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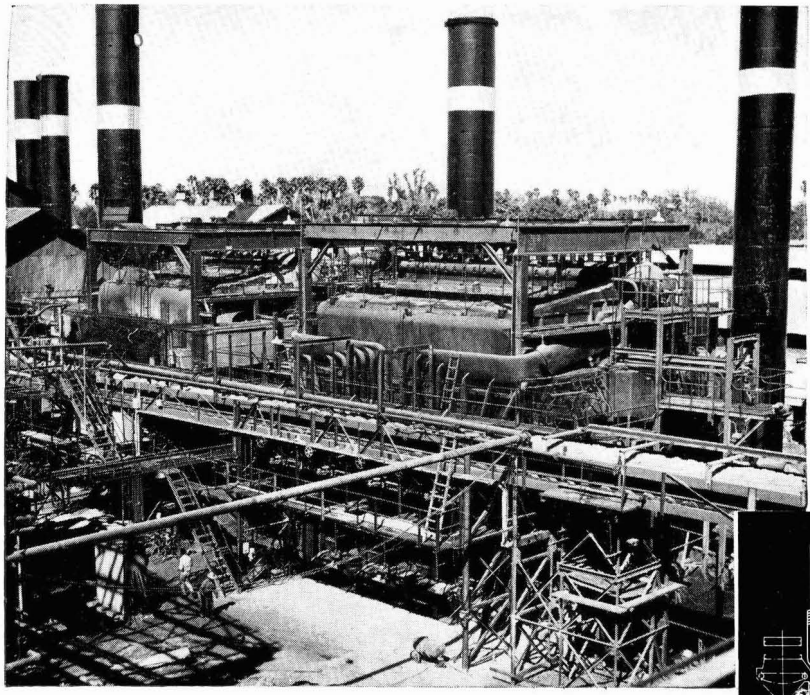
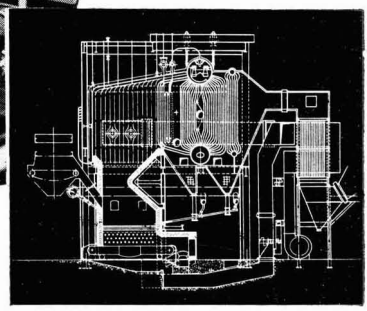


LOS MOCHIS

BABCOCK bagasse-fired boiler plant for the Los Mochis mill of Cia. Azucarera de Los Mochis S.A., Mexico (a total of 11 Babcock boilers) includes these two 125,000 lb./hr. Bi-drum units (left) and two further Bi-drum units each for 165,000 lb. steam/hr; supplied by Babcock & Wilcox Ltd. jointly with Babcock & Wilcox de Mexico S.A. de C.V., Mexico D.F.

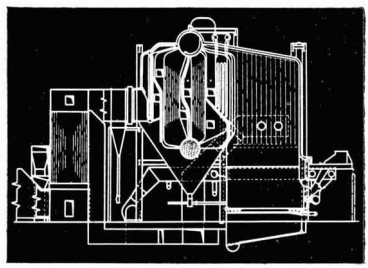


MODERN **BOILER PLANT** for the SUGAR INDUSTRY

(Above) **Arrangement of one of the 125,000 lb./hr. bagasse-fired boilers at Los Mochis. Steam conditions 250 lb./sq. in., 343° C.**
Bagasse is fed through chutes into the Ward furnaces and spread by pulsating air-jets. Each Ward hearth is equipped with a chain grate to effect continuous removal of the ash. Auxiliary oil-firing is provided; also refiring of grits from the boiler hoppers.

For over half a century sugar mills and refineries throughout the world have chosen BABCOCK boilers, fired with conventional fuels such as oil, gas, coal and wood, or with bagasse and other vegetable-refuse fuels, to meet their steam-raising requirements with the utmost reliability, economy and ease of maintenance.

This long and specialised experience is combined with modern design and construction in various types of Babcock boiler plant, with a wide choice of firing equipment to meet local requirements — the versatile Babcock-Detroit spreader stoker, burning bagasse and a variety of other fuels; the widely-used Babcock-Ward bagasse-furnace for efficient combustion and low maintenance and the established Horseshoe and Step-grate furnaces — with auxiliary oil or gas firing, if required.



Bi-drum boiler for bagasse firing with Babcock-Detroit spreader stoker, and with auxiliary oil-firing.

BABCOCK

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BABCOCK & WILCOX (OPERATIONS) LIMITED, BABCOCK HOUSE, 209 EUSTON ROAD, LONDON N.W.1

THE
INTERNATIONAL SUGAR JOURNAL

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NOTES AND COMMENTS

Sugar exporters' measures to improve sugar prices.

As provided for under the scheme adopted by sugar exporting member countries[1], the Exporters' Group met on the 5th–6th April to review the scheme and take such action as might be appropriate.

The Group surveyed the developments that had taken place since the introduction of the scheme on the 4th March and in particular the points in the scheme that had given rise to special difficulty. Experience had shown that, as foreseen by the Group, in view of the many complexities of the sugar trade in general and in particular the circumstances prevailing at the inception of the scheme, it could not be fully effective in such a short period of time. The Group will review the scheme again at its next meeting early in May.

The Group agreed to request the Marketing Advisory Committee to study the possibility of improving upon some of the features of the scheme and present specific proposals.

In order to strengthen the scheme, the Group agreed, subject to subsequent reviews, to substitute for sub-paragraphs 1(b) and 1(c) of the scheme, dealing with the minimum price, the following:

"The objective would be to raise the free market price of sugar; with this in mind exporting member countries would not sell raw sugar at a price which, expressed in U.S. cents per lb avoirdupois, 96° polarization, in bags f.o.b.s. Greater Caribbean basis, would be below the equivalent of

(*a*) 2·50 U.S. cents for shipment during the period April/September 1966;

(*b*) 2·70 U.S. cents for shipment during the period October/December 1966; and

(*c*) 3·00 U.S. cents for shipment as from January 1967".

The representative of the Cuban Government has informed the representatives of the countries participating in the scheme that, although his country is not participating in the scheme, the Cuban Sugar Exporting Enterprise will endeavour to maintain, as far as possible, its traditional policy.

U.K. Sugar Board Report, 1965.

The Eighth Annual Report of the Sugar Board was published on the 23rd March 1966 after presentation to Parliament by the Minister of Agriculture, Fisheries and Food. The Report deals with the activities of the Board for the eighteen months from 1st July 1964 to 31st December 1965 and includes an audited statement of the Board's Accounts for that period.

During the eighteen-month period ended on 31st December 1965, the Sugar Board recovered the deficit of £18¾ million outstanding on their Revenue Account at 30th June 1964, following two years of violently fluctuating world market prices for sugar. In the last six months of 1964 world prices fell from £46 a ton, c.i.f. U.K., to £25 a ton, and during 1965 averaged £21 10s 0d a ton, with variations of about £4 to £5 a ton in either direction.

The recovery of their deficit was completed in the first twelve months of the eighteen-month period, fulfilling the Board's intention announced in their Seventh Report, and was achieved gradually in order to minimize unfavourable reactions on consumers, traders and manufacturers. During this twelve months, the retail prices of sugar and sugar-containing goods in the United Kingdom remained very stable, and showed a decline towards the end. By this time it appeared that retail prices of sugar were, in general, about 1d a lb lower than they had been twelve months previously.

In the last six months of 1965, following the recovery of their initial deficit, the Sugar Board were able to keep their Revenue Account roughly in balance, in spite of some fluctuations in world prices, without the average ex-refinery price of sugar departing very far in either direction from £70 a ton (compared with the average of about £77 a ton experienced over the three years from 1st July 1962, when world price fluctuations were very severe and abnormal). Retail prices of sugar are not subject to control and there is usually a variation in the prices charged between one shop and another, but it appears that there was a further slight decline in general levels of retail prices in the last six months of 1965.

[1] *I.S.J.*, 1966, **68**, 97.

The Board's loss on trading in the eighteen-month period amounted to £68·3 million on 2·6 million tons of Commonwealth, South African and Irish sugar. The Board also paid £40·8 million to the British Sugar Corporation, making a total of £109·1 million. Net receipts of Surcharge collected during the period amounted to £128·3 million, and after meeting the cost of interest and the expenses of the Board and H.M. Customs in collecting Surcharge (partly offset by the interim dividend received on shares in the British Sugar Corporation) the Board showed a net surplus of £18½ million for the period.

As mentioned above, the Board started the period with an accumulated deficit of £18¾ million, and, after achieving the net surplus of £18½ million over the period, there remains an under-recovery of about £¼ million to be carried forward to the next accounting period.

The Report notes that the agreement for the Board to purchase 150,000 tons a year of South African sugar was terminated at the end of 1964. An equivalent tonnage for 1965 was provided mainly by the issue of quotas, under the Commonwealth Sugar Agreement, to Swaziland, India and Rhodesia, and partly by an increase in the authorized acreage for the production of sugar beet in the United Kingdom. Rhodesia, however, was suspended from the Commonwealth Sugar Agreement following the unilateral declaration of independence, when only about two-thirds of her 25,000-ton quota had been shipped.

The Report also notes that under the Anglo-Irish Sugar Agreement the purchase and re-sale of 10,000 tons of Irish beet sugar resulted, for 1964/65, in a net payment of some £164,000 by the Board to the Irish Sugar Company, following the initial two years of the Agreement in which, owing to high world prices, the Board had received payments from the Company.

* * *

Argentine sugar industry situation[1].

The difficulties which the Argentine sugar industry has faced during recent years have been greatly aggravated during the current year (June 1965–June 1966) so that the Government has been obliged to create a special commission which, together with a parliamentary commission, is to investigate the problems of the industry. In the current campaign a record production of 1,200,000 tons has been reached as against 922,000 tons in the 1964/65 season. In 1965/66 sugar consumption in Argentina cannot be expected to be over 800,000 tons, so 400,000 tons are available for export. Initial stocks at the beginning of the campaign year amounted to 91,000 tons so that the country faces the problem of exporting about 500,000 tons.

As things are, this seems impossible, the more so as Argentina did not succeed in getting an import quota of 100,000 tons from the United States. During the last campaign year only about 16,000 tons were exported to the United States. It is supposed that the Argentine Government will strive to limit sugar production provisionally to 700,000 tons. The province of Tucumán will be chiefly concerned with these restrictions.

Of the 37 sugar factories in Argentina, 27 are in the province of Tucumán. But they do not provide 65% of the total production of the country and 35% of its sugar is produced in the provinces of Jujuy and Salta. Against a yield of below 30 tons of sugar cane per hectare in Tucumán, the yield in Jujuy is 80 tons and in Salta 60 tons per hectare. Again, the yield of sugar of the Tucumán factories is 8%, while in Jujuy and Salta a yield of 11% is obtained.

The chief reason for these differences is that the sugar factories of Tucumán are for the most part in the hands of farmers who give but little consideration to the improvement of cane cultivation. In Jujuy and Salta the cane plantations are in the hands of the factories which take pains to harvest as much cane as possible. To overcome these difficulties the Government of the province of Tucumán has proposed that the Central Government nationalize the Tucumán sugar industry, changing it completely to a state-managed enterprise. But there has arisen a great deal of resistance to this plan and the Government in Buenos Aires has not been willing to make the decision.

As a preliminary solution the Government has placed an amount of 300 million pesos as a loan, through the National Bank, at the disposal of the sugar factories of Tucumán. The final solution is expected to involve the closing of a large number of sugar factories which are not economical, having a total production capacity of only 200,000 tons of sugar. Restriction of sugar cane cultivation is expected to coincide with an extension of sugar beet cultivation. In the south of the province of Buenos Aires, and in the provinces of Entre Ríos and Mendoza, are areas which are favourable to the cultivation of sugar beets. Experiments in cultivation have failed chiefly because of the resistance of the sugar cane cultivators.

Meanwhile the government of the province of Entre Ríos has decided to restart the ancient Victoria sugar beet project, and to this end, has founded a Sugar Corporation. Financing of this plan is, however, confronted with difficulties. With the help of the Provincial Government a start has been made on the Mendoza sugar beet plan, experimental cultivations having been carried out using foreign seed from West Germany, Holland and other sources.

Argentine sugar factory closure[2].—Ingenio Esperanza, in the Delfin Gallo area of Tucumán, Argentina, is to be converted into a steel plant. The cooperative which has operated the factory has gone into liquidation.

[1] *Economische Voorlichting*; through F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (7), 13.
[2] *La Industria Azucarera*, 1965, **71**, 409.

AUTOMATIC CONTROL OF SUCROSE CRYSTALLIZATION
from High- and Medium-purity Syrups

By J. DOUCET (CERIS—Raffineries de Sucre de St.-Louis, Marseilles, France)
and C. GIDDEY (Institut Battelle, Geneva, Switzerland)

Introduction

SUCROSE crystallization in the sugar industry is a batch process, operated usually in vacuum pans having a capacity of 250–600 hl or more. Sucrose crystallizes from its supersaturated solutions, the seeding being usually performed when the syrup has attained the critical degree of supersaturation. At this stage the seed crystals are of microscopic size (5–30μ); they grow progressively during the strike and finally reach dimensions of 200–700μ.

The regulation principle usually adopted consists in determining the seeding point by measurement of the supersaturation and in controlling the vacuum and heating steam in accordance with a predetermined time programme. Feeding is controlled by measurement of the tightness of the massecuite in the pan and also by an over-riding control on the level whereby feeding is stopped when the massecuite level reaches an upper limit.

Sucrose crystallization from beet or cane sugar syrup aims at realizing specific goals, which in fact define the optimal parameters of the industrial process.

These goals are: (i) to achieve the maximum yield of crystalline sugar with regard to the original sucrose content of the fresh syrup, and (ii) to produce sucrose crystals with excellent physical characteristics —no conglomeration or false grain, regular shape and fulfilment of the required homogeneous crystal size. Sucrose crystals must also exhibit a high chemical purity.

These goals are subject in actual practice to limiting constraints: First, the massecuite must fall by gravity from the pan when the strike is finished, and therefore must not exceed a certain apparent viscosity, which depends on the design of the pan; the tightness of the massecuite depends essentially on the size of the crystals and on the crystalline phase:mother syrup mass ratio at the end of the strike. The yield of crystalline sucrose is therefore basically limited. Moreover, accidental formation of conglomerates or false grain increases the tightness of the massecuite appreciably.

Second, the efficiency of the centrifugalling, the purpose of which is to separate the mother syrup from the crystals, is directly related to the crystalline properties and to the crystalline phase:mother syrup mass ratio. False grain, conglomerates, etc., increase the retention of mother syrup and disturb the centrifugal separation. The resulting crystals are moist, spoiled, and difficult to dry and sieve.

Third, the undesirable formation of false grain or of conglomerates depends closely on the mode of regulation of the strike and on the properties of the sugar syrup (concentration, purity). Such factors as supersaturation of the mother syrup during the strike, the thermal gradient at the heat exchanger surfaces, the vacuum, and especially the feeding rate also have a predominant influence on the crystalline characteristics of the sugar crystals.

Finally, the duration of the strike ought to be constant and thoroughly correlated with the working schedule of the other stations in the plant. In fact, the crystallization rate depends on technological and physical factors: steam available for heating the pan, purity of the syrup, number (or size) of grown crystals. False grains and conglomerates accidentally produced also alter the crystallization rate appreciably.

Standard automation, which is usually based on adhering to a time programme associated with tightness-feeding control, disregards the practical constraints above. Consequently, standard automation attains only partially the required objectives. A new control principle, on the contrary, has been developed* which is well adapted to surmounting the constraints. Applied on an industrial scale, it has been demonstrated to be fully valid for the crystallization of high- and medium-purity juices in a vacuum pan without circulator.

Principles of the new control method

To achieve the required objective, it appears that two parameters ought to be known at any time during the strike, i.e. the respective values of the *crystalline mass* (m_c) and of the *mother syrup* (m_s) present in the boiler. Regulation of the strike should depend essentially on these two parameters.

The values m_c and m_s could be determined by a physical analytical method making it possible to measure both the crystalline mass:syrup mass ratio in a massecuite sample (e.g. Υ-ray adsorption, X-ray diffraction, etc.) and the massecuite volume. However, critical study of this problem discourages recourse to this procedure.

Our solution is to apply a *mass balance-sheet* method. This measures the crystalline mass (m_c) and the syrup (m_s) continuously. The method requires the use of a number of standard measuring instruments, one of which concerns the massecuite directly. A specific analogue electronic computer performs the calculations and regulates the external parameters.

* Patents pending.

Two algebraic balances characterize the crystallization of sucrose as it is performed on the industrial scale.

Preliminary remarks

(1) Sugar crystallization from the mother syrup causes a decrease of the concentration in sugar of the latter. Water distillation balances the phenomenon; therefore, measurement of the quantity of distilled water allows the amount of sugar which has crystallized to be calculated.

(2) Sugar crystallization and evaporated water promote a calculable decrease of the mother syrup, m_s.

(3) The mass of the mother syrups changes during the strike, for fresh syrup is fed in. Water distillation must ensure the concentration of the feed to the required supersaturation.

To sum up, the water distillation must compensate both the crystallization and the feeding effects.

Mass balance equations

Notations:

Q_f = syrup feed mass rate (volume × density),

C_f = concentration (w/w) of sucrose in feed syrup†,

Q_e = water distillation rate (mass),

m_s = mother syrup mass (in the pan),

C_s = concentration (w/w) of sucrose in mother syrup (in the pan)†,

m_c = mass of crystalline sugar (in the pan), and

Q_j = rate of additional water fed in.

We have also:

m_{si} = mass of the initial syrup in the pan at the time of seeding (footing), and

C_{si} = concentration (w/w) of sucrose in m_{si}†.

† Concentrations of sucrose (C_f, C_s, C_{si}) closely approach the Brix values (total solid concentration by refractometry) in the case where high purity feed syrups are used.

It may be easily demonstrated that at the time t of the operation, we have:

Mass of sugar dissolved in the foot $= m_{si}C_{si}$ ....(1)

Mass of feed syrup $m_f = \int_0^t Q_f dt$ .....(2)

Mass of dissolved sugar brought by the feed syrup $= \int_0^t Q_f C_f dt$ .....(3)

Mass of distilled water $m_e = \int_0^t Q_e dt$ .....(4)

Mass of secondary water injected in the pan $= \int_0^t Q_j dt$ .....(5)

Mass of mother syrup present in the pan (unknown) $= m_s$ .....(6)

Mass of crystallized sugar present in the pan (unknown) $= m_c$ .....(7)

Mass of the sugar dissolved in the mother syrup (unknown) $= m_s C_s$ .....(8)

The state of the massecuite at the time t is therefore defined by two equations:

Mass of crystalline sugar

$$m_c = m_{si}C_{si} + \int_0^t Q_f C_f dt - m_s C_s \quad \ldots\ldots\ldots\ldots (9)$$

Mass of syrup

$$m_s = m_{si} + \int_0^t Q_f dt + \int_0^t Q_j dt‡ - \int_0^t Q_e dt - m_c \quad \ldots (10)$$

‡ As the term $\int_0^t Q_j dt$ is relatively small in absolute value, it may be discarded.

The integrals are masses, i.e. variable rate × time. They will therefore be obtained from integrators "rate × time". The integral giving the mass of sugar in the feed syrup (3) includes two variables, i.e. the rate Q_f and the feed syrup sucrose concentration C_f. Permanent solving of equations (9) and (10) continuously indicates the values of the two unknown fundamental parameters, i.e. crystalline sugar (m_c) and mother syrup (m_s), respectively. The two equations are solved from four independent variables, i.e. the rate of feed syrup (Q_f), its sucrose concentration (C_f), the rate of water distillation (Q_e), and the concentration of sucrose in the mother syrup in the pan (C_s). Two well-defined complementary values are required: m_{si}, mass of the footing ,and its sucrose concentration (C_{si}) at the seeding time.

The principles of measurement of the variables are illustrated in Fig. 1 (Part A).

The equations are solved continuously by an analogue computer that gives m_c and m_s permanently.

Effect of the impurities on the mass balance sheet method

It can be easily demonstrated that the impurities in the syrup do not change the value of equations (9) and (10) provided the concentration C_f and C_s expresses the concentration of sucrose in the feed syrup and in the mother syrup, respectively.

