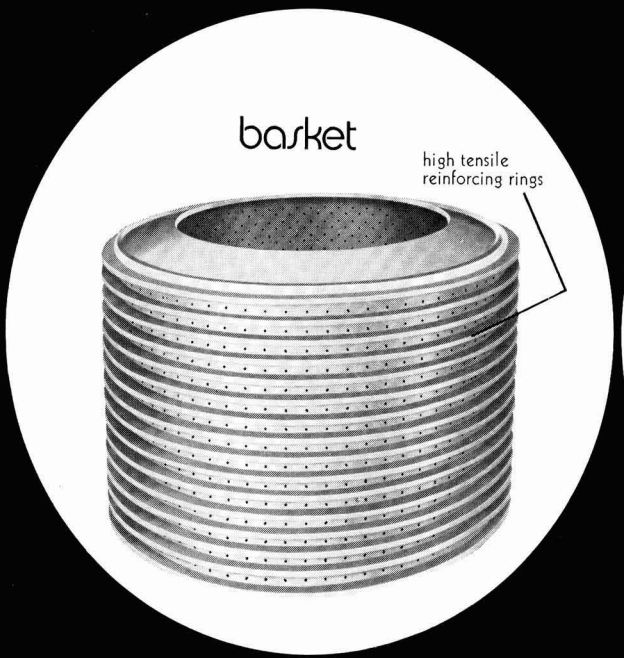
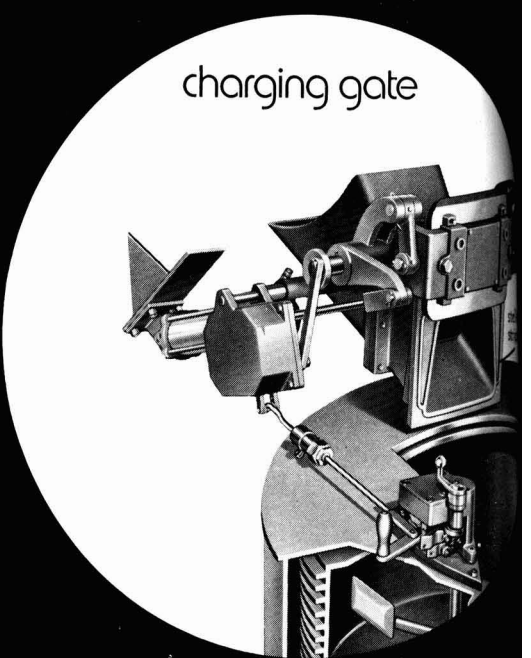
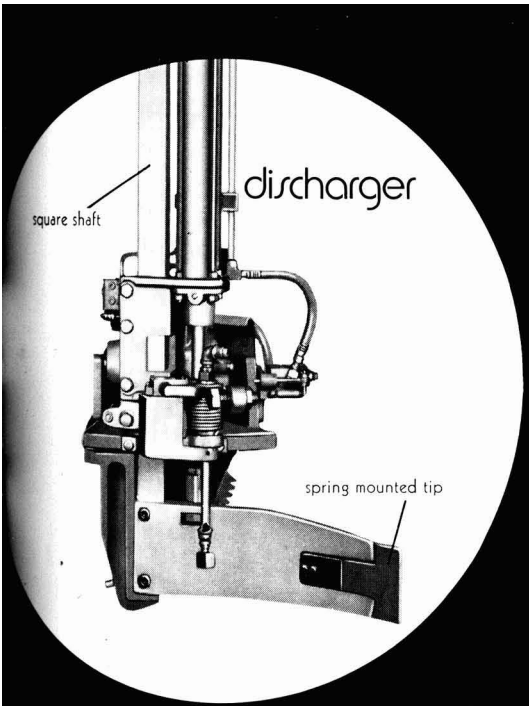
THE International Sugar Journal

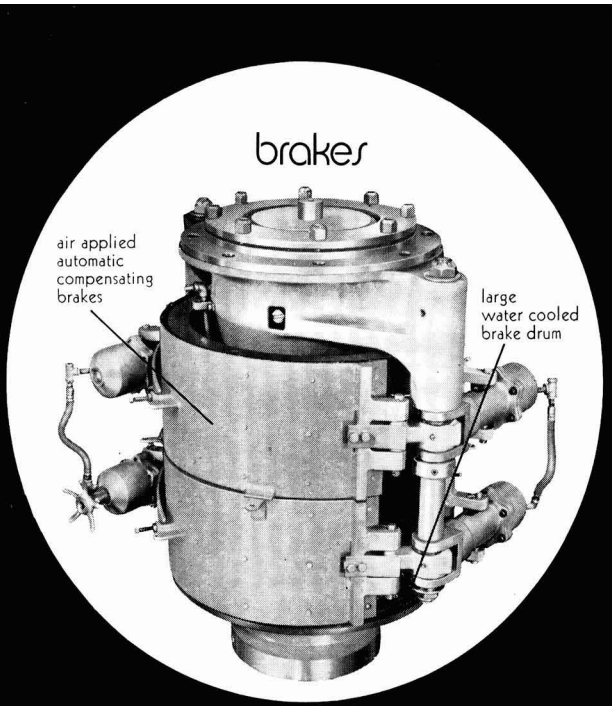
MAY 1971





western centrifugals cost more and are worth more





states

Worth more . . . because the Western States centrifugal design has been guided by over 50 years of centrifugal manufacturing experience. The value added by this experience shows up in the strength and dependability features needed for high volume production.

At Western States we build only centrifugals, and our design is expressly for the sugar industry. No other centrifugal application requires the high volume productivity. We know it and build for it. There's a battery of our machines which has been in continuous high production operation for 33 years. How's that?

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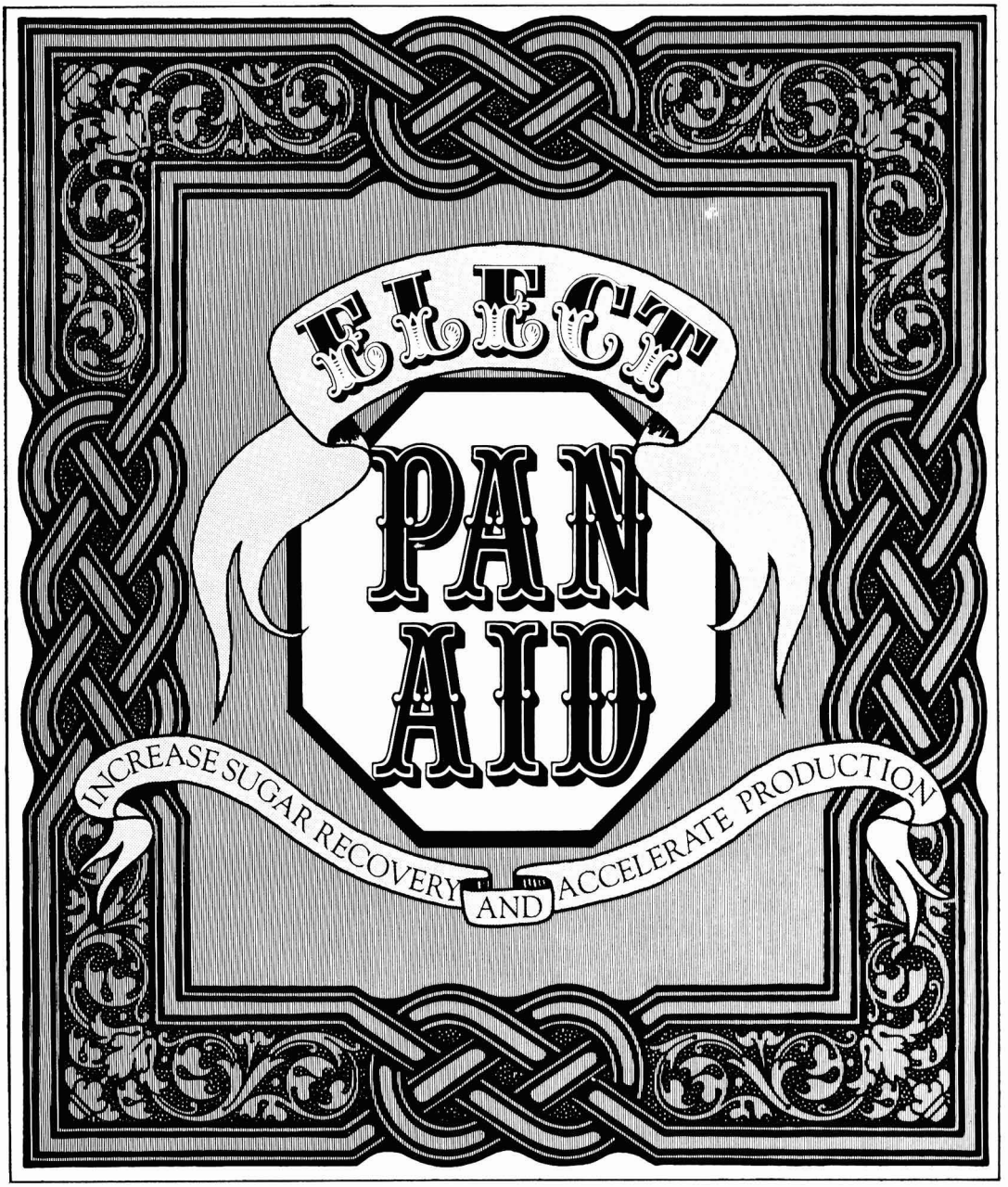
At Western States we use an air actuated discharger. It's square shaft and spring mounted metal tip provide stability, high productivity and long screen life. Our braking is combined regenerative and mechanical with shortest time deceleration . . . water cooled drum . . . long lived brake lining. These are just a few of the design characteristics that are important to you.

It could be worth even more to you to write, now, to Mr. A. H. Stuhlreyer, Director of Sales, for complete details on Western States centrifugals.

