifugals. In the second stage, the cane handling facilities in the mill yard are to be extended, an additional boiler is to be installed, as will be a new 5 MW alternator, four new juice heaters, additional evaporator capacity, two vacuum pans, eight crystallizers and four more centrifugals. Work has also commenced on the R.3½ million (£1,750,000) project at Sezela factory which will bring the capacity to 125,000 tons of sugar per annum. This involves dismantling one of the milling trains and installing a larger tandem of 40 tons of fibre per hour capacity. This should be in commission in June, when the total capacity of the new and remaining old tandem will be 53 tons of fibre per hour, equivalent to approx. 330 t.c.h. A new pan house is being built and a new evaporator. A new cooling tower is under construction and a battery of fully automatic centrifugals is being installed, as are a new boiler, an additional chimney stack, a new electric crane and a new compressor room.

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Congo sugar factory expansion[9].—The Jacob factory of Société Industrielle et Agricole du Niari in the Congo (Brazzaville) will by mid-1965 have finished a programme of expansion which will raise production from 24,000 to 40,000 tons of sugar per year. A second sugar factory and refinery is planned in the neighbourhood of the Jacob factory, with a capacity of 100,000 tons of sugar per year. The first sugar cane plantings have been made for this new installation which should be in full operation by 1969, all the sugar being intended for export.

[1] C. Czarnikow Ltd., *Sugar Review*, 1965, (700), 39.
[2] *Public Ledger*, 13th March 1965.
[3] *The Times*, 25th March 1965.
[4] *Lamborn*, 1965, **43**, 25.
[5] *Indian Sugar*, 1964, **14**, 529.
[6] *Overseas Review* (Barclays D.C.O.), January 1965, p. 50.
[7] *Indian Sugar*, 1964, **14**, 535.
[8] *S. African Sugar J.*, 1964, **48**, 1000–1003, 1030.
[9] *Zeitsch. Zuckerind.*, 1965, **90**, 41.

INTERNATIONAL SOCIETY OF SUGAR CANE TECHNOLOGISTS

As this issue is published, the 12th Congress of the International Society of Sugar Cane Technologists is in progress in Puerto Rico. Delegates will have gathered from all parts of the world to the Puerto Rico Sheraton Hotel in San Juan, where a series of general meetings and sectional meetings are scheduled during the first two days, followed by factory and field group visits to the Fajardo and Roig sugar mills and plantations on the 31st March. While the factory group will continue their deliberations in San Juan on the 1st April, the field group are to visit the Experimental Station of the University of Puerto Rico and the Gurabo Agricultural Sub-Station. On the following day the field group will hold their meetings at San Juan while the factory group are to visit Centrals Santa Juana and Juncos. After meetings in the morning of 3rd April, delegates will visit the Bacardi rum plant on the outskirts of San Juan.

After the week-end, sectional meetings are to continue on Monday, 5th April, while on the next day both factory and field groups will tour part of the island, visiting, respectively, the Aguadilla bulk sugar terminal and Centrals Igualdad and Guánica, and Centrals Aguirre and Mercedita, spending the nights at Mayagüez and Ponce. The factory group will continue to Central Mercedita on the 7th April and return to San Juan, while the field group will visit the Mayagüez A. & M. College and Federal Experimental Station.

Sectional meetings will continue throughout the 8th April, and plenary meetings during the 9th April in the evening of which the Congress will close with a farewell banquet.

After the Congress a number of delegates will be travelling to Florida where on the 12th and 13th April they will visit the Canal Point Sugarcane Station at Clewiston, the Everglades Experiment Station, and the Belle Glade and Clewiston sugar factories.

A more detailed account of the Congress will appear in a later issue of this Journal.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 17th March* 1965)	s d
Anglo-Ceylon (5s)	7/6
Antigua Sugar Factory (£1)	10/–
Booker Bros. (10s)	18/4½
British Sugar Corp. Ltd. (£1)	19/6
Caroni Ord. (2s)	2/3
Caroni 6% Cum. Pref. (£1)	16/3
Demerara Co. (Holdings) Ltd.	3/10½
Distillers Co. Ltd. (10s units)	21/–
Gledhow Chaka's Kraal (R1)	19/–
Hulett & Sons (R1)	30/–
Jamaica Sugar Estates Ltd. (5s units)	4/–
Leach's Argentine (10s units)	20/9
Manbré & Garton Ltd.* (10s)	30/3
Reynolds Bros. (R1)	20/–
St. Kitts (London) Ltd. (£1)	18/9
Sena Sugar Estates Ltd. (5s)	6/7½
Tate & Lyle Ltd. (£1)	30/–
Trinidad Sugar (5s stock units)	2/6
United Molasses (10s stock units)	32/6
West Indies Sugar Co. Ltd. (£1)	10/–

* 1 for 4 Capitalization

CLOSING MIDDLE

New York Stocks (*at 16th March* 1965)	$
American Crystal ($5)	17½
Amer. Sugar Ref. Co. ($12.50)	20½
Central Aguirre ($5)	26
Great Western Sugar Co.	39¾
North American Ind. ($10)	14¼
South P.R. Sugar Co.	29½
United Fruit Co.	17¼

Brevities

Brazil sugar expansion.—In addition to the measures reported earlier[1] further factories are to be installed, bringing the total of new ones to 50[2]. They are to be built under a programme which provides for an increase of sugar production to 100 million bags (6 million metric tons) by 1970.

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Bagasse paper possibilities in Ecuador[3].—An advisor to the Junta Nacional de Planificación y Coordinación recently stated that there would be excellent prospects for a paper and pulp industry, using as raw material bagasse and mixed tropical timbers from the north-west of the country.

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Diversification at Paramonga[4].—W. R. Grace & Co. plan to spend $5,000,000 for facilities to manufacture plastics, using as raw material molasses produced by their sugar factory at Paramonga, Peru. Production of the alkali plant operated in connexion with the bagasse paper mill is also to be expanded, while a 40,000-kW hydroelectric plant is also to be built.

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Paraguay sugar production, 1964[5].—The 1964 sugar harvest was completed on the 25th December with a record output of 48,267 tons, some 13,000 tons more than in 1963. The increase achieved was mainly due to good weather and to the expansion of several sugar mills. Present domestic consumption is estimated at 35,000 tons a year but it is feared that prospects for export of the surplus may not be encouraging because of the decline in world sugar prices.

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[1] *I.S.J.*, 1965, **67**, 64.

[2] F. O. Licht, *International Sugar Rpt.*, 1965, **97**, (1), 15.

[3] *Fortnightly Review* (Bank of London & S. America Ltd.), 1965, **30**, 68.

[4] *Sugar y Azúcar*, 1964, **59**, (12), 45.

[5] *Fortnightly Review* (Bank of London & S. America Ltd.), 1964, **30**, 92.