With high purity syrup, as usually treated in the cane sugar refinery, the concentration of sucrose approaches very closely the refractometric Brix owing to the fact that the concentration of the non-sucrose impurities is very small. In that case, therefore, C_f and C_s in the algebraic equations can be replaced directly by the respective refractometric Brix.

Where lower purity feed syrups are concerned, the concept of purity must be considered for the concentration of sucrose in the feed (C_f) as well as for the concentration of the mother syrup (C_s), the purity of which, moreover, decreases progressively during the strike.

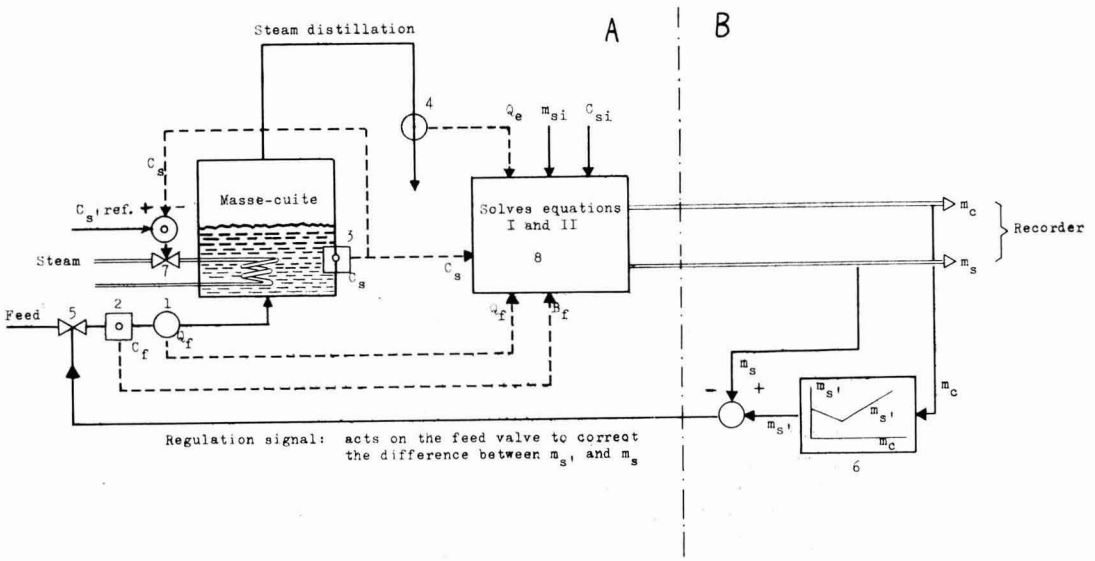

Fig. 1. 1—feed syrup flow meter; 2—in-line refractometer; 3—pan refractometer; 4—steam flow meter; 5—feed valve, 6—function generator; 7—steam valve; 8—computer.

To take this parameter into account, we proceed as follows:

(*a*) Because the purity of the feed syrup (P) (measured by conventional analytical methods) is practically unvarying during the strike, the output of the "in-line refractometer" fitted on the feed pipe (No. 2, Fig. 1) is adjusted in order to obtain the exact concentration of sucrose in the feed (C_f) direct.

(*b*) Calculation of the sucrose concentration in the mother syrup (C_s) is based on the assumption that

$$C_s = B_s \times P' \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (11)$$

where C_s = concentration of sucrose in mother syrup

B_s = concentration of total solids in mother syrup (Brix)

P' = purity of mother syrup

$$= \frac{\text{dissolved sucrose}}{\text{dissolved sucrose} + \text{impurities}}$$

$$\text{or} \quad \frac{m_s C_s}{m_s C_s + \text{impurities}} \quad \ldots\ldots\ldots (12)$$

Impurities in mother syrup are:

$$\text{Imp} = m_{si} \cdot C_{Isi} + C_{If} \int_0^t Q_f dt \quad \ldots\ldots\ldots\ldots (13)$$

where m_{si} = mass of foot

C_{Isi} = concentration of impurity in m_{si}

$$= \text{Brix}_{si}\,(1 - P) \quad \ldots\ldots\ldots\ldots\ldots (14)$$

C_{If} = concentration of impurity in feed syrup

$$= \text{Brix}_f\,(1 - P) \quad \ldots\ldots\ldots\ldots\ldots (15)$$

and Q_f = syrup feeding rate in mass.

Therefore

$$P' = \frac{m_s C_s}{m_s C_s + (m_{si} C_{Isi} + C_{If} \int_0^t Q_f dt)} \quad \ldots\ldots\ldots (16)$$

We thus have the evolutive ratio P' which enables us to correct the Brix B_s given by the pan refractometer (No. 3, Fig. 1).

The effect of impurities, mathematically discussed above, is practically resolved by the electronic circuits shown in broken lines in Fig. 5.

Automation and regulation criteria

The principle of control consists in regulating the external parameters as a function of the evolution of the crystalline mass (m_c). Thus the time factor becomes implicit. In a simplified model it is assumed for example that the mother syrup mass (m_s) is maintained constant during the entire strike. We therefore have:

$$m_s = m_{si} = \text{constant} \quad \ldots\ldots\ldots\ldots\ldots (17)$$

To achieve this condition, we should have:

$$m_f(1 - C_f) = m_e \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

$$m_f C_f = m_c \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (19)$$

The first condition (distillation of water contained in the feed syrup) is met by an independent regulation loop acting on the heating steam and ensuring the

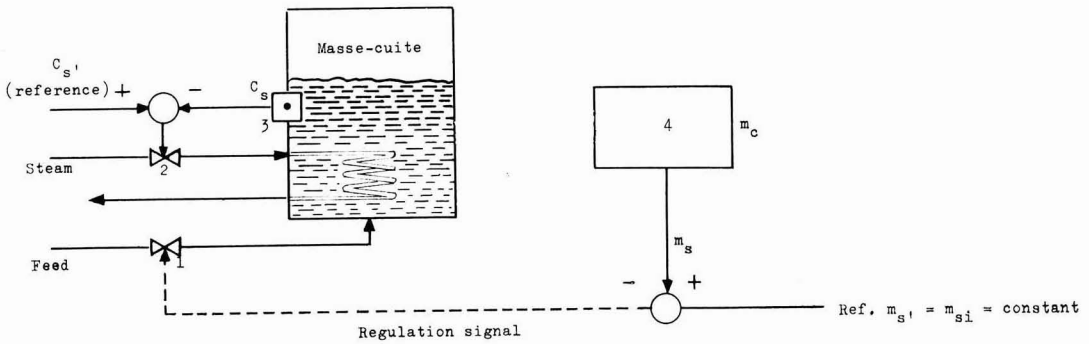

Fig. 2. 1—feed syrup valve; 2—heating steam valve; 3—pan refractometer; 4—computer.

regulation of the concentration of the mother syrup, C_s. The second condition is fulfilled by the calculation of m_s and the regulation loop acting on the feed syrup valve (Fig. 2). Both conditions are automatically achieved if m_s = constant. The ratio $R = \frac{m_c}{m_s}$ is therefore a linear function of m_c (see Fig. 3, curve 1–1'). Consequently, the evolution of ratio R is ensured independently of the rate of crystallization.

In reality, the footing (m_{si}) must be as small as possible relative to the pan size. m_s = constant is also unpractical; in order to obtain a judicious use of the pan, m_s must grow during the strike ($m_{s\,final} > m_{si}$). The factor K, where $K = \frac{m_{sf}}{m_{si}}$, usually lies between 1·5 and 2. The relation between m_c and m_s is achieved by the use of a *function generator* which imposes the reference $m_{s'}$ as a linear function of m_c, e.g.:

$$\text{Ref. } m_{s'} = m_{si} + \alpha m_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (20)$$

α being determined by the desired final value of R.

In Fig. 3, curve 2 and 2/, we have supposed that the function Ref. $m_{s'} = f(m_c)$ is linear. Practical experimentation makes it possible to determine the optimal function, which can differ from linear according to the type of vacuum pan considered. Apart from the analogue computer, which calculates m_c and m_s, the function generator is therefore the principal component of the electronic equipment.

Fig. 4 shows some characteristic functions which can enter into consideration. The function materialized by curve E has been noted as particularly valuable for a natural circulation vacuum pan of 250 hl (footing 125 hl). Fig. 1 (A and B) schematizes the complete control of the vacuum pan including an independent "heating steam $C_{s'}$ loop". $C_{s'}$, indeed, must remain at a value that ensures the proper supersaturation of the mother syrup.

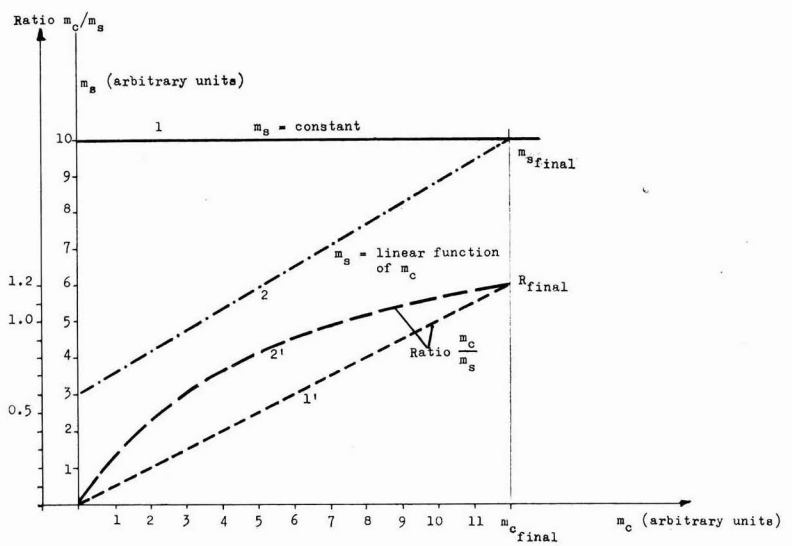

Fig. 3.

Application of the control process

The process and the electronic circuits were devised (Fig. 5) and tested on a pilot laboratory vacuum pan. The industrial equipment further developed has been used for regulating a 250 hl

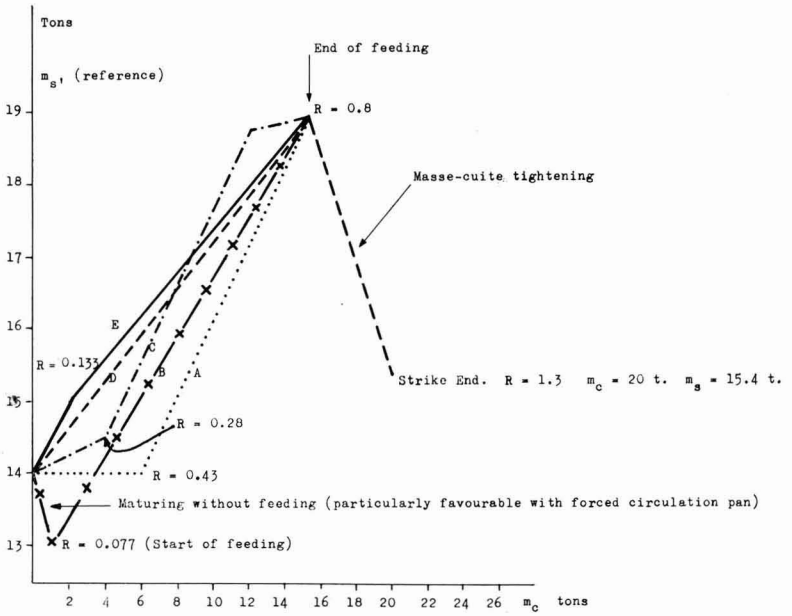

Fig. 4. Function generator curves.
$m_{s'} = f(m_c)$. Functions *A**, *B**, *C**, *D** and *E* have been tested.
E has been noted as particularly valuable on the industrial scale.
* Tested in laboratory.

vacuum pan (natural circulation). The electronic equipment (analogue computer and function generator) was supplied and assembled by the Compagnie Française Thomson-Houston (Paris).

The recording instruments include (Fig. 1):

(*a*) an electromagnetic flow-meter for measuring the rate of feed syrup, i.e. $Q_f = V_f \times d$ (volume × density),

(*b*) an in-line refractometer mounted on the feed pipe, adjusted for measuring C_f (at high purity, C_f closely approaches the Brix of the feed syrup).

This instrument can be omitted if the concentration of the feed syrup does not vary by more than ± 0·5% during the strike.

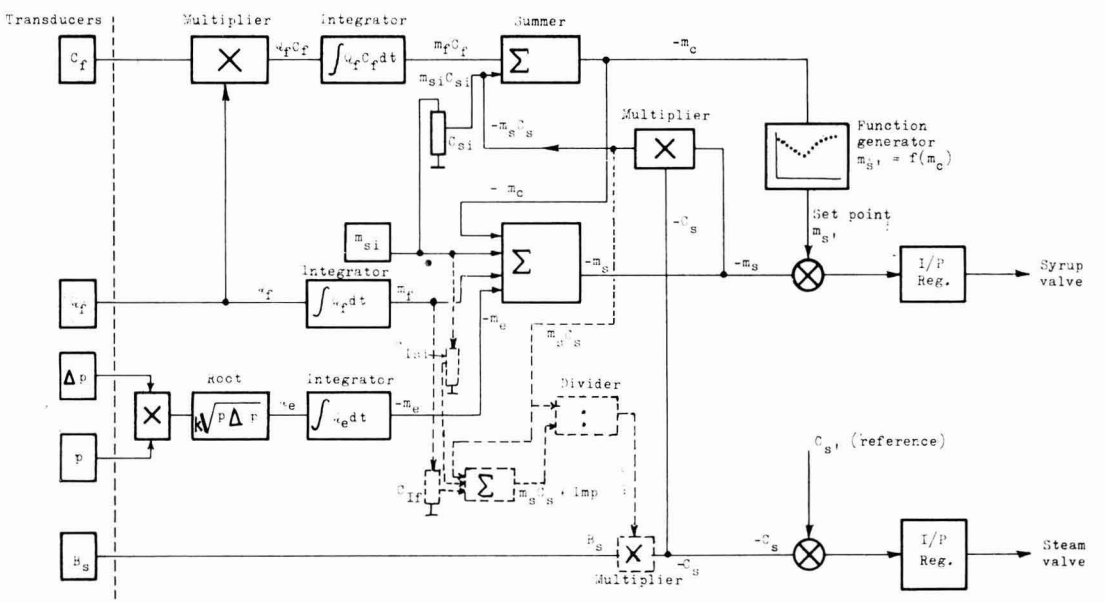

Fig. 5. Main components of computer and regulation circuits.

(*c*) an in-line refractometer fitted on the vacuum pan for measurement of the total solid concentration of the mother syrup (Brix B_s). [with high purity, Brix of mother syrup (B_s) is practically equal to the sucrose concentration (C)$_s$; for lower purity, the Brix is automatically converted to C_s (see above)], and

(*d*) a diaphragm flow-meter fitted on the distillation pipe (vacuum pipe) between the pan and the condenser, Δp and p being measured by a Barton cell.

The control components include:

(*a*) an automatic valve, fitted on the feed pipe and positioned by the function generator,

(*b*) an automatic valve fitted on the steam pipe and controlled by the pan refractometer, and

(*c*) the vacuum control equipment which regulates the vacuum by adjusting the rate of flow of the water in the condenser.

Functions automatically performed

The equipment described performs the sugar strike fully automatically, including (1) addition of the footing; (2) regulation of the concentration of footing syrup; (3) heating regulation; (4) seeding and maturing; (5) feeding; and (6) tightening of the strike.

Summary and Conclusion

A new concept of automatic regulation of the industrial sucrose crystallization process has been developed. It is based on the application of a mass-balance-sheet calculated by a specific analogue computer and a function generator that ensures the control of the external parameters of the strike and can take account of the purity ratio of the sugar syrup.

The control process tested on a laboratory pilot vacuum pan has successfully been transferred to the industrial scale.

The experiments have proved that definite improvements are obtained as regards both the reproducibility of the development of the strike and the quality of the sugar crystals. In particular it has been observed that the residual moisture bound to the sugar crystals is always lower than is the case in the usual manual control on the same vacuum pan.

The automatic industrial process described is in operation for crystallization of high purity sugar at the Raffineries de Sucre de St.-Louis, Marseilles, France.

COLD CAUSTIC PULPS FROM SUGAR CANE BAGASSE

By CARLOS VINCENTY, HECTOR M. RODRIGUEZ, G. V. DE PORRO and ERNESTO RENTAS CRUZ

Paper presented to the 12*th Congress, I.S.S.C.T.*, 1965.

THE efforts to establish bagasse as a paper material began more than a century ago and have continued throughout the years, with many ups and downs, but making steady headway, until today there are bagasse paper and board mills operating in most of the major sugar cane growing areas. This trend will undoubtedly gain new vigour with the passing years. Bagasse mills are now producing a whole range of products, from coarse wrapping and corrugating medium to fine writing and printing papers. The pulping processes in use range from modified soda and kraft cooks, to caustic-chlorine methods and an advocated mechanical fiberizing process similar to "refiner groundwood operation."

During the last two decades, there has been a decided tendency on the part of the North American pulp and paper industry toward better utilization of forest products by more integral use of the trees and the production of the so-called high yield pulps which combine certain desirable properties of chemical pulps with other desirable characteristics of mechanical pulps. Among the processes in use to produce such high yield pulps from both soft and hardwoods are the neutral sulphite semi-chemical, the chemi-groundwood, cold soda, and many others. The cold soda process was developed at the U.S. Forest Products Laboratory and has since been used commercially in North America, Europe, Australia and Japan to produce pulps for use in the manufacture of such diverse papers as newsprint, tissue and corrugating medium.

Basically the cold soda process consists in the impregnation of raw material with a sodium hydroxide solution at temperatures from room to near boiling, draining off the excess liquor and refining the softened material in a disc mill. The impregnation step requires one or two hours if performed at atmospheric pressure, but it can be shortened by applying hydrostatic pressure. Nevertheless the penetration of the

cooking liquor into the wood chips takes time and is far from producing a homogeneously impregnated raw pulp. Because bagasse is such an absorbent material by nature, and its lignin and hemicellulose constituents are more reactive than those of hardwoods, it seemed likely to be easily pulped by this process. The following presents a short account of efforts in this field.

Previous work

The cold soda process was developed at the U.S. Forest Products Laboratory, Madison, Wis., in 1949. BROWN *et al.*[1,2,3,4,5] have given accounts of their work in the application of the process to Northern and Southern hardwoods for the production of paper pulps ranging from corrugating medium to printing papers in laboratory and pilot plant stanges. VON KOEPPEN[6] has discussed the development and present status of the process in industry in a series of articles. VOIGTS and SMITHE[7] describe a cold soda mill producing bleached food board from northern aspen. SNYDER and PREMO[8] describe the use of cold soda pulps in printing papers. BUGG and PEARSON[9] give an account of the production of cold soda pulp in Australia. DIEHM *et al.*[10] have studied the effect of wetting agents on the penetration of cold soda liquor into hardwood chips. LUNER *et al.*[11,12,13] and MARTON[14] investigated the response of cold soda pulps to bleaching agents and suggested the use of sodium borohydride in the alkaline cooking liquor to prevent the formation of coloured bodies during the preparation of these pulps. OHNISHI and AMAMIYA[15] describe the cold soda process used for newsprint furnish in Japan. NICOLAS and NAVARRO[16] studied the application of the cold soda process to Philippine woods and bamboos. ERNST *et al.*[17] applied the cold soda process to wheat straw for corrugating pulps. HINRICKS *et al.*[18] disclose the application of this process to Hawaiian bagasse.

Materials and Equipment

The bagasse used in these experiments was obtained from Central Aguirre, P.R., from cane ground during the 1962 campaign. It was in the form of briquettes which contained approximately 10% moisture by weight. The process by which these briquettes are made removes a considerable portion of the pith and dirt in the fresh milled bagasse. Since the depithed fibre is flash dried shortly after milling, the sugar content of the briquettes is practically the same as that of fresh bagasse coming from the cane mill. These briquettes are cylindrical, about 4 inches in diameter, of varying height and their apparent density is approximately that of water. When immersed in water they expand to about six times their original volume, absorbing up to four times their weight of liquid.