ROBERTS STEVENS

THE WESTERN STATES MACHINE COMPANY

Hamilt· · Ohi· · S A



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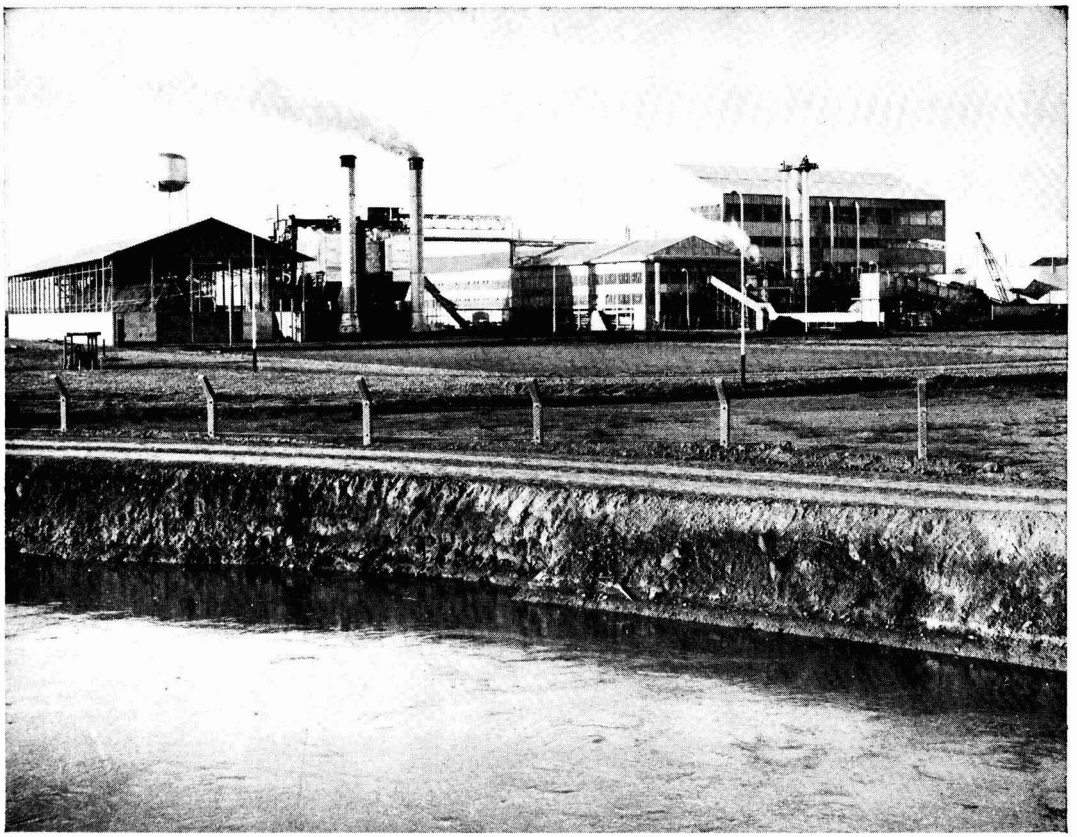

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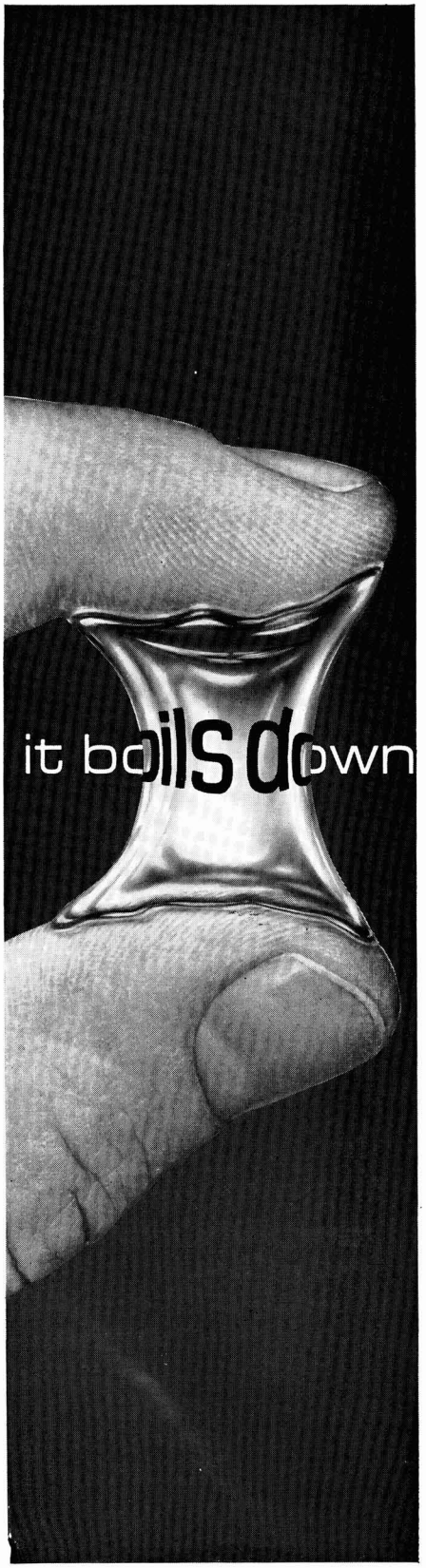

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Computers are basic tools in space exploration, as they are, too, in the design of modern sugar machinery. Our R & D Centre uses them for :

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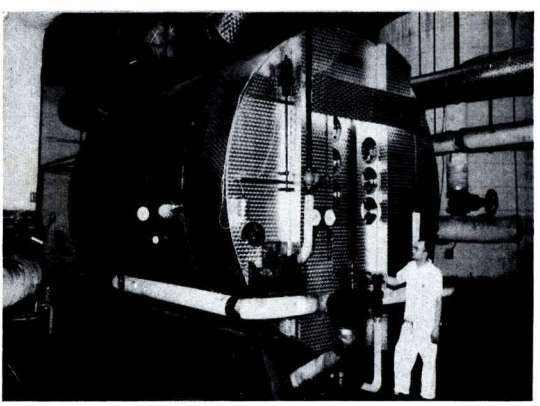
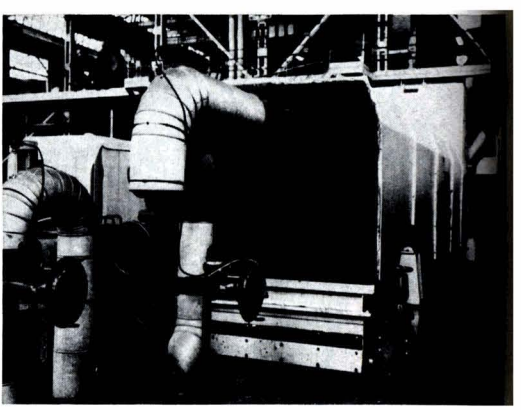
— Improving conventional plant
— Creating equipment of ever-increasing efficiency that will fit easily and coherently into the classic pattern of sugar manufacture.

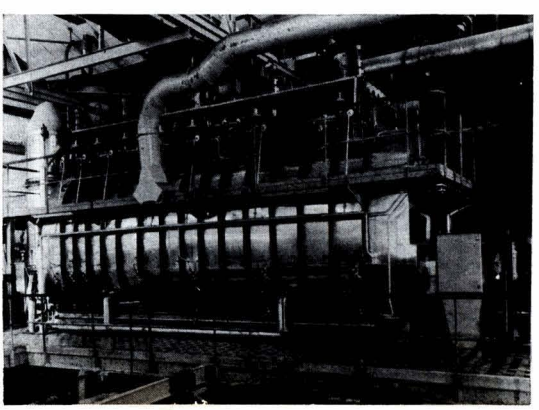
The following list of patented equipment, devised for you by our R & D Centre and service-proven over several years, bears the hallmark of FIVES LILLE - CAIL's technological leadership and its standing as a supplier of the world's sugar industry for over a century.



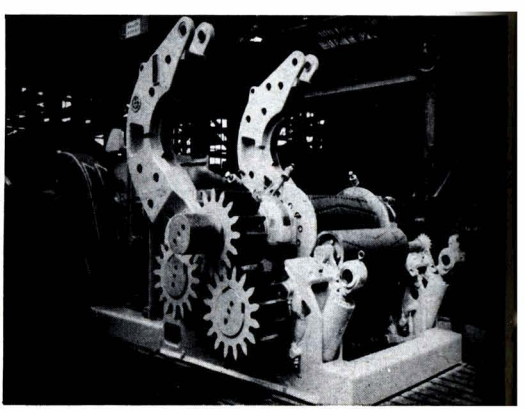
Horizontal vacuum pan with plate type heating element



Prescalder

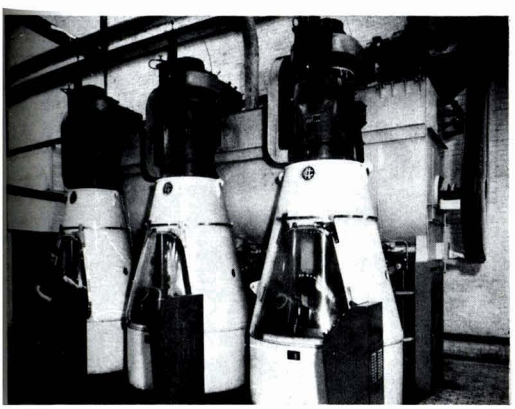


Continuous vacuum pan

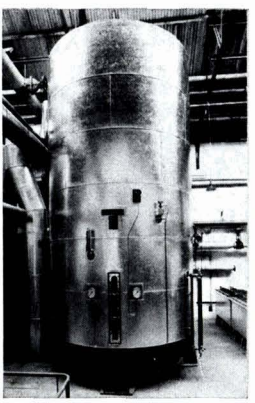


Self-setting cane mills (top housing members raised)