The chemicals used throughout these trials were reagent grade with the exception of sodium borohydride which was technical grade*.

The cooks were performed in stainless steel vessels of suitable capacity, all metal in contact with the raw pulp being stainless steel of various grades. Bleaching was carried out in glass or plastic ware.

A Sprout Waldron, single-disc, 12-inch refiner was used to fiberize the fibre bundles. Three different refining plates were used: Pattern No. C-2975, a spike tooth plate, was used for breaking up, while either Pattern No. 17804-A or 12527-A was used for refining to desired freeness.

Strength development studies were carried out in a TAPPI Standard Niagara beater. Hand sheets were made in a TAPPI Standard Sheet mould, pressed in a Valley 10 in × 10 in press and dried and conditioned at 73°F and 50% R.H. before testing.

Methods and Procedures

The moisture content of the bagasse briquettes was determined using an infra-red heated moisture balance, and the equivalent of 1000 grams oven-dry fibre was steeped in cooking liquor at the desired temperature. The contents of the kettle were thoroughly stirred at frequent intervals to ensure good mixing. The temperature was maintained by setting the vessel on a hot plate. At the end of one hour, the pulp was poured on a screen bottom box and the excess liquor drained and sampled for analysis. The pulp was then washed with tap water until the washings ran free of alkali. The washed pulp was pressed by hand, mixed thoroughly on a stainless steel tray, weighed and sampled for analysis.

The washed pulp was then diluted to around 8% consistency and fed to the Sprout Waldron refiner at a clearance of 0·050 inches between plates. The pulp was recirculated through the refiner with diminishing clearances until the desired freeness was obtained. The pulp was now washed again and filtered through a fine linen cloth, pressed by hand and again weighed and sampled.

About one half of the refined pulp (360 grams) was processed in the Niagara beater as per TAPPI 200 Ts-61 and TAPPI T205-m-58. The test sheets were conditioned at 73°F and as close to 50% R.H. as possible, and tested according to TAPPI T-220-m-60. On some occasions the remaining pulp was bleached using sodium hydrosulphite, peroxide or hypochlorite. Hand sheets of the bleached pulp and sheets for optical tests as per TAPPI T-218-m-59 were also made.

[1] BROWN & MCGOVERN: *TAPPI* 1950, **33**, 364–368.
[2] *idem*: *Paper Industry*, 1953, **35**, 66–69.
[3] BROWN & HILTON: *Paper Trade. J.*, 1956, **140**, (20).
[4] BROWN: *Paper Industry*, 1958, **39**, 844–850.
[5] *idem*: *TAPPI*, 1959, **42**, 158–164.
[6] *Paper Trade J.*, 1961, **145**, (16, 17 and 18).
[7] *TAPPI*. 1962, **45**, 135A–137A.
[8] *ibid.*, 1957, **40**, 901–904.
[9] *Paper Trade J.*, 1958, **142**, (51), 18–24.
[10] *TAPPI*, 1960, **43**, 364–369.
[11] LUNER: *ibid.*, 819–825.
[12] LUNER & SUPKA: *ibid.*, 1961, **44**, 620–624.
[13] LUNER & CHEN: *ibid.*, 1963, **46**, 98–101.
[14] *ibid.*, 1960, **43**, 826–831.
[15] *Tech. Rpt.* (Sprout Waldron Co., Muncy, Pa., U.S.A.), (4).
[16] *TAPPI*, 1964, **47**, 98–105.
[17] *ibid.*, 1960, **43**, 34–37.
[18] U.S. Patent 3,013,392.

* Callery Chemical Co., Pittsburgh, Pa., U.S.A.

Experimental Results

Table I shows the results of six experimental cooks performed at three temperature and two concentration levels. Cooks Nos. 1, 4 and 8 were at a caustic liquor content of 25 grams per litre and at 40°C, 60°C and 90°C while cooks Nos. 9, 10, and 12 were at a liquor concentration of 15 grams per litre and at 90°C, 75°C and 40°C respectively.

Table I
Straight soda cooks

Cook No.	1	4	8	9	10	12
Time (min)	60	60	60	60	60	60
Liquor ratio	8:1	8:1	8:1	8:1	8:1	8:1
Temperature (°C)	40	60	90	90	75	40
NaOH conc. (g/litre)	25	25	25	15	15	15
NaOH consumed (g/litre)	11·0	10·4	9·8	9·7	10·0	9·0
Kappa number	—	—	40·5	—	—	—
Overall yield (%)	63·0	61·5	58·0	64·0	62·0	66·0
Brightness (°Photovolt)	21·5°	24·5°	23·0°	24·0°	31·0°	33·0°
Opacity (Photovolt %)	93%	86%	72%	73%	76%	98%
Freeness (C.S.F. ml)	400	400	400	300	250	300
Breaking length (m)	4500	3900	7800	9700	5600	2400
Burst factor (sq.m.)	24	22	54	48	27	15
Tear factor (sq.dm.)	75	74	64	70	59	39
Fold, M.I.T-df.	100	90	900	1250	135	6
Density (g/c.c.)	0·60	0·62	0·72	0·74	0·67	0·60

Table II shows the results of five experimental cooks at different concentrations and temperatures to which, in all but one cook (No. 17), various other substances beside sodium hydroxide were added to the cooking liquor. Cook No. 7 is basically a Kraft cook at low temperature. In cooks No. 5 and No. 11 part of the caustic was added as sodium peroxide. In cook No. 18 sodium borohydride to the extent of 1% on oven dry bagasse was added to the cooking liquor. The bagasse used for cook No. 17 had been previously washed three times with boiling water to remove residual sugars.

Tabe II
Modified soda cooks

Cook No.	7	5	11	18	17*	3365†
Time (min)	60	60	60	60	60	120
Liquor ratio	8:1	8:1	8:1	12:1	8:1	
Temperature (°C)	90	40	75	70	40	41
NaOH conc. (g/litre)	20	22·5	15	25	25	35·1
Other chemical	Na_2S	Na_2O_2	Na_2O_2	$NaBH_4$	—	—
Other chemical conc. (g/litre)	5	2·5	1	0·8	—	—
NaOH consumed (g/litre)	11·4	—	11·6	10·0	12·4	9·42
Kappa number	31·1	57·5	—	63	—	—
Overall yield (%)	60·3	55	66	60·5	57	92·8
Brightness (°Photovolt)	23	28·5	30	39	35	41·6
Opacity (Photovolt %)	72	77	80	73	54	—
Freeness (C.S.F. ml)	400	400	300	400	90	200
Breaking length (m)	6600	5150	5300	5300	5700	4780
Burst factor (sq.m.)	42	29	23	31	31	24·2
Tear factor (sq.dm.)	58	68	53	67	44	61·0
Fold, M.I.T.-df.	520	112	19	160	150	
Density (g/c.c.)	0·67	0·60	0·59	0·62	0·65	0·48

Discussion of Results

The amount of caustic consumed in cooking does not seem to be a function of either temperature or concentration in the ranges and under the conditions used in these experiments. Pulp cooked at lower temperatures and caustic concentrations in higher yields have lower strength properties, are bulkier, and tend to have better brightness and opacity.

Best strength properties were obtained from cook No. 8 using soda liquor at 25 grams per litre concentration, at 90°C; however the yield obtained was lower than comparable cook No. 7 in which Kraft liquor of the same total caustic concentration was used at the same temperature. The Kappa number of the Kraft cook was lower, which may indicate that Kraft liquor removes more lignin while straight soda exerts a more profound attack on the hemicelluloses of bagasse under these conditions.

Brightness and opacity of cold soda bagasse pulps are generally much lower than for similar pulps from hardwoods grown in temperate zones. The use of sodium peroxide as part of the cooking liquor increases the brightness of pulp, however, and a better and more permanent effect was evident upon the addition of 1% sodium borohydride on weight of oven-dry bagasse. An increase in brightness was also noticed with pulp produced from hot-washed bagasse in cook No. 17; however, the large drop in opacity and yield indicate a more profound change in the constitution of the raw material.

Conclusions

Bagasse is eminently suited to the production, by the cold caustic process, of pulps comparable to those obtained from temperate hardwoods by the same method. Because of its high degree of absorbency and fibrous nature, bagasse does not require the use of pressure or vacuum systems for impregnation nor the expenditure of large amounts of energy for mechanical treatment of the resulting pulp. Chemical requirements are small and processing times moderate. The process can easily be made continuous and the strength and optical properties of the product can be varied by changes in temperature, liquor composition and mechanical treatment. For these reasons the cold caustic process would appear especially suited to the production of pulp in the sugar canc areas of the world since a considerably lower capital requirement is involved and wider flexibility compared with other processes.

Summary

Cold caustic pulps were prepared from bagasse briquettes which had been stored for more than twelve months. Caustic concentrations from 15 to 25 grams per litre and liquor ratios from 8:1 to 12:1 were used at temperatures between 30°C and 90°C. Caustic consumed varied from 9·0 to 12·4 grams per litre of liquor and overall yield from 55 to 66% based on oven dry bagasse. The raw pulps were washed and fiberized in a disc refiner to about 400 ml C.S.F. and

* Sugar content of bagasse: 0·11%.

† Mixture of 80% water oak and 20% willow oak by volume. Hydrostatic pressure of 150 p.s.i. used for impregnation. (Reported by BROWN[5].)

further treated in a Niagara beater for strength development study. Tensile strengths as high as 9,700 metres and burst factors up to 54 square metres were obtained. Similarly tear factors up to 75 sq.dm. and folding strengths up to 1250 double folds were found. Brightness of unbleached pulps between 21·5 and 33°Photovolt and opacities around 72% were obtained. Addition to the cooking liquor of 1% sodium borohydride based on oven dry bagasse increased the unbleached brightness to 39°Photovolt. Pulps bleached with hydrosulphite, peroxide and hypochlorite showed a high degree of reversion; borohydride pulp showed much less. The presence of residual sugars in bagasse may cause a decrease in brightness of cold soda pulps obtained from it. The cold soda process appears to be especially suited to the production of bagasse pulp in cane sugar areas of the world.

SUGAR CANE RESEARCH AT COIMBATORE

Annual Report of the Sugar Cane Breeding Institute, Coimbatore, 1962-63

IT is unfortunate that this report of 58 pages should have been so long delayed in its appearance, not being received until this year. Accounts are given of the many activities of the Institute for the period concerned, under various sections, viz.: Breeding, Botany, Cytogenetics, Physiology, Chemistry, Plant Pathology and Entomology. There are also accounts of work at the two substations at Karnal and Cannanore in Kerala State, the latter being used for the maintenance of the World Collection of sugar cane varieties and wild allies of the sugar cane that have potential value in sugar cane breeding.

Pollen

Reference is made to the development of a technique for the easy observation of the pollen tube in the stylar tissue of sugar cane. The conventional cotton-blue staining technique has not been found to be very suitable since the stylar tissues also take the stain and the stylar tissue is purple. A technique using aniline blue and safranin in acetic acid has been found very advantageous bacause the stains give a contrasting colour to the pollen tube in relation to the surrounding tissue. Transferring the stylets to 45% acetic acid after staining removes the stain almost completely from the stylar tissue but leaves the pollen tube well stained. The pollen tubes are stained deep blue against a very pale purple background.

For the mass germination of sugar cane pollen a satisfactory technique using cellophane sheets has been developed. The pollen tubes adhere to the cellophane and can be easily observed for genetical studies or manipulated as necessary for physiological work. "Polyethylene or enamel trays of dimensions 30×15 cm are used as culture vessels. A 250-ml volume of 26% solution of sucrose is poured into a tray to cover its bottom to a depth of about 5 mm. Five sheets of Whatman No. 1 filter paper and 5 sheets of cellophane, each 28×12 cm, are allowed to soak in the solution for 15 minutes. The cellophane sheets are then removed and blotted to free them of all adhering solution. Next, the sheets of filter paper are carefully taken out individually, allowed to drain for a few seconds and laid singly on the bottom of a clean tray. One cellophane sheet is applied to the surface of the filter paper with care to eliminate all air spaces between the cellophane and the filter paper. Pollen is dusted on the exposed surface of the cellophane and the tray tightly covered with polyethylene film. The pollen tubes adhere to the cellophane and can easily be observed for genetical studies or manipulated as necessary for physiological studies". The method has been found to be particularly suitable for the extraction of hormones from germinated pollen.

Flower Induction

Work, first started in 1956, on inducing shy-flowering varieties of sugar cane to flower was continued. Details of the results obtained in inducing flowering by means of four-hour extra dark treatment are given. In all some 174 different varieties were experimented with. The following were induced to flower: 30 out of 32 Co canes, 85 out of 90 *spontaneum* clones, 10 out of 14 North Indian canes, 17 out of 20 other varieties, 4 out of 12 *officinarums* and all the 6 *robustum* forms. The poor response in the case of *Saccharum officinarum* was considered to be mainly due to their poor growth performance under pot culture.

Investigations were also carried out into the biochemical status of the cane plant during its transition from the vegetative to the reproductive or flowering condition. These studies related mainly to the metabolic changes occurring in the various carbohydrates, the nitrogen content, free amino acid make-up, and pigment composition, but also to the activities of hydrolysing and oxidizing enzymes of the stem apex and top six leaves at four stages. Distinct differences in the various carbohydrates, viz. reducing sugars, sucrose, total sugars, starch and total nitrogen, were observed in the stem apex and top six leaves at the time of flower initiation. Differences in distribution of free amino acid and in activity of oxidizing enzymes (catalase and peroxidase) and hydrolysing enzymes (invertase and reductase) were also quite significant.

Starch Content

An investigation was carried out on the starch content of mature canes in 23 commercial varieties

of sugar cane. From the point of view of sugar manufacture starch is undesirable, for its presence in the cane, beyond a certain limit, interferes with the settling of clarified juice, increases the viscosity of the juice and affects the crystallization of sucrose. Starch content varied from 0·25% in variety Co 740 to 1·17% in variety Co 312 (on a zero moisture basis).

Cane and Waterlogging

Some work on the physiological aspects of the sugar cane plant in relation to waterlogging was carried out, stimulated by the expansion of the area under sugar cane into marginal lands and possibly the total amount of damage caused by waterlogging in cane fields in parts of northern India. Four varieties considered to be tolerant to waterlogging and two varieties considered to be susceptible were grown in pots, cemented internally, and containing clay soil. Artificially waterlogged conditions were maintained in the pots. Control plants in normal pots were watered once daily. The rate and extent of root development was studied, as well as the angle of inclination of the foliage. More roots were found to develop in the four tolerant varieties in the pots under waterlogged conditions. The leaves of the two intolerant varieties did not seem to change appreciably their angle of inclination as compared with normal conditions. On the other hand the four varieties tolerant to waterlogging changed their angle of inclination considerably, presumably to minimize excessive transpiration under the stress of "physiological drought".

The effect of a high concentration of carbon dioxide in the water under waterlogged conditions was also studied. Plants, two months old, of the variety Co 785, which showed the greatest power of adjustment to waterlogged conditions, were placed in glass containers (3 per container). Some plants were subjected to waterlogging, others to waterlogging plus CO_2 (gas bubbled twice daily) and others maintained as controls. After three weeks the plants were removed from their containers and records made on height of shoots, fresh and dry weight, and number and length of roots. Results were tabulated. With CO_2 bubbling the height of the stalks and the amount of dry matter decreased while the number of roots formed increased, presumably as an adaptation to meet the anaerobic conditions. The greatest length of normal root system, however, was shown by the controls.

Field studies on varietal tolerance to waterlogging were also carried out by means of artificially created conditions of waterlogging in the field.

Pests and Diseases

As in past years the internode borer (*Proceras indicus*) remained the most important pest. Nearly a quarter of the total number of varieties examined had an incidence of more than 50% and more than three-quarters showed more than 25%, on a stalk basis. Nine varieties recorded less than 5%, and one variety (Q 44) was unattacked. Details are given of the incidence of attack by top borer (*Scirpophaga nivella*) and early shoot borer (*Chilotraea infuscatellus*) on a number of cane varieties.

A study in correlating morphological characters of sugar cane varieties or sugar cane allies with the incidence of certain insect pests was commenced, as a joint undertaking between the Botany and Entomology Sections. The incidence of white fly (*Aleurolobus barodensis*) on the variants of *Saccharum spontaneum* and the leaf structure and anatomy of selected resistant and susceptible forms were studied. It was found that the vigorous growing narrow leaved forms were preferred by the pest. Evidence of a stylet entering a stomatal aperture and probing the tissue was not confirmed. The formation of chlorotic spots on the leaf surface indicates attack by the insect, but large-scale internal destruction of the cells was not noticeable. Further studies are proposed.

Work on the inheritance of disease resistance, especially in regard to red rot, was continued. Strains "D" and "I" of the pathogen continued to be used for testing the resistance of varieties or seedlings to red rot. The testing of the World Collection of varieties for resistance to red rot was continued. Some 612 varieties or clones were tested, including those of species of *officinarum*, *barberi*, *sinense*, *robustum* and foreign and Indian hybrids. One clone of *Saccharum barberi* ("Matja Shaj") was highly resistant. Four other *barberi* clones were resistant and two were moderately resistant. Whilst it was noticeable that this species contained a number of clones with greater or lesser resistance, a number of them were also susceptible, emphasizing the need for care in selecting parents for breeding. The majority of *officinarum* and of *robustum* clones were susceptible.

Certain intergeneric crosses were also tested for resistance to red rot. First generation progenies of crosses of *Saccharum officinarum* and *Sclerocarya fusca*, and first, second and third backcrosses to *Sclerocarya* were studied. The majority of the seedlings tended to be susceptible. With crosses between *Saccharum officinarum* and *Narenga porphyrocoma* resistance was also relatively rare.

With regard to the progeny of cultivated or hybrid varieties, seedlings from seven parental combinations, involving hybrid canes, were inoculated by the juvenile technique and seedlings that were resistant were planted out for further adult resistance tests. One variety (B 42231), itself highly resistant, gave a number of resistant seedlings. Other relatively resistant parents failed to yield resistant seedlings in the test.

Observations made during the year indicated that in highly susceptible varieties the lesion on the stem caused by the disease tended to cover the entire width of the cane. This is considered to indicate a high degree of susceptibility, whether or not drying of the tops has taken place at the time of observation. It was also noted that the presence of prominent white spots in the inoculated internode indicated susceptibility, irrespective of the extension of the lesion to other internodes.

A total of 614 clones were tested for resistance to smut (*Ustilago scitaminea*), including several species of *Saccharum* and hybrid canes. Many of the foreign hybrids were susceptible in varying degrees. Out of 43 clones of *S. officinarum* 36 proved to be susceptible, discounting the belief that the *officinarum* canes are generally resistant. Of 249 clones in the final test plot 78 showed infection to the extent of more than 10%. At the time of planting conditions were not favourable for infection. F. N. H.

THE LOXODROME CENTRIFUGAL

Comparison of a New Continuous Centrifugal with Conical-basket Continuous Centrifugals

By JULIUS von RÖTEL

EFFORTS have been made to lower the unit cost of production and of space requirements per unit by constructing larger and larger equipment, and centrifugals are no exception to this development. Since 1954 when the writer installed for the first time continuous centrifugals with conical baskets, in the sugar factory at Stuttgart-Bad Canstatt, the throughput of *C*-massecuite of such centrifugals has risen from 1 ton/hr to 3 tons/hr. This large increase could only be obtained by a corresponding increase in the working screen surface and hence of the conical basket.

Size is limited, of course, by the strength of the materials of construction, and we are approaching this limit. Moreover, the power requirement per unit of throughput increases proportionally as the diameter of the screen basket. Consequently it is not possible to achieve any appreciable increase in throughput by simply enlarging existing conical centrifugals.

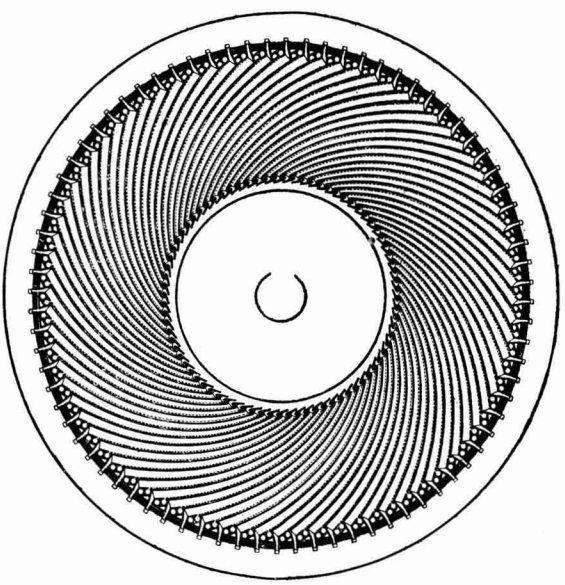

Fig. 1

Increase of throughput may nevertheless be achieved, without enlarging the diameter of the conical drum, by filling the cavity—in the form of an open cylinder—with a large number of curved screen bearers supporting one another. The screen bearers may be close together because only a very thin layer of sugar particles glides over the screen surface. The screens resemble the vanes of a centrifugal impeller and are curved in such a manner that they cut isogonally each radius or direction of centrifugal forces, similarly to the behaviour of conical centrifugals.

The curvature of these screens represents a component of a logarithmic spiral and is called a loxodrome. Using polar coordinates, the equation describing such a curve is:

$$r = r_{\circ_1} e^{\phi \tan \alpha} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where $r_{\circ_1}$ is the initial value of the radius, α is the angle of inclination of the tangent of the curve to the tangent of an intersecting circle around the centre (see Fig. 2) and r and ϕ are the running coordinates.

The individual screen bearers look like wings and such centrifugals have commonly been known as "wing screen" centrifugals. In view of the special shape of these screens the writer prefers to call them Loxodrome centrifugals.

The productivity of different continuous centrifugals may be calculated and compared in terms of their so-called "centrifugal effect". It has been proved that the throughput of continuous centrifugals is proportional to their centrifugal effect provided that other conditions are equal, i.e. the same massecuite, temperature and screen.

The centrifugal effect E may be calculated from the integral of all products of the centrifugal acceleration p_z acting on a screen area element dF and the projection of that area perpendicular to the direction of p_z. For a conical-basket continuous centrifugal this integral becomes

$$E = \frac{\omega^2 \, 2\pi \, \cot\beta \, (r_a^3 - r_o^3)}{3} \quad \ldots\ldots\ldots\ldots (2)$$

where ω is the angular velocity, β is the angle of elevation of the cone, r_a is the largest working radius of the conical screen and r_o its smallest working radius.

The quantity

$$\tfrac{2}{3}\pi \cot \beta \, (r_a^3 - r_o^3) = 2V \ldots\ldots\ldots\ldots (3)$$

where V is the volume of the frustrum of a cone, the convex surface of which forms the working screen area. Thus the throughput L of a conical-basket continuous centrifugal is proportional to the square of the angular velocity (and hence of the speed of revolution) and to the volume of the frustrum of the cone defined by the working area of the screen, i.e. L = constant $\times$ n^2V, where n is the speed of revolution in r.p.m. and V is the volume of the frustrum.

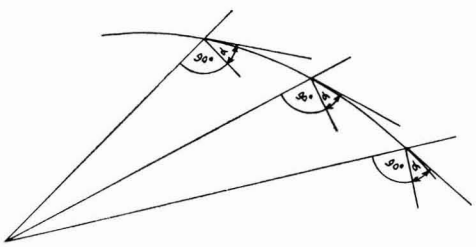

Fig. 2

The working conditions of the Loxodrome centrifugal are similar to the above because the effects of the centrifugal forces created at the curved screens are the same as those of a conical-basket continuous centrifugal. Consequently the same mathematical principles apply for these, whence the centrifugal effect can be shown to be

$$E = \omega_1^2 \, z \tfrac{1}{2} \cot \alpha \; h(r_{a_1}^2 - r_{o_1}^2) \quad \ldots\ldots\ldots (4)$$

where ω_1 is the angular velocity, z is the number of screen bearers, α is defined above for equation (1) h is the breadth (height) of the working screen and r_{a_1} and r_{o_1} its external and internal working radii, respectively.

Here also, the part of the equation (4)

$$\tfrac{1}{2} \cot \alpha \, h(r_{a_1}^2 - r_{o_1}^2) = 2V_1 \quad \ldots\ldots\ldots\ldots (5)$$

where V_1 is the volume of the body ABCDEF (Fig. 3) formed by the curved screen surface

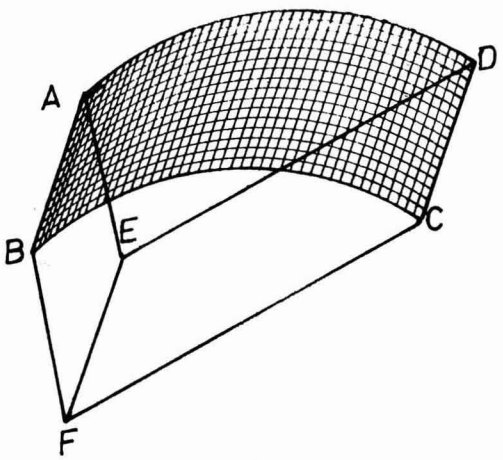

Fig. 3

and the planes perpendicular to and extending from the axis of rotation. ABCD is the curved screen and ABFE, EFCD, AED and BFC are the planes perpendicular to the axis of rotation EF. The formula for the throughput of a Loxodrome centrifugal is thus similar to that of a conical-basket continuous centrifugal, viz.: L = constant $\times$ $n_1^2V_1$ where n_1 is the speed of rotation in r.p.m.

The individual screen bearers support one another against centrifugal force and are held against the inner rim of the centrifugal basket. It is possible to fit or remove each screen bearer individually. A total of 72 screen bearers have been successfully fitted within the cylindrical cavity of a centrifugal basket, to give a working screen surface of 6.5 sq.m.; this gives seven times the throughput of the largest conical-basket continuous centrifugal hitherto on the market, i.e. 21 tons of *C*-massecuite per hr, compared with 3 tons/hr. In the case of *B*-massecuite the highest throughput reached by a conical-basket continuous centrifugal is about 6 tons/hr; the use of such a machine has not been economical, however, because a batch-type centrifugal is able to handle up to 18 tons/hr. The Loxodrome centrifugal, on the other hand, can achieve a throughput of up to 42 tons of *B*-massecuite per hour and, moreover, its construction costs are much lower than those for a batch-type centrifugal with a throughput of only 18 tons /hr. Construction costs per unit of throughput for a Loxodrome centrifugal are only one-third of those for a conical-basket continuous centrifugal.

Because of the high throughput it is possible to use screens with very small openings (0·04 mm or less) and the purity of the molasses is thus brought to a minimum. Use of much smaller screen openings reduces the throughput of the centrifugal, of course, but the reduced throughput of the Loxodrome centrifugal is nevertheless still higher than that of a conical-basket continuous centrifugal.

Deterioration of burnt standing cane, burnt cut cane. H. E. YOUNG. *Sugar J.* (La.), 1965, **27,** (9), 28–30. Trials carried out in four different cane-growing areas of Queensland are reported. The object of the investigation was to obtain evidence concerning the type of mechanical harvesting which would result in the least loss of sugar. In general, results indicated a tendency for cane left standing to increase slightly in moisture content and for the percentage commercial cane sugar to fall. Further trials are considered necessary.

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Selecting new sugar cane varieties. L. ANZALONE, M. GIAMALVA and S. J. P. CHILTON. *Sugar J.* (La.), 1965, **27,** (11), 25.—The cane breeding activities at the Louisiana Agricultural Experiment Station since 1949 are briefly discussed. More seedlings of potential value were selected by the conventional single stool method than by the other two methods. Of these the newly developed drill method proved more effective than the bunch method.

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Importance of potassium in sugar cane fertilization in Louisiana. R. RICAUD and M. B. STURGIS. *Sugar J.* (La.), 1965, **27,** (11), 26–32.—The potassium problem in Louisiana cane soils is discussed and facts and figures from a wide range of analyses given. With an average yield of 29 tons of cane per acre, over 100 lb K_2O per acre leaves the field with each harvest. More K fertilizer must be used to maintain present yields or to increase yields in the future.

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New solutions for preserving sugar cane tassels. R. E. COLEMAN. *Sugar J.* (La.), 1965, **27,** (12), 20–22. Tests were carried out with 95 different compounds in an attempt to improve upon the standard Hawaiian formula. As a group antibiotics and hydrazines or hydrazine relatives, notably *p*-hydrazinobenzene sulphonic acid (20 p.p.m.), *p*-hydrazinobenzoic acid (20 p.p.m.) and hydrazine sulphate (40 p.p.m.), preserved tassels best when added to the HSPA standard solution. Solution changing was reduced by more than 50%. Seed germination was not affected. The rôle may have been that of inhibiting bacterial action developing in the solution.

* * *

Are chemicals hurting our sugar beet yields? R. D. BARMINGTON. *Sugar J.* (La.), 1965, **27,** (12), 29. From evidence collected the author answers "no" to this question. In Colorado there is a tendency to higher yields where pre-emergence weed killers have been used. On heavy soils autumn application was every bit as good as spring application. This may mean a whole new concept of seed-bed preparation and planting practice in the area.

* * *

Select your seed cane now. ANON. *S. African Sugar J.*, 1965, **49,** 669–671.—Advice on the selection of seed cane, particularly avoidance of such diseases as ratoon stunting, mosaic, chlorotic streak and smut, is given. The importance of the suitability of the variety for the location is stressed. In mist belt areas, the well-known variety N:Co 310 is quite unsuitable because of extreme susceptibility to gumming disease.

* * *

Gumming disease surveys (systemic infection) at Deep River—Beau Champ S.E. A. WIEHE. *Rev. Agric. Sucr.*, 1965, **44,** 98–103.—The author explains how rogueing on an estate scale in Mauritius against gumming disease (*Xanthomonas vasculorum*), was carried out. Mechanical rogueing was preferred to destruction by chemical means.

* * *

New cane diseases discovered in Negros. J. R. RIVERA and I. CANO. *Sugarland* (Philippines), 1965, **2,** (4), 18–29.—The discovery in 1964 of three cane diseases new to or previously unrecorded in Negros Occidental is reported; they are leaf blight (*Leptosphaeria taiwanensis*), purple spot or red leaf spot (*Dimeriella sacchari*) and chlorotic streak (virus). Information about each is given to assist fieldmen in recognition.

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Phil. 54-60 continues to excel in yield. ANON. *Sugarland* (Philippines), 1965, **2,** (4), 56.—This Philippine variety gave the highest sugar yield in four trials and the best juice in three out of four tests.

* * *

Bionomics and control of army worm on sugar cane. A. P. SAXENA. *Indian Sugar*, 1965, **15,** 143–149. Results of field and laboratory studies of this cosmopolitan pest, that attacks many crops besides sugar cane, are given. In control trials with various insecticides best results were obtained with "Endrex" 20% E.C. (1·12 litres in 225 litres of water per hectare).

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An intermediate type, virulent isolate of *Colletotrichum falcatum* in the eastern tract of Uttar Pradesh. K. KAR, O. S. RANA and S. C. GUPTA. *Indian Sugar*, 1965, **15,** 161–163.—The appearance of new forms of red rot disease of sugar cane in India, able to attack and damage cane varieties previously thought to be immune or highly resistant, is discussed. The new form of red rot here described is termed R 141.

Foliar diagnosis for sugar cane. G. SAMUELS. *Sugar J.* (La.), 1965, **28,** (2), 61–63.—The value today of foliar diagnosis in cane nutrition studies is stressed by the fact that while 15% of papers on fertilizers and nutrition presented to the 9th I.S.S.C.T. Congress in 1956 were devoted to foliar diagnoses, the proportion had risen to over 90% for the 12th Congress in 1965. The advantages and disadvantages of the method in relation to study of N, P, K, Ca and minor elements, in the light of present-day knowledge, are discussed.

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A variety programme at Central Aguirre Sugar Co. R. TOYOFUKU. *Sugar J.* (La.), 1965, **28,** (2), 70–73. The methods employed in the nurseries of this Puerto Rican estate, to effect rapid propagation of new varieties, are described. Single-eye wax-dipped setts are used and plants spaced 5 feet apart to encourage maximum stalk production.

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Significance of monogerm seed in spring mechanization of sugar beet. E. BORNSCHEUER. *Zucker*, 1965, **18,** 445–449.—The good emergence and uniform distribution are stressed. The high proportion of single plants results in a marked saving in manual work.

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Boron in beet culture. H. BRONNER. *Zeitsch. Zuckerind.*, 1965, **15,** 458–462.—Boron deficiency may cause morphological abnormality or damage before external symptoms are visible. Under dry conditions with boron content less than 0·7 p.p.m. there may be heart or dry rot. Foliar spraying is recommended.

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Belgium's road to mechanized beet production. G. TIBO. *Sugar y Azúcar*, 1965, **60,** (9), 51–54.—Shortage of agricultural labour has forced Belgian beet growers into intensive mechanization in recent years. The tank precision drill, sowing six rows at a time, now used for 80% of the crop, is described, as are other machines such as six and twelve row sprayers, a two-row self-propelled thinner and a multi-row harvester.

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Sugar beet in India. R. R. PANJE and P. S. GILL. *Sugar y Azúcar*, 1965, **60,** (9), 60–61.—Trials have shown that sugar beet may be successfully grown in many parts of Northern India during the winter or cool season as a six-months crop. Yield and sugar content figures for seven different varieties are given.

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The present state of mechanization in sugar beet cultivation in North America. O. NEEB. *Zucker*, 1965, **18,** 487–492.—The opinion is expressed that the United States is no longer well ahead of Germany and other European countries, so far as spring mechanization is concerned, as she was a few years ago. The American methods of production of commercial seed, selecting the best or most suitable localities, might be emulated more in Europe.

The possibility of increasing the efficiency of farmyard manure in relation to the sugar cane crop. R. L. BHOJ, A. NATH and V. S. BHADAURIA. *Indian Sugar*, 1965, **15,** 197–206.—Results are given of trials with farmyard manure and ammonium sulphate over periods of four years in two different areas. With adequate soil moisture, application of farmyard manure 15–30 days before planting and ammonium sulphate at planting time gave the best results. Mixing of the two showed no advantage.

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I.I.S.R. granule sprinkler. A. N. KALRA and M. C. GUPTA. *Indian Sugar*, 1965, **15,** 207–208.—The use of a simple device for applying "Endrin" in granular form to tall cane so that the granules lodge in the growing point or leaf axils, to be effective against borers, is described. It consists of a wooden or bamboo T-pole about 2·5 m long, the crosspiece being the width of the cane rows, with sieves at its two ends of 16 cm dia. and 1 mm mesh. For application the operator walks down the rows holding up and gently shaking the sprinkler. Two rows are done at a time and one hectare takes about 12 working hours.

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A review of the varietal position in Bihar. O. P. NEGI. *Indian Sugar*, 1965, **15,** 219–229.—Past and present distribution of sugar cane varieties in Bihar are discussed and reference is made to the dropping of promising varieties because of attack by a new strain of red rot disease. Descriptions are given of varieties at present cultivated, along with notes on promising new varieties.

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Use of chemical herbicides in the culture of sugar cane for sugar production in Louisiana. E. R. STAMPER. *Sugar J.* (La.), 1965, **28,** (3), 33–38.—The history of weed control in Louisiana sugar plantations, from early days, is first discussed. Chemical weedkillers now used are compared with special reference to costs and the saving made possible by their use.

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The irrigation of sugar cane. F. RUECKER. *Sugarland* (Philippines), 1965, **2,** (5), 10–13.—In this article the author explains to sugar planters how equipment for overhead irrigation can be used to best advantage. The different types of sprinkler and pump that are available are described. The reasons why sprinkler irrigation is less likely to be harmful to the soil than flood irrigation are explained.

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Fertility of sugar beet soils. F. NIESCHLAG. *Zucker*, 1965, **18,** 545–548.—The trend to shifting sugar beet cultivation from heavy to light or sandy soils, whose fertility can be built up, is referred to. The importance of the C:N ratio in such soils is discussed.

Response of a sugar cane nematode population to the addition of nematocides in irrigation water. J. ROMÁN and J. BADILLO. *J. Agric.* (Univ. Puerto Rico), 1965, **49**, (3), 325–330.—Difficulties encountered during this two year experiment lessened its value. "Nemagon" and "Fumazone" were used at ½ and 1 gal/acre, 2 applications being given, at planting time and 5 months later. The nematode population was reduced but gradually increased after application.

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Autumn versus spring planting of sugar cane. R. L. BHOJ and B. K. MATHUR. *Indian Sugarcane J.*, 1965, **9**, 207–211.—Studies were carried out at the Shahjahanpur Sugar Cane Research Station during 1958–1962. Spring planting (Feb.-March) gave a higher germination percentage than autumn planting (Sept.-Oct.). With spring planting the number of tillers per hectare, in both plant and ratoon crops, was much higher than with autumn planting, but autumn planting gave more millable stalks. The total yield of autumn planted cane was higher.

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Studies on the interrelationship of nitrogen and water on sugar cane growth. H. P. VERMA. *Indian Sugarcane J.*, 1965, **9**, 219–222.—Increased nitrogen gave greater increase in tiller production than increased irrigation. It also decreased tiller mortality, not affected by increased irrigation. Uptake of nitrogen by the plant increased both with an increase in the level of nitrogen and the number of irrigations.

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Uptake and accumulation of calcium by sugar cane as affected by age and phosphorus deficiency. J. N. SINGH. *Indian Sugarcane J.*, 1965, **9**, 223–225.—Results are given of an investigation into the effects of phosphorus deficiency on the uptake and accumulation of calcium by the sugar cane plant at different stages of growth. Phosphorus deficiency did not materially alter the calcium content in the different organs of the plant.

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Chemical control of weeds in sugar cane fields in Mysore State. D. K. DUTT, K. SRIRAM SHETTY and G. J. MEDLEY. *Indian Sugarcane J.*, 1965, **9**, 226–228.—A report is given of trials with some half dozen weed killers (triazines) to ascertain how long they remained effective after one application, applied shortly after planting. Some treatments kept weeds down significantly up to 9 weeks. Nutgrass (*Cyperus rotundus*) was not satisfactorily controlled by any of the treatments.

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Studies on phosphorus in sugar cane soils of Bihar. A. P. GUPTA and S. C. SEN. *Indian Sugarcane J.*, 1965, **9**, 229–233.—An investigation of vertical distribution of phosphorus in several sugar cane soils is reported. Total phosphorus decreased with soil depth with most soils but in heavy soils it tended to show an increase. It is concluded that surface sampling alone is inadequate for determining fertility.

Studies on soil application of gamma BHC for the control of shoot borer of sugar cane in Bihar. Z. A. SIDDIQI and A. R. PRASAD. *Indian Sugarcane J.*, 1965, **9**, 242–248.—Extensive trials were carried out on the use of gamma BHC against shoot borers over a period of 3 years (1959–62), the main purpose being to find out the minimum effective dose in different cane growing regions of Bihar. Good control was obtained. There was no effective difference in the rates applied, viz. 0·5, 0·75 and 1·0 lb/acre. The rate of 0·75 lb/acre was recommended.

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Biology and control of armyworm. P. N. AVASTHY and J. P. CHAUDHARY. *Indian Sugarcane J.*, 1965, **9**, 249–251.—The armyworm (*Pseudaletia unipuncta*) is a ubiquitous pest of graminaceous crops and attacks sugar cane in many countries. The life history of the pest and the existence of five parasites are discussed, three being newly recorded. Suggestions for possible biological control are made. Effective control was obtained by flooding fields and dusting 10% "Toxaphene" at 30 kg/hectare.

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Effects of salinity on the growth of sugar cane. F. A. FOGLIATA and P. J. ASO. *Rev. Ind. Agric. Tucumán*, 1965, **43**, (1), 24–45.—The effects of saline conditions and sodium salts on three different cane varieties cultivated near the Ingenio Leales, Tucumán, Argentina, were studied, the varieties being CB 36-14, CP 34-120 and Tuc. 2645. The number or weight of millable canes were adversely affected. Number and length of internodes per stem were also reduced.