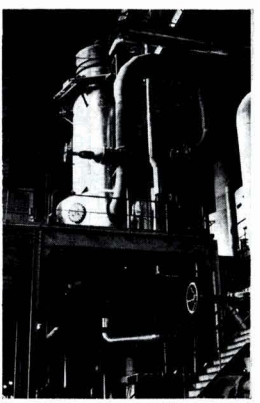
Photo USIS



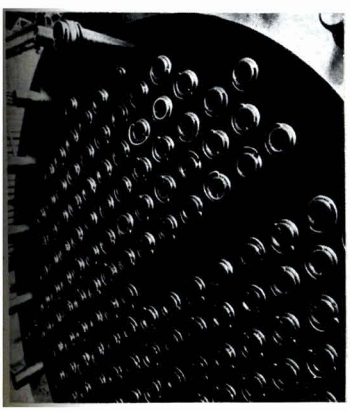
Fully automatic « Compact » centrifugals



Annular space overflow evaporator



Falling film evaporator



Coaxial juice heater (upper tube sheet)

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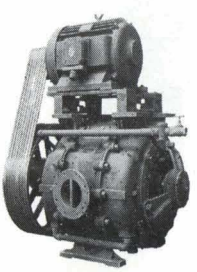

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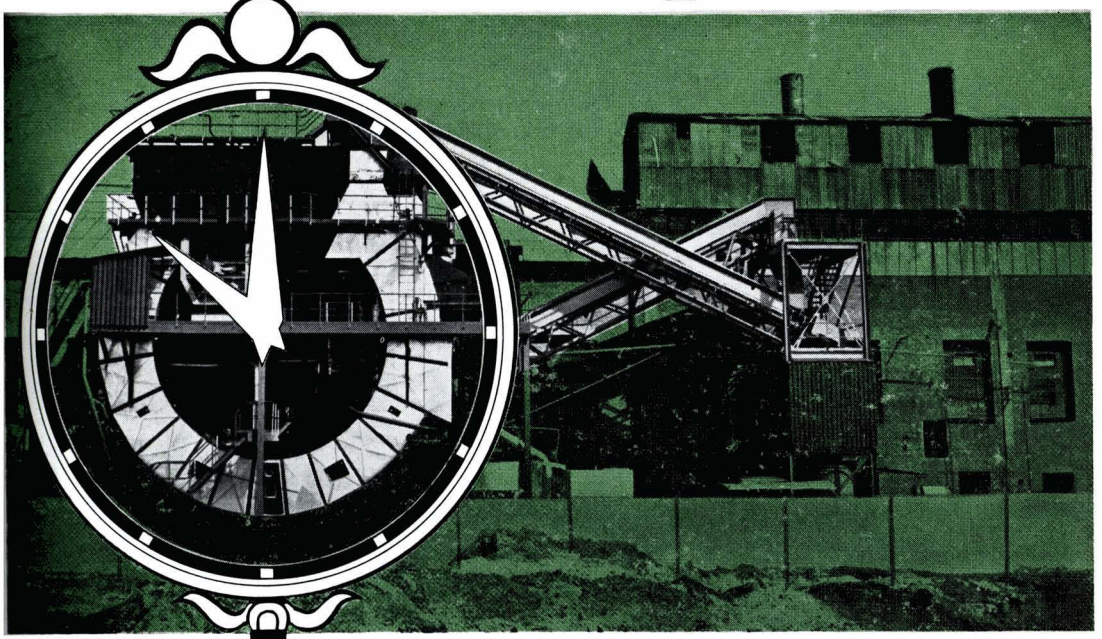
At last... true cane diffusion is here



and it works like a clock.

With its complete continuous counter current maceration and its almost incredible mechanical simplicity.

drive?	*2 rollers, 1 hydraulic jack*
construction?	*1 fixed circular hollow tube*
	1 rotating ring
feeding?	*by gravity*
discharge of the bagasse?	*by gravity*
circulation of the juices?	*by gravity*
power?	*about 30 HP*
wear and tear?	*insignificant*
maintenance?	*negligible*
ground space?	*16' x 26'*

For documentation on the "SATURNE" write to:

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Telex: 29.017 (SUCATLAN-PARIS)

Cable address: SUCATLAN-PARIS

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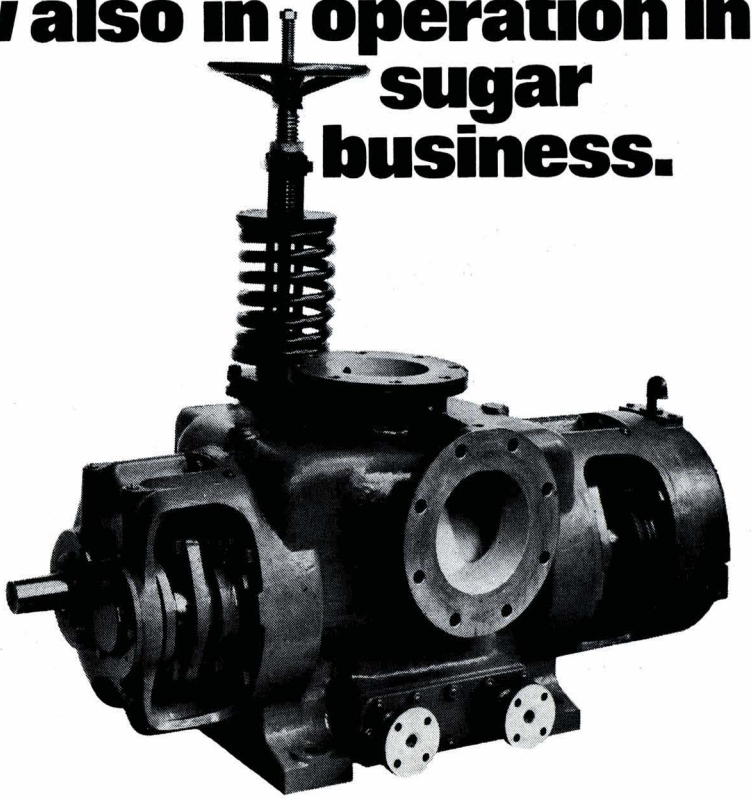
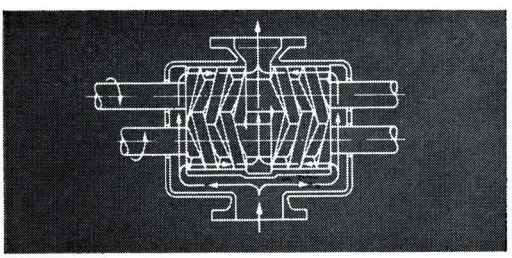
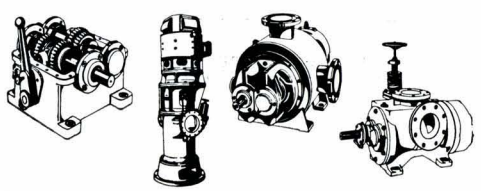
Houttuin screw pumps now also in operation in sugar business.





The two screws that provide the drive for Houttuin positive rotary displacement pumps, intermesh smoothly without metal to metal contact.

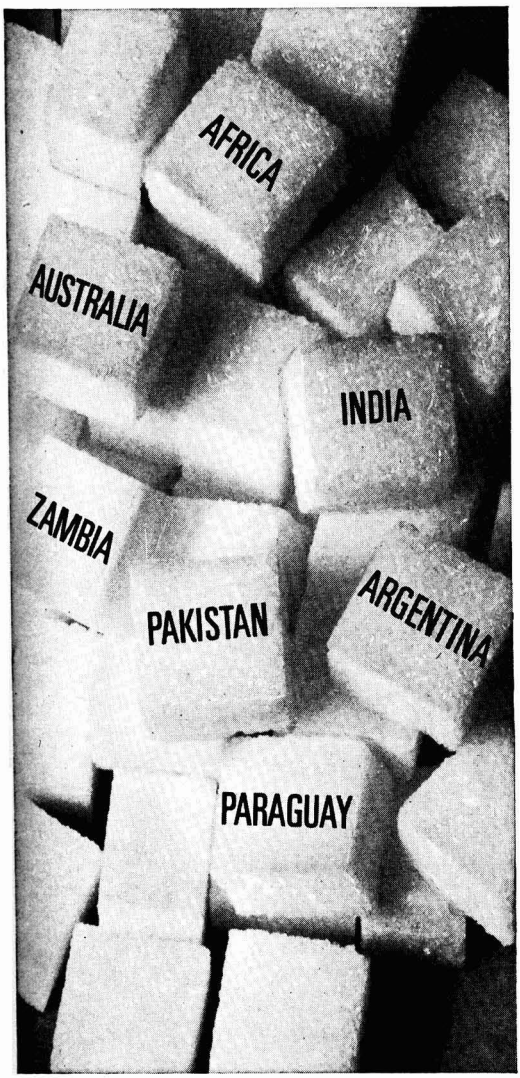
Features:
Selfpriming even under the most unfavourable conditions. Can handle all kind of liquids, including heavy juice, run offs, melts, molasses. Extremely suitable for pumping thin liquids to settling stations and filter presses because of the virtually pulseless flow. Versatile and suitable for all temperatures and capacities encountered in the sugar industry. All liquid contact points can be made from materials carefully selected to suit the liquid you want to pump. Wear resistant even on saturated juices (sulphitation, carbonatation, etc.).
Like to know more? Send for our comprehensive catalogue.



HM houttuin pompen

Sophialaan 4, Utrecht, Holland, tel. 441644, telex 47280

Sweet success for Brotherhood steam turbines

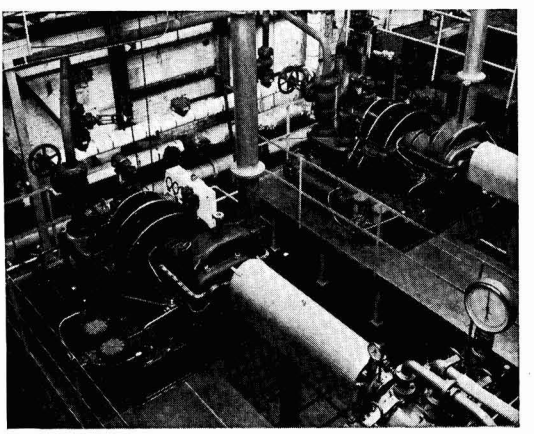


When the big names in sugar mill plant specify Brotherhood turbines, we count it as success. Not that it is unfamiliar, because we have been making turbines for over 60 years, but success is no less sweet.