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Diseases of sugar cane in Tucumán. II. S. ZABALA and N. E. V. DE RAMALLO. *Rev. Ind. Agric. Tucumán*, 1965, **43**, (1), 71–89.—Descriptions and diagnostic characters with drawings in some instances are given of the more troublesome cane diseases. Bacterial diseases are represented by leaf scale, red stripe and gummosis, virus diseases by mosaic and ratoon stunting disease. Numerous fungal diseases are mentioned.

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Sporulation of *Cercospora beticola* affected by an interaction between light and temperature. L. CALPOUZOS and G. F. STALLKNECHT. *Phytopathology*, 1965, **55**, 1370–1371.—The paper records the effects of light and different temperatures on growth and spore production in this fungus disease of sugar beet. On sugar beet molasses agar sporulation was stimulated by light at 15°C and depressed at 30°C.

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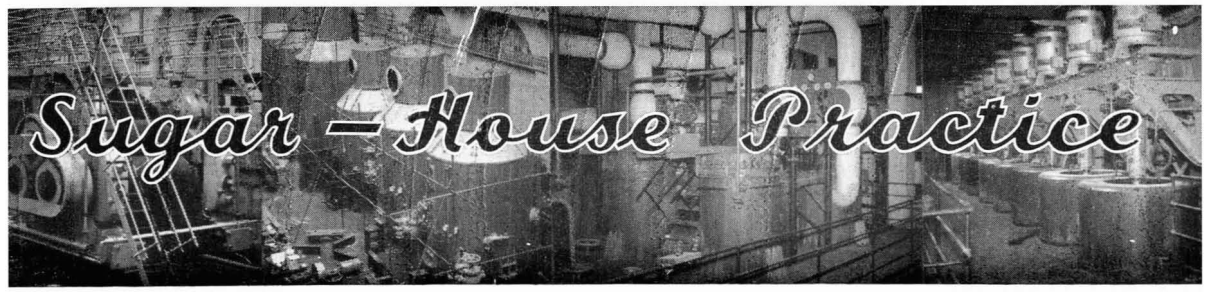
Possibility of assessing polyploidy in sugar beets on the basis of leaf investigations. H. J. RÖSTOL. *Zeitsch. Landw. Vers.- u. Unters.*, 1963, **9**, (2), 139–150; through *Field Crop Abs.*, 1965, **18**, 247.—Diploid sugar beets could be differentiated from tetraploids by the number of stomata per unit leaf area at the 8-leaf stage.



Evaporation. C. M. ALONZO. *Sugar J.* (La.), 1965, **27,** (11), 63–71.—The third effect of a triple-effect evaporator at the author's factory was overhauled and a new 4th effect installed. The h.s. of this new effect is 5240 sq.ft. while that of each of the 1st and 2nd effects is 3800 sq.ft. The new effect features a sealed downtake and an external condensate drain with no internal connexions. (Copper-bearing steel tube sheets were incorporated in the original design, but because of local conditions could not be manufactured.) The new arrangement enabled grinding to be continued a further 18 days compared with the previous season, while the number of stoppages for boiling-out was reduced by one. The crushing rate between boiling-out periods was greater. The problem of entrainment is discussed and the advantages of sealed downtakes and of copper-bearing steel for tube sheets are considered.

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Efficient materials handling. Key to storing and loading of raw sugar. ANON. *Sugar J.* (La.), 1965, **28,** (3), 46–47.—An illustrated account is given of the bulk handling equipment at the Galveston, Texas, warehouse of Imperial Sugar Co.

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Possibilities of saving bagasse in India for the paper and pulp industries through maximum fuel and steam economy measures. S. C. GUPTA, S. L. SAXENA, S. K. GHOSH and P. N. R. RAO. *Paper presented to the 12th Congr. I.S.S.C.T.*, 1965.—A study is reported of the effect of certain factors (moisture % bagasse, flue temperature, etc.) on losses in flue gases etc., and the advantages of an economizer are discussed. Target boiler efficiencies are calculated for five factories and actual figures are compared with these. Steam consumption in power production and process heating are discussed from the aspect of achieving economies. The advantages of heat recovery by collection and re-use of condensate are pointed out, as well as the savings resulting from the lagging of pipes. The possibilities of saving sufficient bagasse for paper making are discussed in relation to factory size.

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Inhibited muriatic acid for cleaning of sugar evaporators. M. K. PATIL and A. G. KELLER. *Sugar J.* (La.), 1965, **28,** (3), 38–43.—Copper and mild and stainless steel samples were suspended in hydrochloric acid of pH 1 and the corrosion rate (weight loss) with and without inhibitor determined at 180°F and 212°F. The corrosion rates in HCl at 212°F were of the order of 50% higher than at the lower temperature. Eight different proprietary corrosion inhibitors were tested; the highest corrosion resistance was provided by "Sharples 225" (at 0·20% on volume of HCl solution this completely inhibited corrosion), followed by "Rodine 220", "Armohib 28", "Rodine 213", "Dowell A74", "Hodag C-51" and "Hodag C-52". While the addition of "Hodag WA-25" wetting agent tended to reduce the corrosion rate, its effect on the inhibitors varied. The efficiency of the "Sharples 225" was reduced, while that of the "Hodag C-51" was increased. Since "Sharples 225" forms a thick film on copper tubing, scale cleaning by acid treatment should be followed by boiling-out with NaOH. Addition of "Dowfax 9N15" and "Dowfax 9N40" surface-active agents to a 6% HCl solution saturated with "Sharples 225" showed that "Dowfax 9N40" improved descaling while it also appeared to increase inhibitor efficiency, as very little of the oxide scale on the steam side of the tube was removed, unlike the rapid dissolution occurring when the samples were placed in uninhibited HCl solution. A study of linings of tanks in which HCl was stored for evaporator cleaning showed that linear polyethylene, polypropylene, "Penton" (manufactured by the Hercules Powder Co. Inc.) and "Haveg 41" (manufactured by the Haveg Corporation) had perfect resistance to boiling HCl inhibited by "Sharples 225".

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Granular carbon pressure drop tests. J. P. BLACK and R. J. HLOZEK. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 17–45.—Factors causing variation in flow through packed beds of granular active carbon have been studied using a pilot plant comprising a 15-ft column provided with pressure taps at 1-ft intervals. Water was percolated through a carbon slurry and the pressure differences between the pressure taps and the tap at the bottom of the column below a "Neva-Clog" screen recorded at percolation rates in the range 0·4–4·0 gal/min. While the total pressure drop across a bed of 12 × 20 mesh carbon increased only slightly, such increase being due solely to recompaction of the bed during percolation, addition of a quantity of carbon fines (through 20 mesh) caused the pressure drop to increase suddenly at 8–9 ft from the screen, after which it remained constant. The resultant graph is typical for all carbons containing more than 10% fines. The pressure drop became uniform when the column was backwashed before further percolation, 30-min backwashing being as effective as 2-hr backwashing in reducing the pressure drop. However, the pressure drop gradually increased during subsequent percolation. An initial backwash is considered necessary before percolation through very dusty carbons, the particle

size governing the optimum backwash rate. The effect of backwashing on stratification was demonstrated by the sharp increase in density near the bottom of the bed and a sharp decrease near the top, while the density in the middle section was fairly constant. The test data were used to develop an empirical relationship between pressure loss across the bed and the other system variables; it takes the form

$$\Delta P = \frac{K^1 \mu VL}{D_p^2 D_c^2} \frac{(1 - f_v)^2}{f_v^3}$$

where ΔP = pressure drop (inches w.g.), μ = viscosity (centipoises), V = flow rate (g.p.m.), L = bed height (ft), D_p = geometric mean dia. (mm), D_c = column dia. (inches), f_v = void fraction and K^1 is a constant.

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The use of the granular carbon slugging system at the Puerto Rican American Sugar Refinery. M. CRUZ V., F. J. SERRALLES and J. E. MAYORAL. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 46–57.—Details are given of the granular carbon moving bed ("slugging") system used for decolorization of clarified liquor[1] at the Mercedita refinery. In an average run, about 80–85 g.p.m. of 59–60°Bx liquor is passed through each of the three columns, in which colour removal averages 84–85%. Improvement of this decolorization efficiency is considered difficult because of the rather low colour content of the raw sugar and the level of decolorization in the clarifiers and filters (25–35% and 15%, respectively). Four white sugar strikes are boiled.

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The evaluation of ion exchange resins for sugar liquor decolorization. F. X. MCGARVEY and G. M. ANDRUS. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 58–80. Details are given of comparative tests conducted on four decolorizing anion exchange resins: "Amberlite IRA-401-S" and "Amberlite IRA-400" (both gel types), and "Amberlite IRA-900" and "Amberlite IRA-904" (both macroreticular types). Both batch and column tests were carried out, using the resin in Cl^- form. Among the variables examined were flow rate, resin particle size and bed height, and their effects on decolorization efficiency were studied, as was the effect of the sugar liquor composition and its electrolyte content. The optimum replacement of resins and the most economical replacement cycle were also determined.

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The compatibility of filter medium and filter aid and its effect on filtration. C. A. FRANKENHOFF. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 81–89.—Tests are reported in which the effect of different types of filter cloths (17 were examined) on the performance of filter aids (15 different types were used) was studied. The variables investigated during the 15-year period included pressure, flow rate, time taken to establish clarity, clarity (excellent or good) and ease with which the filter aid was removed from the cloth after filtration. The results are tabulated.

The use of continuous centrifugals on remelt sugars. J. H. HOLTON and A. LOPEZ. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 90–112.—The performances of a Silver-Hein, Lehmann continuous centrifugal and a Western States semi-automatic batch machine were compared. The continuous machine had considerably greater throughput and with No. 1 remelt gave sugar and syrup purities slightly higher than did the batch machine. With No. 2 remelt it gave slightly higher molasses purity and a lower sugar purity in one case when wash-water was inadequate. The 10–15% crystal breakage in the continuous centrifugal is considered unimportant since the sugar is melted. The economics are considered and found to be highly favourable to the continuous machine.

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Granulated sugar melt system. R. W. CHALMERS and L. A. ZEMANEK. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 113–124.—Details are given of the process used to produce "Canners Liquicane" liquid sugar from granulated sugar at California & Hawaiian Sugar Refining Corp. From the centrifugals after the pan station the wet sugar is discharged to two parallel drag conveyors running the length of the floor, short screw conveyors connecting the centrifugals and the drag conveyors. The sugar drops from the drag conveyors through slide gate openings in the bottom of the drags to a variable-speed screw conveyor which takes half of its requirement from each drag and is kept full at all times. This discharges to a constant-speed screw conveyor delivering the wet sugar to the melting unit via a chute. On its way down the chute the sugar is sprayed by cold water to prevent vapour escaping from the melter up the chute and help lubricate the sugar. The melter is a "Lightnin Mixer" multi-stage mixing column, of 5600 gal effective volume, manufactured by the Mixing Equipment Co. Inc. The column is divided into five compartments horizontally and is provided with an agitator running through the centre of the column. Apart from paddles, the agitator has discs which are located about 1 inch above the floor of each compartment and covering the central hole which accommodates the agitator shaft. Thus each compartment becomes a separate tank and the amount of sugar dropping to the compartment below is minimized. Wet sugar enters the top compartment together with hot water, and gradually makes its way down the central well to the bottom, whence it is discharged by centrifugal pump to further process. Brix is maintained fairly constant at 66·56°. Despite the absence of filters, bacterial counts are low, evidently because of the high temperature of 80°C at which the unit operates. Even at an output greater than 1500 tons/day no undissolved grain was found and Brix control was excellent. Coloration in the column was negligible. The average colour of the liquid sugar was only slightly darker than that of granulated

[1] *See* CHAPMAN, *I.S.J.*, 1964, **66**, 352-355.

sugar at identical production intervals. Information is given on the various controls, including those for Brix and level.

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Methods approach to plant design, layout and construction. W. M. FRANKLIN and J. W. ALBERINO. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 125–131. Information is given on the methods employed by the technical staff of Savannah Sugar Refining Corp. in working out the location, design, cost and construction of the company's new refinery in the Florida Everglades, using models of plant and buildings and working out schedules by the critical path method.

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Significance of pH measurement and control in the sugar industry. E. J. CULP. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 153–162.—The definition and theory of pH and its measurement are outlined and the use of pH as an indication of clarification efficiency, char quality, and colour is discussed. The effect of pH on sucrose inversion rates is also touched on. Twenty references are given to the literature.

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Studies with cation and sodium ion electrode. W. L. REED and J. VLADYKA. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 163–192.—Details are given of preliminary work on the use of the "specific ion" electrodes, recently introduced by Beckman Instruments Inc. for various analytical purposes, and in particular the cation and sodium electrode. The electrodes are stated to have similar characteristics and stability to normal pH electrodes and their possible applications are considered. Three methods were tested for determining the separate K^+ and Na^+ concentrations: (i) determination of the combined cation fraction and plotting the results against the electrode millivolt readings; (ii) direct comparison of the millivolt readings with reference standards; and (iii) titration. The results are discussed in some detail.

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Summary of special clarification tests in U.S.D.A. pilot plant during 1960-62 crops. E. E. COLL, W. F. GUILBEAU, B. A. SMITH and J. T. JACKSON. *Proc. Amer. Soc. Sugar Cane Tech.*, 1963, **10**, 25–31.—Tabulated data are presented which were obtained by the use of clarification aids in pilot plant tests, the data being in terms of comparison with results of standard tests in the absence of aids. A 15–20% improvement in mud weight and a 10% improvement in filtrability were obtained with 2–3 p.p.m. of "Separan AP-30", while 0·4 lb of bentonite per ton of cane, used in conjunction with the "Separan", improved mud volume by 9% (commercially harvested) and 66% (hand-cut cane). Exploratory tests, with neutral to negative results, were made with three water-soluble resins, while no improvement in juice quality arose on adding potato starch. Clarified juice clarity and filtrability fell on substitution of magnesium oxide for lime at the 100% and 38% levels. Unsatisfactory results followed use of sodium aluminate, added after liming.

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Experience with the crusher. L. A. SUAREZ. *Proc. Amer. Soc. Sugar Cane Tech.*, 1963, **10**, 32–33.—An account is given of difficulties encountered at Glenwood sugar factory after changing the 3-inch pitch grooving from 60° to 40°, the journals having been metallized at the same time with stainless steel, new bearings fitted, etc. Pressure had to be reduced to make the top roll float, when occasional excessive lift led to mill chokes. Edwards hydraulic equipment was able to control the speed of the carrier, but to avoid slippage the speed was reduced from 43 to 30 f.p.m. and the opening increased.

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Non-metallic mill bearings. W. S. PATOUT. *Proc. Amer. Soc. Sugar Cane Tech.*, 1963, **10**, 44–48.—See *I.S.J.*, 1963, **65**, 369.

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Continuous centrifugals operating problems. A. G. KELLER. *Proc. Amer. Soc. Sugar Cane Tech.*, 1964, **11**, 14–23.—See *I.S.J.*, 1965, **67**, 20.

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Bridge crane *vs.* revolving derrick used for cane storage and feed mill. J. M. PUGH. *Proc. Amer. Soc. Sugar Cane Tech.*, 1964, **11**, 24–37.—The two types of crane are compared from the viewpoints of area requirements, traffic pattern, capacities, time cycle, stability of operations, controls and safety, development, manpower requirements, operating cost and ease of expansion. All favour the bridge crane.

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Vibrating screens for sugar mill juices. W. P. STILZ. *Proc. Amer. Soc. Sugar Cane Tech.*, 1964, **11**, 38–45. See *I.S.J.*, 1965, **67**, 20.

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Cane handling at Glades Sugar House. P. M. MCINTYRE. *Proc. Amer. Soc. Sugar Cane Tech.*, 1964, **11**, 53–60.—A detailed account is given of the cane transport system used in the Glades Sugar House area, where cane is picked up from rows by loaders which deliver it to 4–4½ ton side-dumping field carts which are taken in trains to a transfer station. Here they are emptied and the cane is conveyed to a 40-ton tractor/semi-trailer road unit which brings the cane to the factory on the public road system. The road units are emptied into separate pits for day and night cane, the latter being accumulated during the day.

BEET FACTORY NOTES

Use of an RSP-11 radioactive counter for production counting. V. I. LITVYAK. *Sakhar. Prom.*, 1965, **39**, 666–667.—Details are given of a scheme involving an RSP-11 counter which counts the bags travelling on a main conveyor to the warehouse. Coordination between main conveyor speed and that of the feed conveyors will ensure that there is no piling of the bags as they pass the counter.

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Hydraulic resistance during massecuite flow. V. D. POPOV and V. P. TROINO. *Sbornik Pishch. Prom.*, 1965, (1), 122–130.—The linear relationship between massecuite flow and pressure head loss and the positive values of head loss with zero flow confirm the applicability of the Shvedova-Bingham law of viscosity to massecuites. With increase in viscosity and ultimate shearing stress or with reduction in temperature, head loss will increase. Under practical conditions massecuite temperature varies during flow, so that all physical constants introduced into equations for calculation of flow properties must be selected for the lowest possible temperature to give required pressure heads. An equation for calculating the generalized Reynolds number (Re*) is given as

$$\mathrm{Re}^* = \frac{1}{\frac{\eta_{pl}}{Vd\rho} + \frac{1}{6}\cdot\frac{\tau_o}{V^2}} = \frac{1}{\frac{1}{\mathrm{Re}} + \frac{1}{6}B}$$

where η_{pl} = plastic viscosity, V = mean fluid rate in tube, d = tube dia., ρ = fluid density, τ_o = ultimate shearing stress and B = Bingham's number ($=\tau_o/V^2\rho$). With reduction in the ultimate shearing stress or in the flow rate, the value of Re* will tend towards the normal form of Reynolds number for true viscous fluids. The linear relationship between Re* and the coefficient of frictional resistance (λ) is expressed by the Poiseuille equation ($\lambda = 64/\mathrm{Re}^*$) and a curve is drawn from data obtained by various authors. It has been found that values of λ under non-isothermal conditions differ only very slightly from values obtained for isothermal flow, which are considered sufficiently accurate for both types of flow. Data obtained for molasses flow in a U-bend[1] have been found to be applicable to massecuite flow under similar conditions. Values of machine oil flow in and out of a tapering tube at an area cross-section ratio between widest and narrowest sections of 0·1 have been found to agree approximately with molasses values and the relationships obtained are considered satisfactory for massecuite until a suitable method for determining hydraulic resistances has been developed.

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Investigation of local hydraulic resistance in the bend of a tube during final molasses flow. Z. S. SHLIPCHENKO, G. E. RUDENKO-GRITSYUK and N. G. KRESAN. *Sbornik Pishch. Prom.*, 1965, (1), 138–142.—The flow of final molasses of various viscosities was examined in a special section of pipeline having four 90° bends[2]. The pressure drop across the section was determined as the difference between the pressures in the horizontal pipeline on each side on the section, also taking into consideration the coefficient of frictional resistance in a straight section. The coefficient of friction (λ) and the pressure drop per unit length were thus obtained and a curve drawn of coefficient of local resistance in a 90° bend *vs.* Reynolds number at Re = 8·5–1280. The coefficient was found to be the same as that in a U-bend of the same relative dimensions, and is given by $\frac{380}{\mathrm{Re}} + 1$.

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Composition of sugar-resistant floors[3]. A. A. DOMASHEVSKII. *Sbornik Pishch. Prom.*, 1965, (1), 143–150. The best flooring for resistance to the adverse effects of sugar solutions has been found to be ceramic tiles bedded on a 3–5 mm layer of latex cement (a normal 1:3 cement-sand mixture to which rubber latex is added). The cement removes water from the latex during setting and hardening, while the minute rubber particles surround the cement particles and fill the pores in the hardened cement, giving the cement resilience, elasticity, adhesiveness to concrete and ceramics as well as corrosion resistance. Details are given of preparation techniques, recommended Soviet stabilizers and grades of latex, etc.

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Advisability of returning pulp-press water to diffusion. A. A. LIPETS and I. M. LITVAK. *Sbornik Pishch. Prom.*, 1965, (2), 45–48.—Analysis of press water showed that during the period from the end of November to the end of January the composition does not change significantly (the Ca^{++}, Na^{+}, SiO_3^{--}, Fe^{+++}, Al^{+++} and total N increase while the K^{+} and Cl^{-} decrease). There was also found to be little effect of the degree of pressing on the colloid content, which ranged from 25·1 to 31·8% on 100°Bx for water of 7·8–21·6°Bx. After pulp separation, the press water was concentrated under vacuum at 60°–70°C to diffusion juice density in the laboratory, carbonatated, evaporated to syrup and crystallized in two stages, to give sugar and exhausted molasses. The results showed that approx. 75% of the sugar in recycled press water (0·227% on weight of beet) could be recovered when processing healthy beet.

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Sugar crystallization diagram. I. S. SKRIPKO and V. D. POPOV. *Sbornik Pishch. Prom.*, 1965, (2), 54–60. Material balance equations describing crystallization are generalized and used to construct a crystallization diagram for products of 50–100 purity in the temperature range 30°–100°C and of 60°–100 Bx. It covers unsaturated solutions of 0·8–1·0 saturation coefficient and may be used for calculations of all products in pan boiling and crystallization. Examples of its use are given.

[1] SHLIPCHENKO & RUDENKO-GRITSYUK: *I.S.J.*, 1963, **65**, 243.
[2] *See also I.S.J.*, 1961, **63**, 18; 1963, **65**, 272.
[3] *See also I.S.J.*, 1962, **64**, 145.

Hydrodynamic calculation of batch and continuous refinery vacuum pans. V. P. TROINO and V. D. POPOV. *Sbornik Pishch. Prom.*, 1965, (2), 107–115.—Equations are developed for calculating a number of parameters involved in the hydrodynamics of pan boiling. The circulation velocity (w_o) is given by

$$w_o = K \frac{f_{op}}{f_{pod}} \Delta t \, CB_y^{-n} \, e^{-b \left(\frac{Kp}{1-Kp}\right)^2} \text{ m/sec,}$$

where K = coefficient, f_{op} and f_{pod} = area cross-sections of downtakes and risers, respectively, Δt = pressure due to temperature, CB_y = massecuite Brix, n is its power, b = factor representing the power of the natural logarithm e, and Kp = crystal content in massecuite (by weight). Values of n and b are determined from nomograms which are presented. The effective pressure head (P_{pol}) and total head loss (ΔP_{op}) in the feed section of the tube circuit are calculated and a graph drawn of w_o *vs.* P_{pol} (P_{op}) using approximate values of w_o that are somewhat greater than calculated values. The point of intersection of the curves is the circulation velocity at which P_{pol} in the risers equals the resistances to circulation in the downtakes. By substituting calculated values of w_o in the above equation it is possible to find optimum values of f_{op} and f_{pod} which can be used in pan design.

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Investigation of heat exchange in industrial continuous massecuite crystallizers. I. S. GULYI. *Sbornik Pishch. Prom.*, 1965, (2), 116–126.—Tests are reported in which 3rd product massecuite was cooled continuously in four rotary crystallizers arranged in series and then heated in a fifth (another crystallizer for cooling was omitted). Graphs of massecuite and cooling water temperature *vs.* length of crystallizer path follow a gently concave curve and are parallel, the pressure due to temperature being constant. For calculation of water usage in cooling, the pressure due to temperature in the first crystallizer should be considered, since it depends on a number of heat factors. The pattern of massecuite temperature reduction with time was the same as for batch crystallizers, but cooling was more regular, mainly because of the constant pressure due to temperature, and crystallization was better. Considerable scattering around the heat transfer curve was attributed to irregular discharge of the massecuite to the centrifugals after crystallization, to variation in massecuite Brix after dropping from pan to buffering mixer, and to the addition of water during crystallization. Reduction in the heat transfer coefficient (K_4) throughout the line was ascribed to increase in viscosity of the mother liquor (ν_m), the relationship being expressed linearly by a log-log graph, for which the equation is $K_4 = A_o \nu_m^{-m_o}$, where A_o varies with peripheral speed and m_o is the angular coefficient of the straight line. The equation applies to both batch and continuous crystallizers. Curves are given showing the changes in the various factors throughout the four crystallizers.

Investigation of the effect of juice flow rate on the coefficient of scale formation in sugar factory heaters. N. YU. TOBILEVICH, I. I. SAGAN', V. T. GARYAZHA and A. A. KNYAZEV. *Sbornik Pishch. Prom.*, 1965, (2), 132–139.—Tests to determine the effect of juice flow rate on the thermal resistance due to scale[1] are reported. In all cases the heat transfer coefficient decreased with time (up to 7–8 days) to a lesser or greater extent. This is shown graphically for raw and 1st and 2nd carbonatation juices. It was also found that with increase in flow rate (0·5 to 2·5 m/sec) the coefficient of heat resistance due to scale (ϕ) decreased. This relationship is expressed approximately by

$$\phi = C. \, 10^{-10} \, w_o^{-2 \cdot 2}$$

where C = a constant (having values of 40, 12·6 and 6·0 for raw or circulation juice and 1st and 2nd carbonatation juices, respectively) and w_o = juice flow rate.

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Some criteria for juice purification with lime and carbon dioxide. S. WOLF. *Zeitsch. Zuckerind.*, 1965, **90,** 573–579.—A brief survey is presented of juice purification processes and the basic requirements of juice purification are discussed. The most important task is considered to be the separation of non-sucrose substances and obtaining juice of the highest possible thermal stability. A description is given of the carbonatation process developed at Novi Sad[2]. This process has permitted recovery of an additional 0·3–0·4% white sugar on beet.

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Storage losses with different beet varieties. L. SCHMIDT, B. VORLIČKOVÁ, A. HAVRÁNEK and J. ZAHRADNIČEK. *Zeitsch. Zuckerind.*, 1965, **90,** 579–581.—Tests in Czechoslovakia with different beet varieties showed that losses in storage were higher with higher initial sucrose content. Of the 16 non-Czechoslovak varieties tested (both diploids and polyploids) by comparison with the Czechoslovak variety Dobrovice A, the lowest losses occurred in the English variety Johnson-Triplex M.

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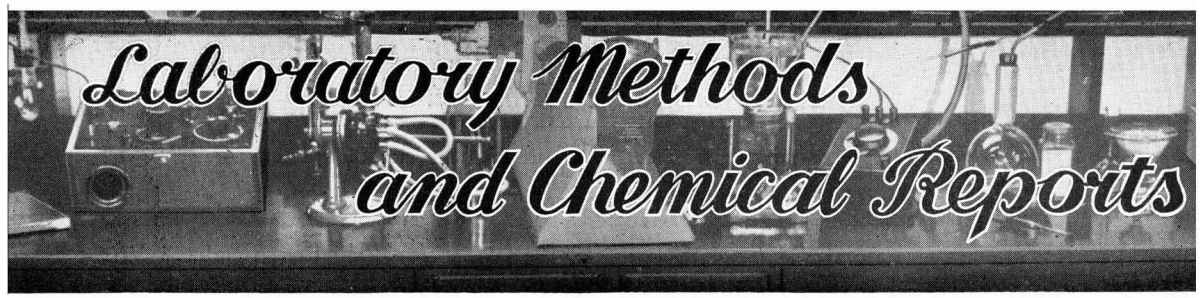
Effect of pectic substances on the filtration and sedimentation rates of 1st carbonatation juice. F. N. DOBRONRAVOV. *Sakhar. Prom.*, 1965, **39,** 740–743. With increase in the amount of dry Ca,Mg pectate (0–0·40%) added to a 12·5% sucrose solution carbonatated by three different methods, the filtration rate fell while the settling rate increased. In the case of raw juice, the adverse effect of the pectins (added dry or as solution) on filtration was somewhat reduced when unfiltered 1st carbonatation juice was returned to pre-liming (1:1). Again, the settling rate was increased; the pectins are compared to micelles of polyelectrolytes, able to form agglomerates with $CaCO_3$. Low filtration and settling rates encountered in the processing of sub-standard beet are attributed to invert decomposition products rather than to pectin accumulation.

[1] *See also I.S.J.*, 1965, **67,** 117.
[2] *I.S.J.*, 1965, **67,** 53, 310.



Sucrose crystal nuclei. S. I. SIRENKO and M. M. POLYACHENKO. *Sbornik Pishch. Prom.*, 1965, (1), 19–26.—The mechanics of nucleation are described and relationships between nucleus size and certain factors in steady state examined. The relationship between nucleus radius (r, cm) and supersaturation (P) at equilibrium is expressed by

$$\ln P = \frac{2\sigma M}{\rho r R T} - \frac{L}{RT} + C$$

where σ = surface tension between solution and solid phase (erg/sq.cm.), M = sucrose mol. wt., R = gas constant (erg/°K), T = absolute temperature (°K), ρ = crystal density (g/c.c.), L = energy of dissolution of 1 mole of sucrose, and C = integration constant. For a spherical nucleus, a simplified equation can be used:

$$r = \frac{D\sigma}{T \ln P}$$

where, for sucrose, $D = 5{\cdot}3 \times 10^{-6}$ c.c./°K/erg. By extrapolation, a graph of surface tension *vs.* temperature has been extended in the range 40–100°C. Graphs are also given of r *vs.* P at 20°C and 90°C and of P *vs.* temperature at r = 1–5 Å. It is shown that the lower the supersaturation the greater will be the critical radius of the crystal nucleus. The data confirm WEBRE's division of crystallization into three zones[1]. The "viable" zone corresponding to r = 2–5 Å is equated with WEBRE's intermediate zone. In this zone, factory practice has shown that "priming" is necessary before nucleation is possible, while in the labile zone (above 5 Å) spontaneous nucleation is possible.

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The rheological properties of sugar massecuites. YU. A. TERENT'EV, V. D. POPOV, YU. D. KOT and T. V. YASINSKAYA. *Sbornik Pishch. Prom.*, 1965, (1), 38–46.—Investigations by various workers of massecuite physical properties are surveyed. Examination of artificial massecuites of known composition and crystal content revealed that at low purity and crystal content of less than 52%, massecuite displays pseudo-plasticity, the deviation from Newtonian flow increasing with rise in Brix. Temperature was found to have little effect on the dynamic ultimate shearing stress (which characterizes pseudo-plasticity) while the viscosity of the liquid phase and the volume % of the inter-crystal interstices exerted considerable influence. The effect of the degree of dispersion on massecuite flow was also studied. It is recommended that 2nd product massecuite should be crystallized to 40–46% crystal content, the ultimate content being governed by the type of crystallizer and its rotary speed. In the tests an RV-8 rotary viscometer was used, giving similar curves to those obtained with a Höppler viscometer at 0·25–0·40 mm crystal size. (The Höppler instrument was found to be unreliable where the crystal size exceeded 0·30 mm.) From measurements with an immersion viscometer, nomograms have been drawn for determining the effective viscosity of massecuites at varying shear rate gradients and crystal contents up to 50%, but with a standard intercrystalline molasses viscosity of $4{\cdot}4 \times 10^5$ dynes/sq.m. A number of formulae are presented for calculating various flow parameters.

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The effect of amino acids on molasses polarization. V. G. KOVAL' and A. S. EGOROV. *Sbornik Pishch. Prom.*, 1965, (1), 80–85.—Paper chromatography and electrophoresis were used in qualitative and quantitative determination of amino acids in beet molasses. Butanol:acetic acid:water (4:1:1) were used as solvent and the spots developed with a 0·5% solution of ninhydrin in acetone containing 4% glacial acetic acid. Sixteen amino acids were identified, and a model mixture containing these in the proportions found was then subjected to polarization. Under various conditions the mixture had an optical rotation to the left ranging from –0·20° to –1·54°S. The polarization was reduced by only 0·20°S on adding basic lead nitrate and ammonium monophosphate. The polarization rose abruptly with pH increase from 1 to 6, after which it became constant. A non-sugars complex isolated from the molasses by fermenting the latter with bottom yeasts had a levorotation ranging from –2·10°S at pH 7 to –0·70°S at pH 1. Hence, the character of change in the optical activity of both mixtures with pH was the same. It has been shown that the acid inversion method of polarization for molasses sucrose and raffinose determination will give an error of 0·36% and 0·83% absolute for sucrose and raffinose, respectively.

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The effect of alkaline degradation products of pectin and invert sugar on the colour, viscosity and filtrability of sugar solutions. I. A. PRIKHOD'KO. *Sbornik Pishch. Prom.*, 1965, (2), 49–53.—Laboratory tests, in which 14–15% sucrose solutions containing known amounts of specially prepared pectin in the range 0·2–0·7% by weight were heated and carbonatated to pH 11, tested for filtrability and viscosity and then processed to 2nd carbonatation juice for optical density determination, showed that while the filtrability and optical density increased with pectin content, the viscosity did not. Similar tests with aqueous pectin solutions showed that alkaline decomposition prod-

[1] "Beet sugar technology". Ed. R. A. MCGINNIS. (Reinhold, New York.) 1951. p.343.

ucts of pectin have little effect on filtrability, viscosity and coloration. On the other hand, parallel experiments with aqueous invert sugar solutions (containing 0·1–2·5% invert by weight) showed a considerable reduction in filtrability and rise in optical density and 2nd carbonatation lime salts with invert content, while the viscosity remained almost unchanged.

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Thermo-physical properties of certain beet sugar products. YU. A. TERENT'EV and V. D. POPOV. *Sbornik Pishch. Prom.*, 1965, (2), 61–68.—Some considerations in the determination of massecuite thermo-physical properties are discussed and a technique using a special concrete comparison calorimeter[2] considered to come closest to answering the requirements. The thermal constants of the calibrating instrument are determined using mercury, glycerine and bidistillate. Equations are developed for calculation of the various parameters including the determining temperature to which the factors are referred. The method has an accuracy of ± 5% and results, including thermal and "temperature conductivity" (sq.m./hr), specific heat and heat assimilation, are tabulated for sugar, massecuite and molasses of known Brix, purity and crystal content. The sugar data agree with those of KRASOVSKAYA and the final molasses data with those obtained by POPOV & CHERNYI[3]. The thermal properties of the inter-crystalline molasses have a considerable influence on the effective thermal conductivity of the massecuite.

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The significance of aerobic and anaerobic thermophilic spore-forming bacteria as sources of infection in beet sugar factories. II. Occurrence and significance of *Clostridium thermohydrosulfuricum* **in beet sugar manufacture.** H. KLAUSHOFER and E. PARKKINEN. *Zeitsch. Zuckerind.*, 1965, **90**, 582–585.—Tests were carried out to determine the number of *Cl. thermohydrosulfuricum*[4] in various beet factory products as well as in soil adhering to the beets, flume and wash water, etc. While the numbers in various parts of the tower diffuser greatly exceeded the *Bacillus stearothermophilus* count, the picture was reversed for the raw juice, and *Cl. thermohydrosulfuricum* was found in only a very small quantity in carbonatation juice on one occasion during the test period and in one clarifier (on a different occasion). The micro-organism was found in only a few samples of white sugar, and then only in extremely small quantities compared with *B. stearothermophilus*.

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The effect of invert sugar on purified juice quality. L. P. REVA. *Sakhar. Prom.*, 1965, **39**, 738–739. Laboratory tests are reported in which 0·3–1·5% of invert sugar was added to raw juice, which was then heated to 85°C and lime added in two separate doses (0·25% and 2·25% CaO). The juice was then saturated to pH 11, filtered, heated to 98°C, saturated to pH 9·2–9·3 and filtered. Analysis revealed that as the amount of added invert was increased, so the 2nd carbonatation juice purity decreased and the colour and Ca salts content increased. The amount of invert remaining undecomposed in liming and passing to the 2nd carbonatation juice also increased with increased doses of invert. It is concluded that modern carbonatation techniques will give high purity juice only if the beet are healthy and hence their invert content low. For treatment of sub-standard beet a scheme is required which will ensure that the invert sugar will pass through the factory undecomposed and be discharged with the molasses. The requisites of such a scheme are described.

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Thermo-physical characteristics of moist white sugar. V. I. SYROEDOV and A. B. VERZHINSKAYA. *Sakhar. Prom.*, 1965, **39**, 749–751.—The thermal conductivity (λ) and temperature conductivity (a) of white sugar of known crystal content and grist size and moisture content in the range 0·23–3·7% (by weight) were determined using a special cell containing a wall heater and two differential copper-constantan thermocouples. One, attached to the flat heater surface, measured the temperature at the point of contact between sample and heater, while the other measured the temperature at a distance of 8 mm from the wall. Over the moisture range tested the relationships between λ and a and moisture content were linear and were expressed by empirical formulae. The specific heat (c_w) remained almost constant with increase in moisture content. Comparison of measured with calculated values of c_w using a formula involving the specific heat of a dry substance showed good agreement. A formula involving only the moisture content (w) is given: $c_w = 0{\cdot}319 + 0{\cdot}0068w$ joules/kg/°.

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Paper chromatography-anthrone determination of sugars. S. G. SUNDERWIRTH, G. S. OLSON and G. JOHNSON. *J. Chromatog.*, 1964, **16**, 176–180; through *S.I.A.*, 1965, **27**, Abs. 551.—Mixtures of sucrose, glucose and fructose were separated by descending chromatography with ethyl acetate:acetic acid:water (6:3:2). The spots containing up to ~200 mg of sugar were eluted with water, and the sugar was determined colorimetrically with anthrone. The procedures are described. It was necessary to run the sugar standards through chromatograms on the same day to eliminate errors in recovery and anthrone reagent quality.

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Studies on sugar cane bagasse. V. Sugar make-up of the hemicelluloses of sugar cane bagasse fibre. S. R. PATHAK and V. R. SRINIVASAN. *Paper presented to the 12th Congr. I.S.S.C.T.*, 1965.—Hemicellulose fractions isolated from bagasse fibre[5] were hydro-

[2] KRASOVSKAYA: *Zhurn. Tekh. Fiziki*, 1949, (9).
[3] *Pishch. Prom.*, 1960, **2**, (10), 27.
[4] *I.S.J.*, 1966, **68**, 63.
[5] PATHAK: *Proc. 11th Congr. I.S.S.C.T.*, 1963, 1211-1216; *I.S.J.*, 1964, **66**, 92.

lysed separately with 1% sulphuric acid to constant optical rotation, neutralized with $BaCO_3$, concentrated, de-ionized with "Zeo-Karb 226" resin, dried, and the syrups extracted with pyridine. After stripping off the solvent, the syrups were dissolved to give 1% solutions in water which were subjected to descending paper chromatography, developing with 4:1:5 *n*-butanol:acetic acid:water. Spots were obtained by spraying with aniline hydrogen phthalate and the proportions of xylose, arabinose, glucose and galactose determined by colorimetric comparison with known amounts of these sugars similarly chromatographed. The proportions are tabulated for the fractions A_1, A_2, B_1, B_2, C_1 and C_2.

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Refractive indices of sucrose-water solutions in the range from 24 to 53% sucrose. D. F. CHARLES. *Anal. Chem.*, 1965, **37**, (3), 405–406; through *S.I.A.*, 1965, **27**, Abs. 561.—Refractive indices N of sucrose-water solutions containing between 22 and 59% of sucrose were measured with a Bausch & Lomb precision sugar refractometer. Corrections were applied for temperature and for moisture in the sugar, and the scale was checked against an N.B.S. test plate. Results are given in a table, and a graph is shown of $(N - N_o)/C$ *vs.* concentration C, where N_o = refractive index of water. The results cover the range of 24–53% sucrose for which recent data are lacking. The new data are found to deviate significantly from the scale officially adopted by ICUMSA in 1936, being higher by 0·00014 than the latter at ~40% sucrose, and lie along a more uniform curve than do the older data.

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Determination of invert sugar in refined white sugars. C. LEAVITT and J. SULLIVAN. *Proc. 24th Meeting Sugar Ind. Tech.*, 1965, 137–152.—Tests are reported in which the KNIGHT & ALLEN method for determining reducing sugars in refined white sugar[6] was used to find optimum sample concentration, reagent concentration and reaction time which would give the most accurate true invert content of refined sugar.