Throughout the sugar producing world Brotherhood turbines are at work. The illustration shows part of a recent contract for horizontal, multi-stage steam turbines developing 2,500 kW on test prior to despatch to the Caribbean.

Brotherhood build single-stage and multi-stage turbines for mill, cane knife and generator drives, with controlled or uncontrolled pass out to process.

Detailed brochure SMT66 tells you all about Brotherhood turbines. Send for your copy today.



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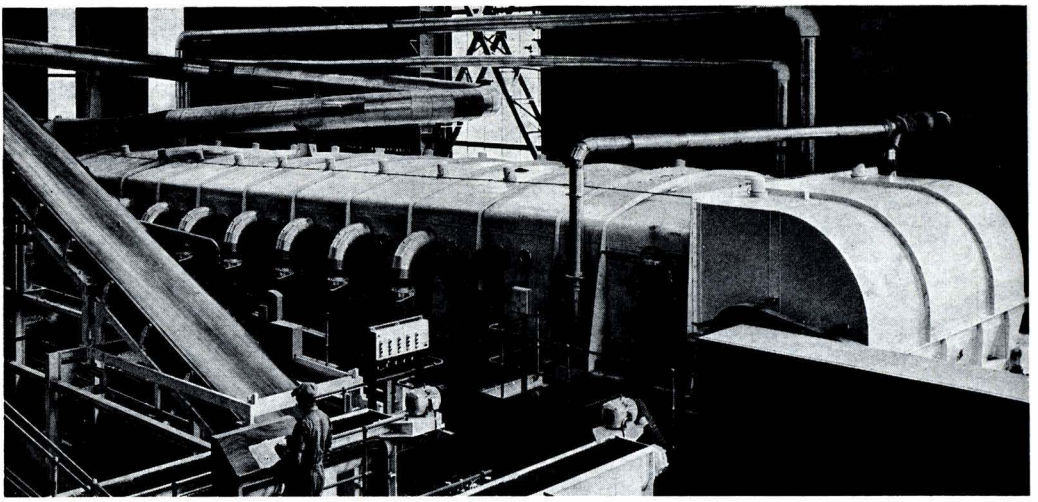

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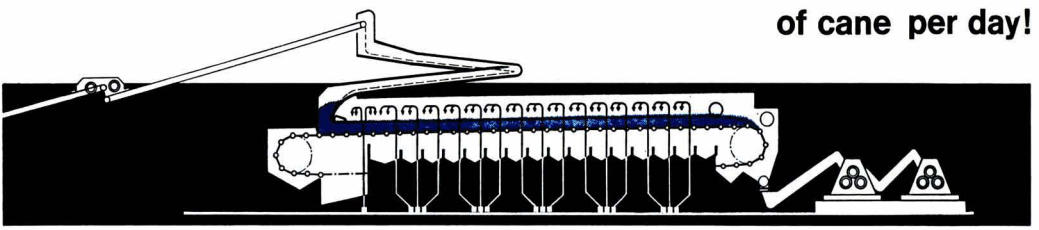
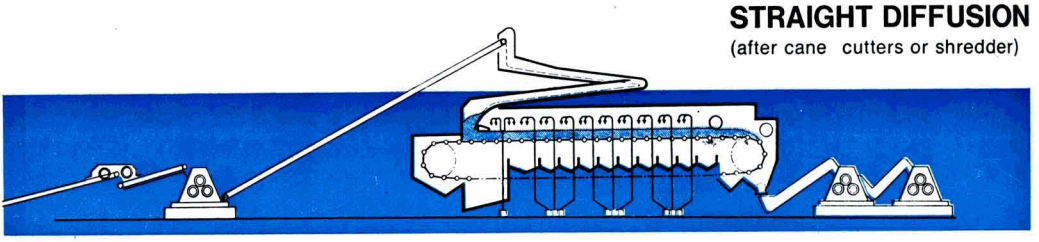


STRAIGHT DIFFUSION
(after cane cutters or shredder)



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International Sugar Journal

May 1971

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Contrôle de l'évaporation. J. H. DITMAR JANSSE. *p.* 131

On décrit une méthode simple de contrôle appliquée à un évaporateur à quadruple effet aux Indes Occidentales Britanniques.

* * *

Quelques nouveaux développements en génie de contrôle. 1re partie. R. J. BASS et M. J. JOBLING. *p.* 132–135

On donne dés details sur des expériences effectuées au cours de deux campagnes à la sucrerie de betteraves de Bury St. Edmunds de la British Sugar Corporation Ltd. en vue d'examiner les problèmes liés au contrôle de la vitesse de presses à pulpes horizontales.

* * *

Les acides lactique et volatiles en sucrerie de betteraves. 1re partie. Les acides lactique et volatiles dans les mélasses. M. KIELY et P. O'DRISCEOIL. *p.* 135–139

On décrit une méthode de détermination des acides lactique et volatiles dans les mélasses de betteraves, comprenant la précipitation du sucre des mélasses par le méthanol suivie de la méthylation de la solution résultante et la chromatographie en phase gazeuse avec un détecteur à ionisation de flamme. Les résultats obtenus sur des mélasses de deux campagnes menées dans les quatre sucreries irlandaises sont repris dans un tableau.

* * *

Amélioration des performances de colonnes de noir animal par l'utilisation d'un flux de liqueur recyclée. B. SILBERSTEIN. *p.* 140–142

On a évalué sur une colonne test de laboratoire les avantages liés à l'emploi d'un flux de liqueur recyclée pour la décoloration de liqueur de raffinerie par le noir animal. Ce flux, constitué d'une fraction de liqueur insuffisamment décolorée obtenue après passage sur une première colonne après la fraction de produit acceptable, est dirigé sur une seconde colonne avant de démarrer avec l'alimentation normale. On a déduit une relation quantitative entre l'amélioration de la performance de la colonne et la proportion de liqueur recyclée. On peut obtenir ainsi une réduction considérable de la consommation de noir tout en traitant la même quantité de liqueur dans la colonne.

Verdampferregelung. J. H. DITMAR JANSSE. *S.* 131

Es wird eine einfache Methode beschrieben, die zur Regelung einer vierstufigen Verdampfstation in Britisch Westindien angewendet wird.

* * *

Einige neue Entwicklungen in der Regeltechnik. Teil I. R. J. BASS und M. J. JOBLING. *S.* 132–135

Es werden Einzelheiten über Versuche mitgeteilt, die über zwei Kampagnen in der Zuckerfabrik Bury St. Edmunds der British Sugar Corporation Ltd. zum Problem der Drehzahlregelung bei horizontalen Schnitzelpressen durchgeführt wurden.

* * *

Milchsäure und flüchtige Säuren in der Rübenzuckerfabrikation. Teil I. Milchsäure und flüchtige Säuren in Melasse. M. KIELY und P. O'DRISCEOIL. *S.* 135–139

Es wird eine Methode zur Bestimmung von Milchsäure und flüchtigen Säuren in Rübenmelassen beschrieben. Bei dieser Methode wird der Zucker aus der Melasse mit Methylalkohol ausgefällt. Die resultierende Lösung wird dann der Methylierung unterworfen und gaschromatographisch mittels eines Flammenionisationsdetektors untersucht. Die Ergebnisse von zwei Kampagnen für Melassen aus den vier irischen Zuckerfabriken sind in Tabellen zusammengestellt.

* * *

Verbesserung der Leistungsfähigkeit eines Knochenkohlfilters durch Rücknahme eines Kläreteilstroms. B. SILBERSTEIN. *S.* 140–142

Die Vorteile der Rücknahme eines Kläreteilstroms bei der Entfärbung von Raffinadekläre mittels Knochenkohle wurden in einem Laboratoriums-Versuchsfilter zahlenmässig erfasst. Dieser Teilstrom von unvollständig entfärbter Kläre, der von ersten Filter nach dem einwandfrei entfärbten Produkt anfiel, wurde über ein zweites Filter geschickt, bevor der normale Zyklus begann. Ein quantitativer Zusammenhang zwischen der Verbesserung der Filterleistung und dem Anteil der zurückgenommenen Kläre wurde festgestellt. Es wurde gefunden, dass es möglich ist, den Kohleverbrauch bei Behandlung der gleichen Kläremenge im Filter beträchtlich zu reduzieren.

Control del evaporador. J. H. DITMAR JANSSE. *Pág.* 131

Un método sencillo de control se describe que se aplica a un evaporador de cuadruple-efecto en las Antillas Británicas.

* * *

Algunas novedades en la ingeñiería de control. Parte I. R. J. BASS y M. J. JOBLING. *Pág.* 132–135

Se presentan detalles de experimentos hecho en dos campañas a la azucarera remolachera en Bury St. Edmunds de la British Sugar Corporation Ltd. para investigar problemas en el control de prensas horizontales de pulpa de remolacha.

* * *

Acidos láctico y volátiles en la fabricación de azúcar de remolacha. Parte I. Acidos láctico y volátiles en melaza. M. KIELY y P. O'DRISCEOIL. *Pág.* 135–139

Se describe un método para determinar ácidos láctoci y volátiles en melaza de remolacha, que envolve precipitación del azúcar de la melaza con métanol y pues metilación de la producida solución metanólica, y análisis por cromatografía en fase gaseosa con el ayudo de un detector a ionización en llama. Los resultados se presentan en forma tabular que cubren melaza de dos campañas de las cuatro azucareras irlandesas.