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Determination of the rate of nucleation of crystallization centres in sucrose solutions. A. V. ZUBCHENKO. *Khlebopekar. Konditer. Prom.*, 1965, (4), 18–21; through *S.I.A.*, 1965, **27**, Abs. 568.—Changes in the concentration of sucrose solutions of 1·29–1·60 supersaturation were measured at 40°C in a sealed apparatus[7]. A decrease in the latent period t_l with increasing supersaturation S was demonstrated, in agreement with the Gibbs-Thomson hypothesis that the critical size of the nuclei decreases as S increases. The number of nuclei J formed in unit volume and time was assumed to be proportional to $1/t_l$; the latter increased steeply with S. The relationship between J and S was in agreement with the equation of DUNNING: $\ln J + 3 \ln \ln S = \ln K_1 - B/(\ln S)^2$, where K_1 is a temperature-dependent constant, and $B = 16\,\pi\, N_o M^2 \sigma^3 / 3R^3T^3d^2$, where N_o = Avogadro number, M = molecular weight, σ = surface tension between phases, R = gas constant, T = absolute temperature, and d = crystal density. B was found as the slope of a linear curve with $\ln^{-2}S$ as the abscissa, from which the value of σ was calculated to be 2·34 ergs/sq.cm.

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Caking of raw sugar. Y. HORIKI. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 16–25.—Tests are reported in which 40 g of sugar were placed in a shallow dish 60 mm in dia. and 20 mm deep and the dish stored in a desiccator at constant temperature and humidity, the various R.H. levels being obtained by using lithium chloride solutions. The degree of caking of the sugar was determined by measuring the weight per sq.cm. necessary to break the cake. It was found that when the equilibrium R.H. of the molasses film surrounding the raw sugar crystals was higher than the R.H. of the atmosphere in which the sugar was stored, the raw sugar moisture content fell until equilibrium moisture was attained, and vice versa. The lower the purity of the molasses film and the smaller the sugar grains, the quicker was the moisture loss at low humidity. Of the factors found to affect caking, atmospheric R.H. proved to be the most significant, while the effects were increased if the raw sugar moisture content before storage was higher. Caking was found not to occur below the surface layer, and it was found possible to prevent caking by maintaining atmospheric R.H. above 60%, i.e. as near as possible to the equilibrium R.H. of raw sugar.

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Sulphite distribution in sugar crystals made by the double-sulphitation process. A. MORI, K. SUZUKI and T. YAMANE. *Proc. Research Soc. Japan Sugar Refineries' Tech.*, 1965, **16**, 26–31.—Plantation white sugar samples produced by the sulphitation process were sieved, and 200 g of crystal from each sample washed at 20°C to remove the outer layer, and centrifuged. The crystals were then re-washed at 20°C to remove the middle layer, re-centrifuged and the sugar solutions from the outer and middle layers and the remaining inner crystal analysed for sulphite. The highest sulphite concentrations were found in the surface layers containing the molasses film and the top crystal layer, while the concentrations in the middle layers were relatively low, this sulphite having been absorbed during crystallization. The sulphite found in the inner layers was mainly derived from seed crystals and hence occurred in greater concentrations than in the middle layers. To minimize the sulphite content, it is recommended that uniform and slightly larger crystals be made during boiling and as much crystal film be removed as possible by washing during purging.

[6] *I.S.J.*, 1960, **62**, 344–346.
[7] *I.S.J.*, 1965, **67**, 249.

BY-PRODUCTS

Experiences in developing, building and operating bagasse pulp and paper mills. J. E. ATCHISON. *Paper presented to the 12th Congr. I.S.S.C.T.*, 1965.—An account is given of the highly important preliminaries and requirements in establishing a plant for manufacture of pulp or paper from bagasse, with reference to five projects by the author's company. The time from original consideration to signing of contracts for a project may be two to seven years, during which a local group must be formed with some capital and means of raising more. A complete technical and economic feasibility study must be carried out by competent personnel and detailed studies must be reported to the institution from which the major financing is to come. Organization of the engineering of a project is discussed as is the time delay between confirmation of financing and start-up. Comments are made on personnel training; usually the plant is entirely in local hands by the end of three years from start-up. Reviews are made of methods of handling, storing and depithing bagasse as well as pulping methods, and widening uses for bagasse pulp are surveyed.

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Biological preservation of (beet) pulp. N. LOBACH and S. SEMCHUK. *Sakhar. Prom.*, 1965, **39**, 662–664.—An account is given of a sugar factory plant for lactic fermentation of beet pulp-molasses mixture. The treated mixture contained only traces of butyric and acetic acids. Cattle fed on the mixture gave higher milk yields, and in many cases the fat content of the milk was also increased.

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Results of using ammoniated (beet) pulp as cattle fodder. Z. SOBCZAK. *Gaz. Cukr.*, 1965, **73**, 216–218. Details are given of tests in which ammoniated pulp was fed to young beef cattle (bullocks and heifers) and to milch cows for varying periods. In the case of the beef cattle, the daily weight increase ranged from 0·841 to 1·241 kg, while the amount of protein giving 1 kg increase ranged from 451 to 678 g. In the case of the milch cattle, the two groups showed a weight increase and a drop in the milk fat content. However, while in one group the daily milk yield rose, in the case of the other group it decreased. Test data are tabulated.

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Blackstrap molasses *vs.* cane molasses. S. L. CROCHET. *Sugar J.* (La.), 1965, **28**, (3), 28–33.—The beneficial effects produced by feeding blackstrap molasses to cattle, as evidenced by test results, are discussed and definitions suggested for the two types of molasses[1].

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Chemical treatment of roughages. E. J. STONE, H. F. MORRIS, R. E. GIROUARD and J. B. FRYE. *Sugar J.* (La.), 1965, **28**, (3), 36–37.—The effect of alkali and/or enzymes on the content and digestibility of certain plant material, including bagasse, was studied. It was found that the cellulose content of bagasse can be significantly altered by treating with 2% caustic (10 parts caustic:1 part of dry bagasse) for at least 6 hr at room temperature, thereby raising the cellulose digestibility by 300%. Treatment with enzymes after the caustic treatment gave an additional 5–10% digestibility of the cellulose, although enzyme treatment alone was ineffective.

* * *

A study of the prospects of bagasse fibreboards in the local market. G. I. RIVERA. *Sugar News* (Philippines), 1965, **41**, 383–387, 440–451.—The prospects of expanding bagasse board production in the Philippines are considered in the light of the present supply and demand of plywood and various types of fibreboard. It is concluded that the three existing insulation board factories produce sufficient board to satisfy local demand up to 1970 and that the present market position of bagasse board is not healthy, although an improvement in the sisuation is thought possible. The export market is generally considered suitable only for absorbing surplus production. Reference is made to the report on the feasibility of manufacturing bagasse board in Jamaica published by The Tayler Corporation.

* * *

Sugar beet by-products in the production of beef. II. E. CORDIEZ. *Sucr. Belge*, 1965, **85**, 49–60.—Tests showed that dried pulp gave greater weight increases when fed to young bulls than did pulp silage[2], the daily weight increases being 1·235 and 1·276 g at 1% and 0·75% on live weight, respectively, compared with 1·188 and 1·205 g with ensilaged pulp. However, the amount of dried pulp consumed daily per kg of weight increase was also greater. At the 1% level the cost difference between the two types of feed is relatively small. Also investigated were feeds containing pulp silage and beet crowns and pulp-lucerne mixtures. In the case of the feeds containing lucerne, the dried pulp was again better than the pulp silage.

* * *

Present aspects of the evaluation of sugar beet by-products. ANON. *Pub. Vulg. Inst. Belge Amél. Betterave*, 1965, (1).—From data obtained in Belgium regarding the value of beet by-products used as fodder for young grazing beef cattle, it is shown that the consumption of fresh beet leaves and crowns from 1 hectare of beet will produce 250 kg of meat, compared with 406 kg produced by leaves and crowns ensilaged with beet pulp, 297 kg produced by pulp silage alone, and 329 kg by dried pulp. Hence, in Belgium these beet by-products represent an annual production of 31,500 tons of meat. The monetary value of the various factors to be considered in evaluation of each type of fodder is detailed.

[1] *See also I.S.J.*, 1965, **67**, 27.
[2] *See I.S.J.*, 1966, **68**, 61.

UNITED KINGDOM

Production of L-glutamic acid. AJINOMOTO CO. INC., of Tokyo, Japan. **981,358.** 30th April 1963; 27th January 1965.—A micro-organism, e.g. *Brevibacterium lactofermentum*, is cultivated under aerobic conditions in the presence of beet or cane molasses or juice, raw sugar, etc., and in the presence of a nitrogen source, e.g. urea or gaseous ammonia, and of inorganic salts. A monohydric alcohol, e.g. *iso*-butanol, *iso*-amyl alcohol, methanol, *iso*-propanol or fusel oil, is added partway through the incubation.

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Beet harvester. C. SIELING, of Melissant, Holland. **982,602.** 20th November 1962; 10th February 1965.

* * *

Refining of sugars using aqueous alcohols. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **983,262.** 8th June 1962; 17th February 1965.—Raw sugar crystals are contacted (at 20–40°C) with such a quantity of water and 50–90% by weight of a water-soluble alcohol that the ratio of raw sugar to alcohol by weight is in the range 1:0·4 to 1:1 and in such a manner that the molasses film on the crystals becomes suspended in the aqueous solution (20–30% water, 50–60% alcohol, 15–20% sucrose) and the refined crystals recovered. Afterwards the washed sugar may be treated with more water and alcohol and the temperature raised (to less than 150°C) to dissolve the crystals, the suspended impurities separated and the refined sugar recrystallized. The mother liquor from the recrystallization may be used as wash liquor for the initial washing.

* * *

Phosphoric esters of polyhydric alcohols. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **983,340.** 6th March 1963; 17th February 1965. A polyhydric alcohol (sucrose, galactose, glucose, etc.) and water are mixed with a stoichiometric quantity of a calcium oxy compound [CaO, $Ca(OH)_2$, $CaCO_3$] and the resultant mixture phosphorylated, at −10 to 30°C (~0°C), with a solution of $POCl_3$ in a chlorinated hydrocarbon solvent (trichloroethylene). The calcium salt of the phosphoric acid ester is separated from $CaCl_2$, by countercurrent extraction of the reaction product with alcohol or aqueous ethanol or by gel filtration or by ion exclusion, and converted to the salt of other cations via the ester.

* * *

Production of yeast. M. DELOFFRE, of Luxembourg. **983,491.** 5th April 1961; 17th February 1965.—An aerobic fermentation is carried out in two phases, A and B; in phase A a wort containing sacchariferous material, e.g. beet molasses, is inoculated with a yeast culture and fermentation continued to produce both yeast and alcohol. In phase B the broth at the end of phase A is diluted and fermentation continued with the addition of further molasses and nutrient salts to produce more yeast and alcohol or to produce more yeast while part of the alcohol is resorbed. The resulting broth is then subjected to a third phase C with addition of further molasses and nutrient salts until all the alcohol has been resorbed, this resorption resulting from adjustment of the molasses supply. The molasses used in phases A and B represents about 50% of the total.

* * *

Extracting sucrose from sugar cane. THE COLONIAL SUGAR REFINING CO. LTD., of Sydney, N.S.W., Australia. **984,164.** 15th September 1961; 24th February 1965.—On the discharge side of a three-roller cane mill shown in Fig. 1 a trough 6 is arranged so that the discharge opening of the mill is completely enclosed by the trough in which the level of liquid is maintained above the discharge opening by maceration liquid 7 supplied through an inlet 8. The bagasse is discharged from rollers 2 and 3 in a compressed state under the liquid seal in trough 6, where it expands under complete exclusion of air. The bagasse is then transferred by conveying means 9 extending into trough 6 to a further mill stage or

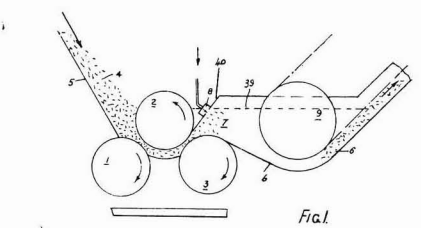


Fig.1

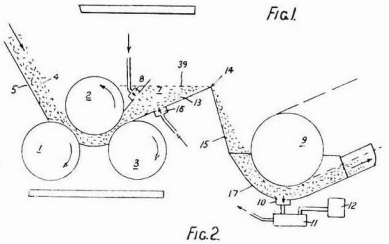


Fig.2

Copies of Specifications of United Kingdom Patents can be obtained on application to The Patent Office, Sale Branch, Block C, Station Square House, St. Mary Cray, Orpington, Kent (price 4s 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. 20231 U.S.A. (price 50 cents each).

other location. An alternative arrangement shown in Fig. 2 consists of a funnel-shaped trough 13 arranged at an angle so that the outer edge of the lower plate of the funnel forms an overflow edge 14 which is connected to a slide 15 with a further receptacle 17 into which the conveying means 9 extends. Two inlets 8 and 16 in the top and bottom plates of trough 13 pass the maceration liquid into the funnel, thus maintaining a liquid seal across the discharge opening of the mill, any surplus liquid together with the bagasse flowing over edge 14 into receptable 17 whence it is drained at outlet 10 and recirculated to inlets 8 and 16 together with additional liquid drawn from tank 12 to top up the liquid in the trough. The upper and lower plates of the rectangular-section trough may be extended by grids to permit surplus maceration liquid to be drained from the bagasse before it leaves the upper end of the trough; this surplus liquid will then be returned to receptacle 17.

* * *

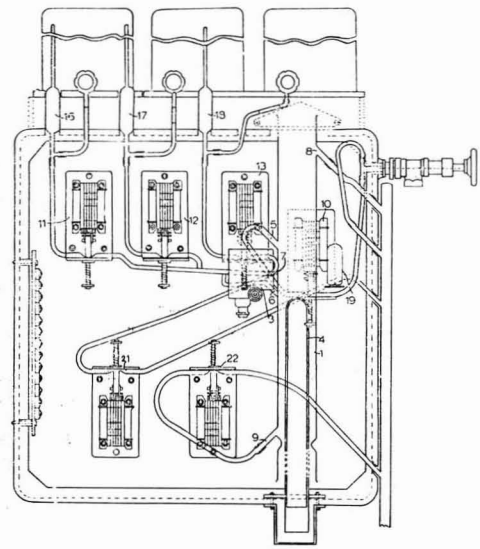
Sugar solution (which will stand prolonged storage without growth of yeasts and/or fungi). GEBR. VAN GILSE KANDIJFABRIEK N.V., of Roosendaal, Holland. **984,713.** 13th September 1963; 3rd March 1965. An aqueous solution containing 50–65% (58–62%) by weight of sucrose having an ash content of at most 0·15% by weight, is demineralized to such an extent that the ash content is less than 0·001% (less than 0·0006%) by weight.

* * *

Beet harvesters. (A) J. D. DYSON and C. R. DYSON, of Peterborough, Northants. **985,272**; **985,273.** 29th June 1962; 3rd March 1965. (B) MASSEY-FERGUSON S.A., of Paris 16e, France. **985,925.** 5th January 1962; 10th March 1964. (C) J. D. DYSON and C. R. DYSON, of Peterborough, Northants. **988,613.** 26th May 1961; 7th April 1965.

* * *

Boiler feed water sugar detector. BRITISH SUGAR CORPORATION LTD. and H. J. BOND. **985,825.** 21st November 1961; 10th March 1965.—A tall glass vessel 1 has two inlet apertures 5 and 6 and two outlet apertures 7 and 8 (the last not normally used) towards the top of the side walls, and an outlet aperture 9 at the bottom. Magnetic valves 10, 21 and 22 control flow through apertures 5, 7 and 9 and magnetic valves 11, 12 and 13 control the flow of reagents through aperture 6 from automatic burettes 16, 17 and 18. The magnetic valves are controlled by a cam shaft which makes one revolution in 15 min, during which the following sequence of operations takes place: outlet aperture 7 and inlet aperture 5 are opened simultaneously, outlet aperture 9 already being open. Boiler feed water is admitted through aperture 5 and flushes out the vessel for approx. 1 min, after which aperture 9 is closed and the vessel fills up to the level of aperture 7. An electric coil heater in the base of the vessel is automatically switched on and after a pre-determined period, based on the time taken for the water to reach boiling point, a pre-determined volume of 5% H_2SO_4, sufficient to bring the pH of the water to 2–4, is fed through aperture 6 from burette 16. After 2½ minutes' boiling any non-reducing



sugars present in the water are hydrolysed and a pre-determined volume of a solution containing 2N NaOH, sufficient to adjust the pH to about 11, is fed through aperture 6 from burette 17 and a pre-determined volume of 0·1% triphenyl tetrazolium chloride indicator is supplied from burette 18. Boiling is then continued until the reagents have mixed thoroughly, when the heating coil is automatically switched off. After about 2 min a signal from a photocell 19 is switched into circuit and measures the intensity of light passing through the solution from a light source 3 on the other side of the vessel which has a pair of parallel windows in opposite walls. The triphenyl tetrazolium chloride produces a red coloration on reacting with the reducing sugars. If the light intensity is less than a pre-determined value, a relay is energized and a warning is given. The photocell signal is then switched out and the outlet aperture 9 opens to discharge the mixture. If the light intensity is normal, the photocell signal is switched out, the outlet aperture 8 and the inlet aperture 5 are opened and the vessel is flushed out before a fresh analysis is started.

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Beet elevator. G. TIRELLI, of Piacenza, Italy. **986,118.** 28th June 1961; 17th March 1965.

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Beet thinner. F. SCHÜRMANN, of Vienna 9, Austria. **988,823.** 16th May 1963; 14th April 1965.

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Beet topper. J. M. REEKIE, of Arbroath, Angus, Scotland. **990,568.** 15th May 1961; 28th April 1965.

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.

"Busan 881" for micro-organism control in cane sugar mills. Buckman Laboratories Inc., Memphis, Tenn., 38108 U.S.A.

Cane juice is an ideal medium for the growth of a wide variety of micro-organisms. As unprotected cane juice splashes over the interior of the mill housing and flows through troughs and pipes during recirculation it comes in contact with the many billions of micro-organisms attached to metal and concrete surfaces. Together with the dirt and cane fibres these bacteria form a slime which can be observed on the lower part of the interior of the mill housing and in the troughs which discharge juice over the cane entering the various mills. Frequent and thorough cleaning of the slime from milling equipment helps to reduce the sucrose losses. However, the rapid growth of micro-organisms in the highly nutritious cane juice makes it impossible to control slime accretion adequately by good housekeeping practices alone, since there are too many surfaces in the juice-handling system that are inaccessible to steam and hot water for sufficient periods of time. On the other hand, no bacteriological control can be adequate without frequent and thorough clean-ups in the accessible areas. However, treatment of cane juice with "Busan 881" combined with regular and thorough steaming of the conveyors, troughs, and other accessible areas will permit an essentially slime-free operation.

"Busan 881" is a liquid which is fed directly to the cane juice at a point or points where the treated juice can circulate to all parts of the grinding equipment, troughs, screens, and pipes with which juice comes in contact. In all cases, the "Busan 881" is added continuously to the juice at the rate of 20 p.p.m. on weight of cane ground. It should never be added to the maceration water. About a quarter of the total daily dosage is applied to the juice from the crusher and the rest to the juice from the last or next to last mill, depending on pH and temperature of the juice coming from these mills. If the pH of the juice in the last mill is above 5·5 or the temperature of the juice in the last mill exceeds 140°F, it is recommended that the "Busan 881" be added to the juice from the next to last mill. Best results are obtained where arrangements are made to circulate treated juice by compound imbibition back to enter ahead of the first mill or crusher, and the entire dosage of the "Busan 881" is added to the juice leaving the last mill.

* * *

"Magox HG" in cane sugar clarification. Basic Inc., Chemicals Divn., 845 Hanna Building, Cleveland, Ohio, 44115 U.S.A.

"Magox HG" is a chemical grade of magnesium produced from selectively mined Nevada magnesite ore by burning to a moderately high reactivity. It is specifically designed for use in liming sugar juices where a rapid neutralization rate is required together with a minimum insoluble residue. "Magox HG" is used as a replacement for calcium hydroxide, to eliminate evaporator scaling and increase mud density. Many factories in various parts of the world, including Hawaii, Puerto Rico, Jamaica, Peru, Mexico, Mauritius and Louisiana and Florida, are using "Magox HG". Results obtained include a reduction in down time and lower costs for evaporator cleaning and higher grinding rates leading to an increase in productivity. The small additional cost for "Magox" is far exceeded by this increased productivity between shutdowns, savings in the cost of chemicals and maintenance labour and a reduction in tube and valve replacements.

"Magox" neutralizes approximately 1·85 times as much acid as lime. Reduction in scaling results from the fact that the sulphate salt of "Magox" is soluble while that of lime is insoluble. Reports of mill superintendents indicate that a "Magox"-limed juice enables them to make excellent quality raw sugar.

* * *

Portable pneumatic stitching machine. The Thames Packaging Equipment Co., 28 City Road, London E.C.1.

The new T.P.E. Fischbein portable bag stitcher announced is pneumatically-operated and can seal all types of bags, including paper, jute, cotton and polyethylene sacks, normally in just a few seconds. The resultant seal is stronger than the surrounding material and unskilled and casual labour can be used to operate the machine.

* * *

Swan-neck elevator-conveyor. British Automatic Conveyor and Equipment Co. Ltd., 41–42 Prescot Street, London E.1.

Details have been released of a simple mobile electrically-driven swan-neck belt elevator designed for loading of road and rail trucks from ground or other levels. It is mounted on heavy-duty solid rubber-tyred castors and is thus easily movable by one man. The belt is of standard grip-type rubber and runs over a series of free-running rollers. An easily adjustable tensioning device is incorporated. The conveyor operates off any standard 3-phase power supply in the range 380–440 volts at 50 c/s and is supplied complete with switchgear. The conveyor is supplied in heights to suit customers' requirements.

* * *

Metal detector. Scientific Systems Ltd., Yate, Bristol.

A new cheap but highly sensitive tramp metal detector which has application in the food industry is announced. It works on the established principle of distortion of a magnetic field but the system is of sufficiently high sensitivity to enable search heads to

be economically and easily adapted to various types of conveyor layouts, no matter how unusual or difficult. The search head can be fitted around a conveyor without having to break the belt. The control circuit can be arranged to stop the conveyor instantly when metal is detected, to sound an alarm or to initiate any subsequent action required.

* * *

Spherical roller bearings. Link-Belt Co., Prudential Plaza, Chicago, Ill., 60601 U.S.A.

A new self-aligning spherical roller bearing, the Series 22500, is announced. It combines extra shaft stability with increased load, life and speed ratings. Inner rings extended on both sides provide a larger bearing area for higher loads. Rigid shaft control is assured by two spring-locking collars which combat fretting corrosion in applications where an interference fit is not used. The basic dynamic load ratings range from 13,100 lb for the smallest shaft size (1 $\frac{7}{16}$ in) to 102,000 lb for the largest (5 in). The two- and four-bolt cast-iron pillow blocks and the formed-steel cartridge units may be of the fixed or expansion type. The "Impervron" sealing system standard with this bearing is the floating-labyrinth type H which consists of eight separate seals floating concentrically just off the surface of the inner ring. Other types of seals are also available.

PUBLICATIONS RECEIVED

CONVEYOR SLATS. William Bain & Co. (Fencing) Ltd., Lochrin Works, Coatbridge, Lanarkshire, Scotland.

A brochure is now available giving information on steel conveyor slats supplied by the firm to conveyor manufacturers and to sugar factories throughout the world. The slats, normally manufactured in thicknesses up to $\frac{1}{4}$ or $\frac{3}{8}$ in and in lengths of up to 10 ft. are available uncoated, oiled or galvanized and are generally supplied holed ready for attachment to the conveyor. Typical profiles are shown, and other specialized pressings produced by the firm are briefly mentioned.

* * *

OIL FIRING EQUIPMENT. International Combustion Products Ltd., 19 Woburn Place, London W.C.1.

A new well-illustrated brochure gives details of equipment for firing water-tube boilers with oil and gas, methods of converting coal-fired boilers to oil-firing and the techniques developed by International Combustion for burning fuel oils at very low excess air without smoke production. Full details are also given of the system of firing with spill tip shut-off oil burners which has been introduced in a number of countries.

* * *

FLOW INSTRUMENTS. Flowsheet Instruments Ltd., Electronic Centre, Deansgate Lane, Timperley, Cheshire; Josef Heinrichs Messgeräte, 5 Köln-Braunsfeld, Stolberger Str. 393, Germany.

An illustrated information sheet is available giving details of Josef Heinrichs variable-area flowmeters and flowguards and tank-level indicators. The last may be mounted outside or inside the tank and can be made to transmit and control the level.

* * *

DUST COLLECTORS. Thermix Industries Ltd., 143 Maple Rd., Surbiton, Surrey.

The latest publication from this firm gives details of its range of "Thermix" cyclones and "Tubix" multi-tubular centrifugal dust collectors, which are basically groups of cyclone cells mounted in parallel and welded between tube plates at 45° to the horizontal.

* * *

TRIPLE ROLL MILLS. The Pascall Engineering Co. Ltd., Gatwick Rd., Crawley, Sussex.

The latest brochure gives details of the complete range of three pulverizers, with outputs from a few ounces up to 100 lb/hr depending on model and application.

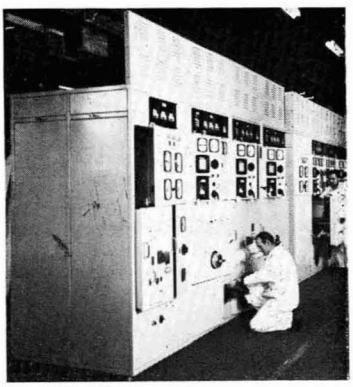
* * *

BEET FACTORY EQUIPMENT. CEKOP Foreign Trade Enterprise, P.O. Box 112, Mokotowska 49, Warsaw, Poland.

Details are available in printed form of some of the beet factory equipment supplied by CEKOP, including a continuous carbonatation vessel, with or without gas distributor, the Szarejko pressure filter, a vortex beet pump (Model 400 WB-2) and a beet tail utilization station, comprising catcher, washer and slicer

Brevities

Sugar factory alternator controls.—The illustration shows two control boards recently completed for the Caribbean by



Brookhirst Igranic (Metal Industries Group). They are designed to control a series of back-pressure turbo-alternators, varying between 750 and 2000 kW at 480 V, and incorporate special busbar designs up to and including 6000 amp.

* * *

Czechoslovak sugar factory for Pakistan[1].—Technoexport has concluded a contract with a firm in West Pakistan under the terms of which the Czechoslovak agency will deliver a sugar factory with a crushing capacity of 1500–2000 t.c.d. This will be the first Czechoslovak sugar factory to be supplied to Pakistan.

* * *

Fletcher & Stewart Ltd.—Fletcher & Stewart Ltd. have taken over the whole of the hydraulic baling press business of Fawcett, Preston & Co. Ltd., of Bromborough, Cheshire, once well-known as suppliers of sugar machinery. The business will be handled at the Derby works of Fletcher & Stewart Ltd. and will increase the company's range of sugar machinery in the field of bagasse baling. A three-way press has been developed in which very high pressure is exerted on the material in three directions simultaneously, the pressed bagasse being then suitable for use in the manufacture of fibre-board.

[1] *Czechoslovak Heavy Industry*, 1966, (4), 31.

French Sugar Imports and Exports[1]

Metric tons, tel quel	1965 *Not Exceeding* 99·8°	1965 *Exceeding* 99·8°	1964 *Not Exceeding* 99·8°	1964 *Exceeding* 99·8°
IMPORTS				
Belgium/Luxembourg	27	2,080	1	227
Brazil	21,000	—	5,250	—
Congo (Brazzaville)	1,967	—	—	—
Dominican Republic	—	—	21,275	21
Guadeloupe	112,970	—	125,859	—
Guatemala	—	—	11,000	—
Haiti	—	—	2,683	—
Honduras	—	—	3,000	—
Malagasy	16,010	—	34,326	100
Martinique	62,228	—	52,720	—
Mexico	18,917	—	7,925	—
Poland	15,840	—	—	11
Réunion	166,367	—	166,972	—
Taiwan	17,780	—	20,824	—
Thailand	—	—	9,934	—
Other Countries	3	—	8	—
	433,109	2,080	461,777	359
EXPORTS				
Algeria	106,561	43,081	84,244	69,940
Belgium/Luxembourg	26,125	17,409	3,267	9,928
Burma	6,000	—	—	—
Cameroons	1,724	5,654	1,157	7,364
Dahomey	325	3,841	211	4,869
Ethiopia	—	7,490	—	—
Gambia	1,250	229	—	34
Germany, West	115,875	13,513	31,245	2,797
Ghana	350	33,004	—	962
Greece	2,378	8,530	100	18,764
Guinea	1,000	9,386	647	4,572
Iran	6,500	1,000	5,750	8,894
Israel	2,550	145	—	14
Italy	56,476	7,154	28,057	33,169
Ivory Coast	1,004	7,570	3,431	7,268
Jordan	3,250	1,250	—	—
Kenya	2,506	648	—	14
Lebanon	5,250	65	—	115
Liberia	—	1,531	—	1,136
Libya	—	—	9,905	1
Mauritania	6	1,119	—	3,875
Morocco	25,000	9,940	28,000	25,989
Netherlands	54,605	37,010	5,462	3,325
Niger Republic	591	5,590	1,488	3,272
Nigeria	350	8,927	—	8,670
Pakistan	3,150	1,050	—	—
Saudi Arabia	500	4,500	—	6
Senegal	15,790	39,330	25,124	29,624
Sierra Leone	700	4,411	—	2,902
Spain	5,825	11,271	1,800	262
Spanish N. Africa	115	2,324	—	997
Sudan	19,290	—	12,574	—
Sweden	10,947	1,500	2,730	2
Switzerland	41,478	100,029	5,454	81,013
Togo	70	1,955	373	3,193
United Kingdom	28,789	1,376	4,923	2,305
U.S.A.	5,380	2,500	1,000	1,846
Upper Volta	250	5,567	370	6,100
Other Countries	1,814	3,234	7,850	11,167
	553,774	403,133	265,162	362,889

Queensland sugar crop, 1965[2].—Harvesting of the 1965 sugar crop in Queensland has now been completed; the State's 31 mills handled 13,547,000 tons of cane, harvested from 495,000 acres, to produce a record 1,882,360 tons of sugar. In the previous season sugar production totalled 1,855,000 tons. Recent rains have given all cane growing areas a good start for the success of the 1966 crop, but further rains will be needed in some districts to consolidate the position.

BREVITIES

Philippines sugar production, 1965[3].—The Philippines Sugar Association has reported that production in 1965 amounted to only 1,716,697 short tons, a fall of 139,182 tons on the previous year. The drop in yield was attributed to bad weather conditions and limited milling facilities. While the cane acreage increased from 555,750 acres in 1961 to 839,800 in 1965, mill capacity remained more or less constant, resulting in cane being milled after the optimum recovery period. At the same time average yield per hectare dropped from 100 piculs to only 70 piculs (7 short tons to 4·9 short tons). Estimated production in 1966 is expected to be only 1,725,000 tons, of which 600,000 tons will be required for domestic consumption. Despite a carryover of 40,000 tons it is calculated that the Philippines will be short of its commitments by some 80,000 tons and it is feared that the quota for the U.S. this year of 1,233,440 tons will not be filled.

* * *

Uruguay sugar production[4].—The Honorary Sugar Commission in Uruguay puts sugar production for the 1964/65 season in that country at 64,961 metric tons, tel quel, of which 54,903 tons was manufactured from beet and the balance of 10,058 tons from cane. In addition 112,795 tons of refined sugar was produced from imported raws.

* * *

Sugar licensing prospects[5].—Four of the world's major sugar importing countries have given assurances to Jamaica that if other big importers agree, they are willing to license sugar imports as part of a new international sugar agreement. The Jamaican Minister of Trade said that, having secured the adherence of half of the eight major sugar importing countries to the principle of licensing, Jamaica was trying to get the agreement of the other four. The Minister did not specify which importers had agreed to the proposals but regarded as among the largest importers are the United Kingdom, the U.S.S.R., the U.S.A., West Germany, Canada, Japan and Italy. Licensing was proposed by Jamaica at the 1965 U.N. Sugar Conference; the idea is that big importers would agree to buy no sugar except from signatories to a world agreement and to ensure this being done they would issue licences to apply only to the specified exporters.

* * *

Yugoslavia sugar production, 1965/66[6].—Sugar production in Yugoslavia in 1965/66 is reported at 310,000 metric tons, white value, equivalent to 345,000 tons, raw value. This compares with 357,090 tons, raw value, produced in the previous campaign. The sugar beet crop in 1965/66 amounted to 2,620,000 tons, compared with 2,830,000 tons in the previous year, and sugar extraction is calculated at 13·17% in 1965/66 compared with only 12·62% in 1964/65.

* * *

Czechoslovakian sugar crop, 1965/66[7].—At a recent conference of the various sugar beet interests in Czechoslovakia it was announced that the quantity of beet harvested in the 1965/66 season amounted to 5·25 million metric tons, according to *die Wirtschaft des Ostblocks*, which compares with the original target of 7·75 million tons. A total of 7·03 million tons of roots was harvested during the previous crop against the plan of 7·6 million tons. It is estimated that about 9000 hectares of roots are still in the ground and have had to be abandoned.

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New Austrian sugar research institute[8].—A new Sugar Research Institute is under construction in Austria. It is situated north-east of Vienna, in the centre of a sugar beet growing district, and will comprise a small factory with laboratory, a working hall and also a library.

[1] G.N.I.B.C.; through C. Czarnikow Ltd., *Sugar Review*, 1966, (750), 36.
[2] *Queensland Newsletter*, 3rd February 1966.
[3] *Public Ledger*, 22nd January 1966.
[4] C. Czarnikow Ltd., *Sugar Review*, 1966, (747), 25.
[5] *The Times*, 24th January 1966.
[6] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (3), 11.
[7] C. Czarnikow Ltd., *Sugar Review*, 1966, (747), 24.
[8] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (2), 4.

BREVITIES

U.K. spring mechanization demonstration.—The 1966 demonstration is to be held on the 18th–19th May at Sedgeford, near King's Lynn, where large acreages of processed monogerm and pelleted monogerm seed, the latter sown at wide spacing, have been included together with areas of multigerm seed for subsequent hand singling or mechanical thinning. The full range of machinery entered includes precision drills, band sprayers, mechanical thinners and tractor hoes, while static exhibits will include beet harvesters and cleaner-loaders.

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U.K. beet price, 1966.—The guaranteed price to be paid for sugar beet in 1966, according to the Annual Review and Determination of Guarantees, 1966, will be the same as for the 1965/66 campaign, i.e. £6 10s 6d per ton, basis 16% sugar content, this price being applicable to beet from the same area as 1965, viz. 443,000 acres.

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New Pakistan sugar factory.—The Mirpurkhas Sugar Mills factory at Jamrao, near Karachi, has started operations recently, despite setbacks which delayed completion, planned for November 1965. During the Indo-Pakistan fighting in 1965, some of the equipment en route to the factory was confiscated at sea by the Indian Government, and essential items had to be made in Pakistan to drawings supplied by Fletcher & Stewart Ltd.

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Philippines sugar production 1964/65[1].—Sugar production from the 1964/65 crop in the Philippines, which ended when Ormoc sugar mill closed on the 21st December, totalled 24,626,028 piculs or 1,716,927 short tons. Estimated production for the 1965/66 crop is 27,981,740 piculs or 1,950,867 short tons.

Stock Exchange Quotations

London Stocks (*at 18th April*, 1966)	CLOSING MIDDLE s d
Anglo-Ceylon (5s)	5/–
Antigua Sugar Factory (£1)	10/–
Booker Bros. (10s)	21/4½
British Sugar Corp. Ltd. (£1)	23/7½
Caroni Ord. (2s)	1/9½
Caroni 6% Cum. Pref. (£1)	16/6
Demerara Co. (Holdings) Ltd.	2/9
Distillers Co. Ltd. (10s units)	20/1½
Gledhow Chaka's Kraal (R1)	15/3
Hulett & Sons (R1)	17/–
Jamaica Sugar Estates Ltd. (5s units)	3/1½
Leach's Argentine (10s units)	9/–
Manbré & Garton Ltd. (10s)	31/7½
Reynolds Bros. (R1)	19/3
St. Kitts (London) Ltd. (£1)	15/6
Sena Sugar Estates Ltd. (5s)	8/9
Tate & Lyle Ltd. (£1)	28/–
Trinidad Sugar (5s stock units)	2/1½
West Indies Sugar Co. Ltd. (£1)	8/–

New York Stocks (*at 16th April*, 1966)	CLOSING MIDDLE $
American Crystal ($5)	18⅜
Amer. Sugar Ref. Co. ($12.50)	31⅜
Central Aguirre ($5)	33⅝
Great Western Sugar Co.	42¼
North American Sugar ($10)	14½
South P.R. Sugar Co.	25
United Fruit Co.	29½

Commission Internationale Technique de Sucrerie

13th General Assembly

The next General Assembly of the C.I.T.S. will take place in Falsterbo, Sweden, from June 5th to 9th, 1967.

The Scientific Committee has chosen "The crystallization of sugar" as the subject of priority, but papers on any theme concerned with sugar processing will also be accepted provided that the work was of a scientific nature.

The Svenska Sockerfabriks A.B. has kindly offered its collaboration in making local arrangements for the conference.

Falsterbo offers unique opportunities for a most congenial and enjoyable meeting. The programme of the discussions and the conditions for participation will be announced later.

Bulk handling in Réunion[2].—A bulk sugar store has recently been put into operation at Pointe-des-Galets, in Réunion. The silo is of 40,000 tons capacity and can receive sugar at the rate of 200 tons/hour and discharge into ships at an average rate of over 400 tons/hr. It is expected to lower the cost of the island's sugar.

* * *

Greek sugar industry expansion[3].—A survey of the sugar industry in Greece prepared by a French Company on behalf of the Greek Ministry of Coordination has been completed. The survey is reported to conclude that a further three sugar factories could be built. It has been learnt from other sources that the Government is contemplating the possibility of establishing two new factories with production capacities of 28,000 and 14,000 tons, respectively, as well as increasing the production capacity of the three existing factories by 50%. This would raise annual production capacity to 85,000 tons of sugar, and would require an investment of $30,000,000.

* * *

U.S. beet area, 1966[4].—The area authorized by the U.S. Dept. of Agriculture for beet sowings in the spring of 1966 has been set at 1,435,000 acres; however, the Crop Reporting Board estimates that the area which will actually be planted will amount to only some 1,324,000 acres. This should be enough to meet the 1966 domestic beet area sugar quota of 3,025,000 short tons, raw value. An area of 1,375,000 acres was authorized for 1965, the first time for four years that beet area restrictions had applied, and of that some 1,316,500 acres were actually planted. Losses, however, were reported to have been higher than usual and some 1,251,000 acres were finally harvested. This area yielded about 20,935,000 tons of roots from which some 2·9 million short tons, raw value, of sugar were manufactured.

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Sugar factory for Ecuador[5].—Cía. Azucarera Tropical Americana, a company formed by French and Ecuadorean interests, is to build a sugar factory in the Province of Guayas[6]. Sugar production is to commence in 1967 and a paper mill is to be built later which will use bagasse as raw material.

[1] *Sugar News*, 1966, **42**, 4–6.
[2] *L'Usine Nouvelle*, 1966, (4); through *Sucr. Belge*, 1966, **85**, 280.
[3] F. O. Licht, *International Sugar Rpt.*, 1966, **98**, (8), 13.
[4] C. Czarnikow, Ltd., *Sugar Review*, 1966, (756), 62.
[5] *Fortnightly Review* (Bank of London & S. America Ltd.), 1966, **31**, 166.
[6] *See I.S.J.*, 1964, **66**, 63.