* * *

Mejoramientos del funcionamiento de columnas de carbón animal por uso de un flujo de licor reciclado. B. SILBERSTEIN. *Pág.* 140–142

Las ventajas del uso de un flujo de licor reciclado en las descolorización de licor en una refinería se evaluan en una columna experimental del laboratorio. Este flujo, una fracción de licor inadecuadamente descolorizado obtenido de una primera columna despues de la fracción de producto aceptable, se suministra a una segunda columna antés del comienzo de alimentación normal. Se derive una relación cuantitativa entre mejoramiento del funcionamiento de la columna y la proporción de licor reciclado. Fué posible reducir notablemente el consumo de carbón animal mientras que se trata la misma cantidad de licor.

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Notes & Comments

World sugar production, 1970/71.

Revised estimates of world sugar production during the 1970/71 crop year were published by F. O. Licht in February[1]. The total is now put at 72,977,109 tons against the earlier estimate of 73,254,749 tons and the revised figure for 1969/70 of 73,829,693 tons. World beet sugar production is now put at 30,430,422 tons, or about 270,000 tons more than in the previous season, while cane sugar production, at 42,546,687 tons, is about 1·1 million tons down on the previous season's output and 435,000 tons less than the earlier estimate. This is, of course, a consequence of the greatly reduced output expected in Cuba this year. Other changes include a reduction of the Puerto Rican estimate to around the previous season's figure, while the Hawaiian estimate was also reduced. The reduction from the previous forecast of production in the Dominican Republic of 1,180,000 tons might have been expected, but the revised figure of 1,000,000 tons is somewhat surprising, especially in view of the recent official announcement from that country putting the authorized crop at a much higher level.

Estimates of production in Colombia, India, Pakistan and Australia have also been reduced by sizable amounts, while figures for the Philippines and Taiwan have been raised. The estimates are reproduced elsewhere in this issue.

* * *

Britain and the EEC.

Commonwealth sugar featured as a main topic at the meeting of the EEC Foreign Ministers in discussions aimed at agreeing a Community position before meeting the UK negotiator, Mr. GEOFFREY RIPPON. No agreement was reached, however, and the topic is being held over to the next meetings in May.

While all the Six agree that the Commonwealth Sugar Agreement should run to its normal conclusion at the end of 1974, it is the situation after then which causes the difficulty. The Dutch are reported[2] to have taken the most favourable view, viz. that the Commonwealth countries concerned, except Australia which is being dropped because it is not a developing country, should have a place comparable to the one they have now as a supplier to Britain. The other members of the EEC are less specific and speak only of giving the Commonwealth suppliers a reasonable place or comparable advantages.

The main difference between France and the rest is that the latter want to agree on a general formula and leave the details until later when Britain is inside the EEC, while France wants to work out the details now. She wants to ensure that sugar imports from the Commonwealth are gradually reduced to 500,000 tons after 1974 (compared with the 1,373,000 tons for which Britain has asked). The French have said that this reduction should be compensated for by an increase in prices but, as Signor MALFATTI, President of the EEC Commission, has pointed out, sugar exports are not just a question of prices for the countries concerned but also play an important rôle in employment.

The discarding of Australia as a supplier to the UK is dangerous in itself since she would need to find alternative markets for the 340,000 tons CSA quota. While the International Sugar Agreement provides for renegotiation of quotas for exporters losing their markets under preferential agreement (such as the CSA), other ISA exporters would not take kindly to expansion of the Australian quota by so much, especially as the UK would not present an enlarged market for "world" sugar because the principle of the Treaty of Rome is to encourage self-sufficiency in Europe. Thus sugar production in Britain and other European countries, especially France, would expand to fill Britain's needs. Thus the stability of the ISA would be put at hazard and also the economies of many developing countries for which sugar is important.

Loss of a further 873,000 tons of sales to the UK by Commonwealth suppliers would be very likely to bring about the collapse of the International Agreement, with disastrous effect on developing sugar producers.

[1] *International Sugar Rpt.*, 1971, **103**, (6), 1–5.
[2] *The Times*, 15th March 1971.

Lord CAMPBELL OF ESKAN, President of the West India Committee, discussing the negotiations, writes[1] of the CSA that it has underpinned the economies and societies of a number of developing countries, has given to the British housewife assured supplies of sugar at lower prices than those paid by any other major developed country, and has been reconciled with the development of a British beet sugar industry which is both agriculturally and economically highly efficient. If Britain were to join the EEC without special provisions, quantifying adequate access for Commonwealth sugar, there will be nothing to inhibit cane sugar being squeezed out by beet sugar. The British refining industry would be diminished, and the people who would pay the price of Britain's entry would be the Commonwealth primary producers and the British housewife.

* * *

UK sugar surcharge.

In view of the fall in the world price of raw sugar on the London Market, the UK Minister of Agriculture, Fisheries and Food made Orders under the Sugar Act, 1956, whereby the Sugar Board surcharge was raised from £2 to £6 per ton from the 17th February. Subsequently further Orders were made whereby the surcharge was again raised from £6 to £8 per ton from the 26th March 1971.

* * *

International Sugar Organization.

The sixth session of the International Sugar Council finished on the 26th March 1971.

During the session the Council adopted a revised estimate of the net import requirements of the free market for 1971 to a total of 8,952,000 tons (against an estimate of 8,864,000 tons made in November 1970).

The Council, in the light of firm assurances, given respectively by Thailand and the Dominican Republic, that every endeavour will be made by those countries to ensure that the situation which had caused them to apply for relief does not recur, agreed to grant temporary relief of 35,000 tons to Thailand and 60,000 tons to the Dominican Republic over and above their current quotas in effect for this year; any additional entitlements which each of those countries may receive under any of the provisions of the Agreement would count against their temporary relief.

In the light of a firm undertaking by Hungary not to export or re-export any sugar to any destination in 1971–1973 inclusive, it was agreed that all exports by Cuba to Hungary during those years and provided that Hungary maintained its undertaking would be outside Cuba's export quota to the free market. As a result, Hungary will have a shortfall in respect of its entire quota in effect for each of those years; Hungary's present quota in effect of 56,973 tons for 1971 has since been re-distributed, as tabulated below.

Their shares of the re-distribution of the Polish shortfall[2] having not been accepted by Taiwan and the West Indies, these amounts were also re-distributed. Again the provisions of Article 47(5)(b) applied, so that developing countries received the initial 20% of the reallocations, the remainder being shared by all exporters.

	Quotas in effect on 20th March	*Total re-distribution*	*Quotas in effect after re-distribution*
Argentina	61,776	752	62,528
Australia	1,228,820	10,938	1,239,758
Bolivia	10,232	136	10,368
Brazil	561,598	6,832	568,430
British Honduras	24,710	301	25,011
Colombia	184,205	2,241	186,446
Congo (Brazzaville)	46,051	561	46,612
Cuba	2,414,875	29,379	2,444,254
Czechoslovakia	301,619	2,685	304,304
Denmark	45,801	408	46,209
Dominican Republic	225,914*	2,541	285,914*†
Fiji	174,096	2,118	176,214
Guatemala	11,255	150	11,405
Honduras	11,255	150	11,405
Hungary	56,973	(—56,973)	0
India	280,799	3,416	284,215
Malagasy Republic	46,051	561	46,612
Mauritius	196,560	2,391	198,951
Mexico	107,827	1,311	109,138
Peru	112,320	1,366	113,686
Poland	257,000	—	257,000
South Africa	698,193	6,214	704,407
Swaziland	61,776	752	62,528
Taiwan	707,615	(—14,615)	693,000
Thailand	50,435*	492	85,435*†
Uganda	43,804	533	44,337
West Indies	224,640	(—4,640)	220,000
TOTAL	8,146,200*‡	76,228	8,238,167*†‡

* Including hardship allocations: Dominican Republic 17,000 tons; Thailand 10,000 tons.

† Including temporary relief as follows (original relief less share in re-distribution):
(a) Dominican Republic = 60,000 — 2,541 = 57,459
(b) Thailand = 35,000 — 492 = 34,508

‡ The Philippines have an export entitlement of 60,000 tons under Article 41(2) which is not included in the total of quotas in effect.

The Council also made arrangements for the conduct of a review of the operation of the Agreement to be carried out before the end of this year.

Bahamas sugar factory closure[3].—Inadequate technology has been cited as the cause of the closure of Owens-Illinois sugar operations on Great Abaco, Bahamas, established barely two years ago. It has not been possible to achieve a sugar yield sufficient for profitable operation and yield improvements could not be achieved soon enough to justify further losses and additional investment. The sugar mill was completed late in 1968 and was designed to produce 50,000 tons of raw sugar from its 23,000-acre plantation. The 1971 crop will not be harvested although it will be maintained while a buyer is being sought to continue the sugar operation. The Company's US quota of 10,000 tons will be met from sugar stocks and Bacardi's rum interests will be unaffected as the latter's supply of raw materials has always been imported.

[1] *W. Indies Chronicle*, 1971, **86**, 101–103.
[2] *I.S.J.*, 1971, **73**, 97.
[3] *W. Indies Chronicle*, 1971, **86**, 15.

Evaporator control

By J. H. DITMAR JANSSE

(Mardon Engineering N.V., Brummen Holland)

THE control system described below was put into operation about ten years ago on the quadruple effect evaporator of a raw sugar factory in the West Indies and is somewhat similar to that described by Mr. MILOVAN BOSNJAK[1].

The evaporator of the plant had just been equipped with an electronic control system consisting of a Brix control using the tube loop system on the first vessel, actuating the main steam valve. The same method of Brix control was installed on the last vessel, the outflow being controlled by means of a butterfly valve on the pressure side of the syrup pump together with a return conduit to the vessel. Further, each vessel was equipped with an independent level control with Masoneilan level controllers, of the buoyancy-torque tube type, regulating the inflow to each vessel by means of air-operated butterfly valves. The condenser had no vacuum control at all, the water valve being left fully open.

As may be imagined, the system did not work at all smoothly and, as mentioned by Mr. BOSNJAK, the outlet Brix setting had to be adjusted constantly according to the grinding rate. In actual fact, we had so much trouble with the system that we had to put back an operator on the station until another solution had been found.

No extra funds were available to purchase additional equipment so we had to make do with the available controllers and valves. By a stroke of luck, a spare level controller and valve were in stock, which was most fortunate as they were needed for the system which we devised. This system is shown in Fig. 1.

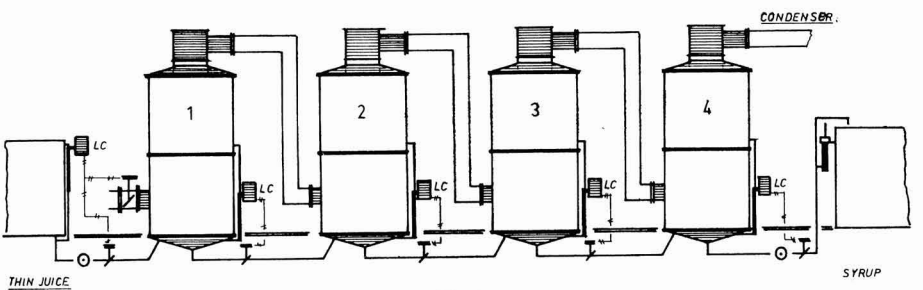

Fig. 1

Level control in the thin juice tank was maintained within a 10-inch range by regulating the flow of juice to the first vessel. The air signal from the controller was passed to the steam valve as well as to the juice valve. The pressure in the main steam line was kept constant with a make-up valve, using an existing system. Each vessel was provided with a level controller which regulated the outflow from the vessel by means of a butterfly valve.

Cooling water supply to the condenser was normally fully open, but when necessary it was regulated by the pan boiler if the grinding rate had to be reduced for any reason. At the inlet of the syrup tanks a Brix spindle was placed in a continuously overflowing vessel to provide a visual check on the Brix.

The travel of the steam valve was set at three quarters of its full range, to correspond with full travel of the juice valve; this setting was determined by experience. The setting of the level controllers in each vessel was based on the need to allow for the effect of the Brix of the juice in each vessel on the float of the level controller. Working from the calculated average Brix in each vessel for a maximum variation of 3 points in thin juice Brix, a standard setting was chosen with the level fixed at $\frac{1}{3}$ of the height of the evaporator tubes and the outflow valve regulated between fully open and fully closed by a 2-inch difference in level.

The system was installed during a regular week-end close-down for cleaning of the evaporator, which normally took 12 hours. After it was put into operation we had to make some minor adjustments in the settings but from then on the system worked perfectly, without the need for an operator. The only maintenance needed by the system was the regular check-up on the controllers and, once every two months, cleaning of the floats to remove the occasional small amount of scale. Later, a water valve was installed at the thin juice tank as a precaution against extreme low levels.

Through some changes made in the boiling scheme the sugar output of the plant had been increased from an average of 93 tons/day to 128 tons/day, and using manual control the average syrup Brix reported was 62°. With the new automatic control system in operation the syrup Brix rose to an average of 64° for the weekly run, starting the week with a Brix of slightly over 65° and dropping to about 63° as the evaporator became scaled-up.

It is the writer's experience that often too intricate control systems are installed where the control problems can be solved by such simple methods as that described here. In countries where no specialist engineers are available, or where factories are situated in remote areas, care should be taken that the most simple control systems and instruments are used as, otherwise, automatic control can become a nuisance instead of a benefit.

[1] *I.S.J.*, 1970, **72**, 235–236.

Some new developments in control engineering

By R. J. BASS and M. J. JOBLING

Paper presented to the 20th Tech. Conf., British Sugar Corporation Ltd., 1970

PART I

Introduction

THE last decade has seen the development of an enormous number of control engineering devices. This development has taken place in every field of the subject from transistors, integrated circuits and computers on the electronic side to actuators and motors in the power field and logic circuits in the pneumatic field. During this period a great deal has been learned about the reliability of the equipment and, as a consequence, there has been a significant change in the availability and the maintenance required to keep these devices working.

Once the objects of a control scheme have been clearly defined and the economics of the scheme proved, there is no lack of good equipment to implement the ideas. However, the definition of the requirements is not always simple. The major problem involved is often the measurement of the parameter to be controlled. Each industry has its own peculiar measurement problems and the sugar industry is no exception. When a control system fails it is often the measurement or the measurement transducer at fault. It is undoubtedly this field where major efforts are now required if new control developments are to be continued.

This paper deals with several attempts to use new devices and new measurements to overcome old problems. Control of a pulp press station and a beet washer station are examined as integrated projects and a novel method of measuring the level in a beet hopper is explained.

PULP PRESS STATION CONTROL

For a number of years the effective speed control of horizontal pulp presses has been difficult to achieve. Several systems have been installed and all of them have had their failings.

During the past two campaigns a series of experiments have been carried out at the Bury St. Edmunds factory to investigate some of the problems.

The installation at this factory consists of four fixed-speed presses and three variable-speed presses (Fig. 1). The variable-speed units are driven via thyristor controllers by D.C. motors, which enable the final shaft speeds of the presses to be varied from 1 to 5 r.p.m. Each press may be switched from automatic to manual control and set at any fixed speed within this range if required.

Single Press Unit

The development of this control system is centred around the search for a reliable and cheap control signal; however, before such a signal could be used it was necessary to investigate the characteristics of a single press and successfully control its speed.

The first set of experiments were designed to investigate the characteristics of the press. The capacity of the press at various throughput speeds was tested. It was not possible to measure this factor directly as there was no way to collect the pulp from an individual press. However, it was possible to measure the retention time of a tracker passing through the press. This was done for a number of press speeds and the results are illustrated in Fig. 2. This graph shows that the throughput is proportional to speed and that no measureable slippage occurs between the press scrolls and the pulp.

The variation in pressed pulp dry substance was also measured with respect to press speed. However, this investigation was not conclusive, as many factors affect this parameter besides that of speed; not least are those of wet pulp pH and temperature, the type of diffusion plant being used (e.g. R.T. or tower

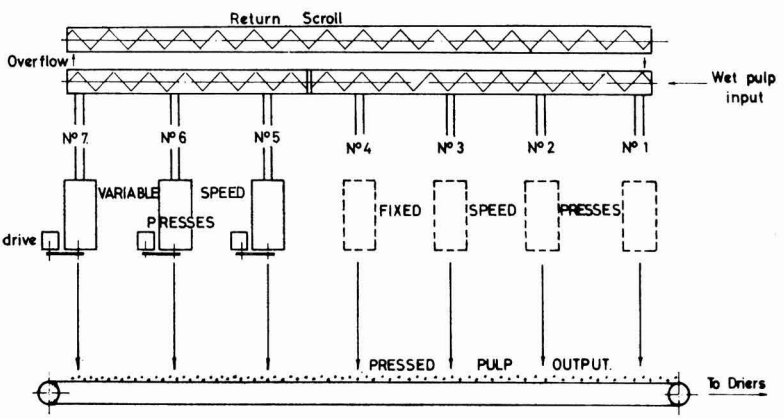

Fig. 1. Pulp press station general arrangement

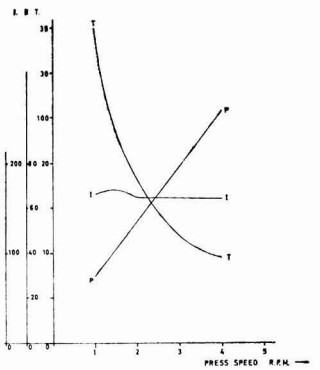

Fig. 2. Steady state test results. T = pulp residence time, min; P = power to press, hp; I = Current, amp, proportional to torque.

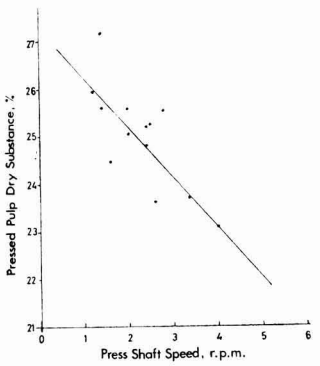

Fig. 3. Bury St. Edmunds pulp press speed /dry substance experiment

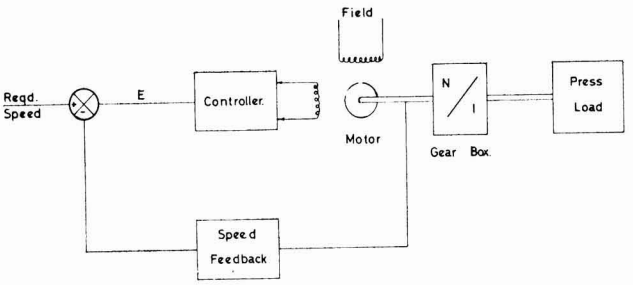

Fig. 4A. Block diagram of press control loop

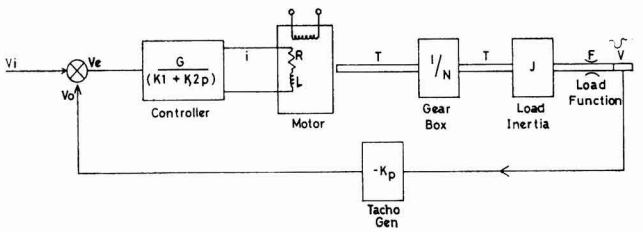

Fig. 4B. Press speed control analysis

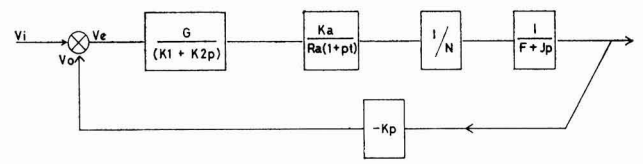

Fig. 4C. Press speed control analysis

diffuser) and the height of the wet pulp chute into the press which applies pressure to the pulp entering the press.

The results of these tests all show the same general characteristics illustrated in Fig. 3.

The presses were driven by D.C. motors with a top speed of 1500 r.p.m. and a speed range of 6:1. The drives were designed as constant-torque drives with an output of 90 hp at top speed. A torque of up to 2·5 times full load torque could be developed if required during the starting period.

The control of these units is achieved using the feedback control system illustrated in Fig. 4A. From the following analysis it can be seen that the system can be unstable in the dynamic state (Figs. 4B and 4C).

Let the Transfer Function of the Controller be F_1

$$= \frac{G}{K_1 + K_2 P},$$

Transfer Function of the Motor be F_2

$$= \frac{Ka}{Ra\,(1 + pt)},$$

Transfer Function of the Gearbox be $F_3 = \frac{1}{N}$,

(where N = gear box reduction),

Transfer Function of the Load be $F_4 = \frac{1}{(F + Jp)}$

(where J = Inertia of Load and F = Friction of Load), and the

Transfer Function of Tachogenerator be $F = -Kp$.

Note: p = Laplace Transform Operator

The loop equation represented in Fig. 4C can be reduced as follows:

$$\frac{Vo}{Ve} = F_1, F_2, F_3, F_4, F_5 = F_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where Vo = output voltage from the tachogenerator and Ve = Error Voltage.

$$\frac{Vo}{Ve} = \frac{V_1}{Vo} = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where G = amplifier gain, K_1 and K_2 amplifier time constants, Ka motor constant, Ra = motor armature resistance, t = motor time constant, and Vi = desired value of control system input.

The closed loop transfer function is given by

$$\frac{Vo}{V_1} = \frac{Fo}{1 + Fo} \quad \ldots\ldots(3)$$

By substitution in the open loop equation (1)

$$\frac{Vo}{V_1} = \frac{G\,KaKp\,I/N}{(K_1 + K_2P)\,(Ra)\,(1 + pt)\,(F + Jp)} \quad \ldots\ldots(4)$$

This transfer function may now be used to analyse the response of the system to demanded input changes. By taking the inverse transform of this function it is possible to predict that it can be made stable; however, as was experienced on plant, the system can also be made to approach the unstable conditions with the wrong selection of parameters G, K_1 and K_2.

The load response of the press was assumed to follow the normal relationship for a Load-Friction system and it was not proved experimentally. The speed loop control proved adequate in practice both for stability and speed of response.

Multiple Press Control

From the results of the tests considered above it became obvious that the objective of the press station control system would be to run the presses at the slowest possible speed consistent with the plant throughput. The first attempts to control this speed were made using only one variable-speed press driven by a hydraulic coupling. The signal to control the coupling speed was obtained either from a level monitoring device in the chute down to the final press or by the amount of pulp being returned after the press station (Fig. 1). This system suffered from the limitation of the fluid coupling which could only vary the press speed by a ratio of 2:1 and resulted in a press output change so small that it could only accommodate the very smallest of factory throughput alterations.

Feedback system

At Bury St. Edmunds factory three variable-speed D.C. drives were installed. The first attempts to control these drives were centred around the system described in Fig. 5.

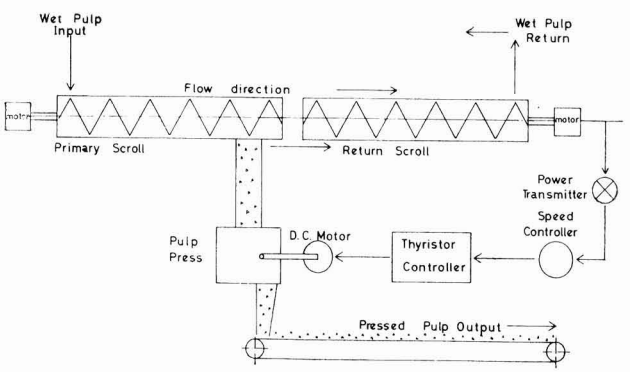

Fig. 5. Feedback loop control

The control is completely based upon the feedback principle. The amount of wet pulp which failed to enter the presses is measured and returned to the input of this station. The object of the control system was to adjust the speed of the presses so that the amount of returned wet pulp remained approximately constant. It soon became apparent that the long time constants involved in the system made the overall speed control of the presses unpractical. The changes in throughput from the diffusion plant were often of a shorter duration than the time constants involved in the pulp press station and the control parameters could not be adjusted to accommodate them.

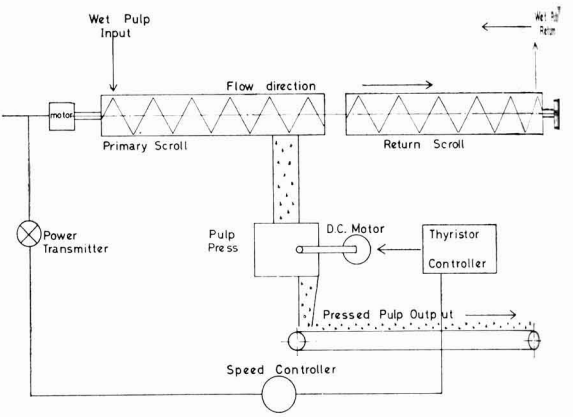

Fig. 6. Feed forward loop control

Feed forward system

The next arrangement investigated was the feed forward system illustrated in Fig. 6. The amount of pulp approaching the three variable speed pulp presses was estimated by measuring the power in the primary conveying scroll. The signal was then used to control the speed of the presses in an "open loop" fashion in order to meet the variation in wet pulp flow. It was assumed for the operation of this system that any error would be accommodated by the return of the wet pulp to the input.

Unfortunately, this arrangement also had severe limitations. The pulp throughput/primary scroll power signal is not consistent, changing for several reasons. This causes the speed of the presses to be incorrect which in turn causes a build-up of wet pulp returning in the secondary scroll. The control parameters on this system have to be set to respond relatively fast so as to follow the scroll signal and this often causes the pressed pulp output to change even more rapidly than the wet pulp flow rate into the station, a fact which can then introduce problems for the control of the following station (i.e. pulp driers).

Feed forward/feedback combination systems

Following the difficulties with the two conventional systems of control described above, it was decided to use a multi-loop system, viz. a combination of both

the feedback and feed forward signals. The final arrangement is shown in Fig. 7 where it can be seen that the press speed depends on an element of the signal proportional to both the wet pulp in the primary scroll and in the return scroll. The primary scroll signal sets the initial speed of the presses and the return scroll signal corrects for errors in this signal. The addition of this correction signal allows the system parameters to be set up with much lower loop gains and in consequence the change in speed of the presses is much slower. However the use of the return scroll correction signal allows the system to act fast enough to follow and correct for all the errors in the primary signal.

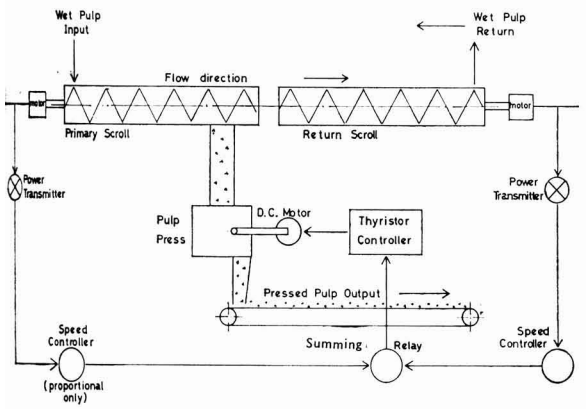

Fig. 7. Combination feed forward and feed back control

It soon become apparent that this multi-loop system was quite satisfactory for small wet pulp fluctuations but it had to be tested under large flow rate changes. Figs. 8 and 9 show the results of flow changes in excess of 20% and it can be seen that the press speed follows the combination signal well. In Fig. 8 the speed of responses was too fast and the small diffuser discharge fluctuations were causing trouble; however, when the response was reduced the long term changes were still detected and controlled while the short term transients were smoothed out.

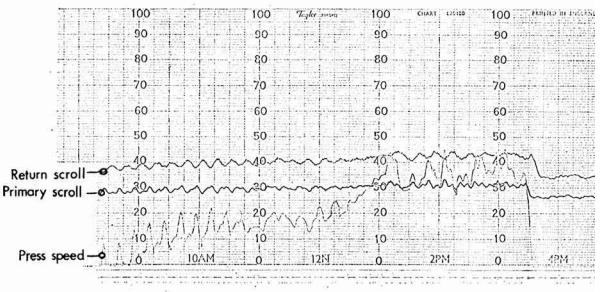

Fig. 8. Feed forward/feed back control loop (system response too fast)

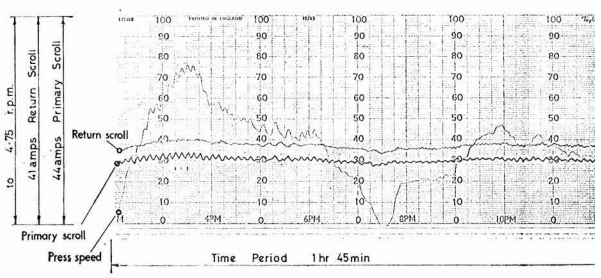

Fig. 9. Feed forward/feed back control loop response (actual recorded results during large load swings)

(To be continued)

Lactic and volatile acids in beet sugar manufacture

Part I. Lactic and volatile acids in molasses

By M. KIELY and P. O'DRISCEOIL

Comhlucht Siuicre Eireann Teo., Research & Development Department, Carlow, Ireland)

Introduction

THE determination of lactic and volatile acid levels in molasses, raw juice and sugar syrups has a significance in the sugar manufacturing industry and in microbiological processes in which molasses is used as a raw material. (Estimation of lactic and volatile acids in raw juice will be described in part II of this series.)

The determination of lactic acid in molasses and raw juice may be used[1] to estimate the sugar losses caused by thermophilic bacterial action in the diffusion process or at other stages where dilution and temperature are favourable to the growth and propagation of these bacteria, e.g. in pulp and press waters. Lactic acid may also be produced by alkaline degradation of invert.

Volatile[2] acids may result from bacterial action at low temperatures or by thermal decomposition of

[1] SHORE: *I.S.J.*, 1958, **60**, 24.
[2] OLDFIELD: *ibid.*, 1958, **60**, 24.

sucrose during processing. The presence of these carboxylic acids in molasses, particularly those of higher carbon number — butyric and valeric — are known[3] to have an inhibiting effect on microbiological processes, e.g. in the production of bakers' yeast.

Previous methods[1,4,5,6] concerning the estimation of lactic acid in molasses describe either a colorimetric or gas chromatographic technique, applied to an ion exchange eluate. OLDFIELD *et al.*[7] describe a procedure in which a dilute solution of molasses is acidified with periodic acid and injected on to a heated injection port, preceding a gas chromatographic column. The methods discussed in this paper were found to be quicker and more accurate than any of the other methods which had been tried in this laboratory. The analytical procedure is based on the fact that sugar is insoluble in methanol and can therefore be precipitated from the molasses. A sample of the resulting solution is then subjected to a methylation procedure and the lactic acid content determined on a gas chromatograph, using a flame ionization detector.

The quantities of acid were assessed by comparing the peak heights from the samples with those obtained from a standard acid solution.

EXPERIMENTAL

Reagents

Methanol A.R.
Sodium sulphate (anhydrous)
Acetyl chloride
Benzene
Phosphoric acid
Sodium bicarbonate
Sodium carbonate
Lithium lactate

Methods of analysis

(1) *Lactic acid*

12·5 g of molasses were homogenized at room temperature with 10 ml of 50/50 orthophosphoric acid, giving pH = 1. The mixture was heated under a reflux condenser for 1 hour. 70 ml of methanol were added, and sufficient anhydrous sodium sulphate was then added to the mixture to remove all the water present. The solution was filtered and made up to 100 ml with anhydrous methanol.

To 2 ml of the above solution in an ampoule, 2 ml of a methanolic HCl reagent (comprising 20:1:4 anhydrous methanol:acetyl chloride:benzene) were added and the ampoule heat-sealed. The mixture was heated in a water bath at 64°C for 2 hours.

To the cooled solution sufficient of a solid neutralizing mixture (prepared by thoroughly mixing sodium bicarbonate, sodium carbonate and anhydrous sodium sulphate in a 2:1:2 ratio) was added to neutralize the solution and the solution injected directly on to the column. The lactic acid was then determined by gas chromatography using a Varian Aerograph model 1520 instrument, fitted with a 10-ft single column.

The column was of $\frac{1}{8}$ in S.S. packed with 15% D.E.G.S. + 2% phosphoric acid on 80/100 firebrick. It was operated at a column temperature of 95°C, with an injector temperature of 235°C, and detector temperature of 200°C. The carrier gas was nitrogen at a flow rate of 50 ml/min. The detector was a flame ionization detector, and the sample size used was 0·5 µl.

Verification of method for lactic acid determination

Samples of the same molasses, to which known quantities of lactic acid (as lithium lactate) were added, were examined. The equivalent of 0·5%, 1·0%, 1·5% and 2·0% of lactic acid was added.

The results are as shown in Table I.

Table I

Sample	% *Lactic acid added*	% *Lactic acid found*	% *Recovery*
Molasses	0·00	1·87	
,,	0·50	2·40	106·0
,,	1·00	2·84	97·0
,,	1·50	3·33	97·3
,,	2·00	3·75	94·0
Average recovery			98·4

All injections were carried out in duplicate. Fig. 1 illustrates a chromatogram of methyl lactate in molasses.

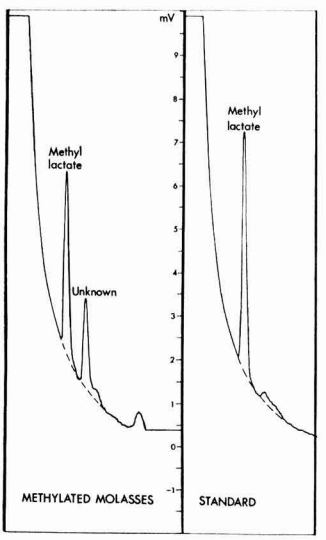

Fig. 1

(2) *Volatile acids (acetic, propionic and butyric acids)*

It was originally expected that the molasses solution prepared for the lactic acid determination could also be used for the direct determination (without methyl-

[3] DIERSSEN *et al.: ibid.*, 1956, **58**, 35.
[4] PREY *et al.: Zeitsch. Zuckerind.*, 1959, **94**, 614.
[5] STARK *et al.: J. Agric. Food Chem.*, 1953, **1**, 564.
[6] OLDFIELD and SHORE: *I.S.J.*, 1970, **72**, 3–4.
[7] *ibid.*, 35–40.

ation) of the volatile acids. It was found that the volatile acid content varied with the pH to which the molasses was reduced, before the addition of methanol. The variation took place whether the solution was dehydrated or not.

This was investigated. The results are shown in Table II and Fig. 2.

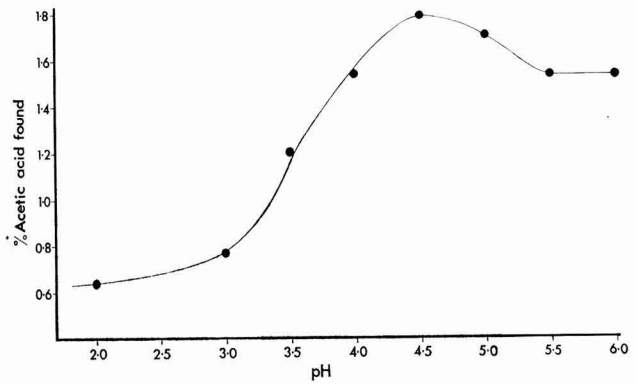

Fig. 2

It was suspected that partial methylation of the volatile acids takes place at low pH levels. It was not possible to separate the methyl esters of acetic, propionic and butyric from the methanol solvent. However, the presence of methyl lactate at low pH indicated that some methylation of the acids had taken place.

Table II

pH before the addition of methanol	*% Acetic acid found*
2·0	0·64
3·0	0·77
3·5	1·20
4·0	1·54
4·5	1·79
5·0	1·70
5·5	1·53
6·0	1·53

The technique for preparation of molasses solution for gas chromatography of volatile acids present was as follows:—

12·5 grams of molasses were homogenized with 10 ml of water and the pH adjusted to 4·5 with orthophosphoric acid. The mixture was heated under a reflux condenser for one hour at 60°C. After cooling to room temperature, 70 ml of methanol were added, the solution was filtered and made up to 100 ml with methanol. Under these conditions there was no evidence of methylation, and methyl lactate was completely absent.

Verification of method for volatile acids

The equivalent of 0·5%, 1·0%, 1·5% and 2·0% acetic acid (as sodium acetate) was added to samples of the same molasses.

The results are shown in Table III.

Table III

Samples	*% Acetic acid added*	*% Acetic acid found*	*% Recovery*
Molasses	0·0	1·07	
,,	0·5	1·57	100·0
,,	1·0	2·07	100·0
,,	1·5	2·55	98·6
,,	2·0	3·10	101·5

Many of the methods previously used for the determination of volatile acids were based on a separation by steam distillation. It is the experience of this laboratory that steam distillation of volatile acids at atmospheric pressure invariably gives low results.

The column used was the same as that used for methyl lactate. It was operated at a column temperature of 125°C, an injector temperature of 250°C, and a detector temperature of 200°C.

The carrier gas was again nitrogen at a flow rate of 50 ml/min. A flame ionization detector was used and the sample size was 0·5 ml.

Fig. 3 illustrates a chromatogram of volatile acids.

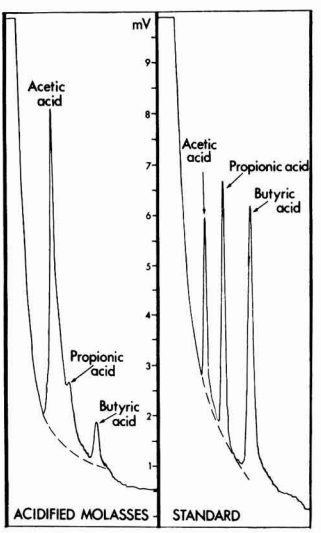

Fig. 3

Results

Samples of molasses from 4 Irish sugar factories were analysed during the 1968/69 and 1969/70 campaigns. These were average weekly samples from the four factories, and the results of the analysis appear in Tables IV–XI.

Table IV. Carlow molasses 1968/69

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Propionic acid*	% *Butyric acid*
24/10/68	6·7	2·01	3·09	0·01	0·33
7/11/68	6·7	1·70	2·30	0·01	0·34
21/11/68	6·6	2·25	3·63	0·01	0·16
5/12/68	6·7	2·81	2·13	nil	0·24
19/12/68	6·4	2·28	2·50	0·02	0·11
Average		2·21	2·73	0·01	0·24

Table V. Carlow molasses 1969/70

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Butyric acid*
10/10/69	7·8	1·61	1·06	0·06
17/10/69	7·5	1·57	1·33	0·01
24/10/69	7·4	1·57	1·80	0·03
31/10/69	7·4	1·86	1·33	0·03
7/11/69	7·4	1·16	0·84	—
14/11/69	7·8	1·26	0·80	0·02
21/11/69	7·5	1·19	0·93	—
28/11/69	7·2	1·58	1·12	—
5/12/69	7·3	1·42	1·06	—
12/12/69	7·2	1·77	1·24	—
Average		1·49	1·15	

Table VI. Mallow molasses 1968/69

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Propionic acid*	% *Butyric acid*
20/10/68	8·4	2·06	3·30	0·02	0·23
27/10/68	8·3	1·90	2·83	0·02	0·23
3/11/68	8·1	1·90	3·20	nil	0·22
10/11/68	8·6	1·79	2·83	0·02	0·57
17/11/68	8·2	1·95	2·95	0·02	0·32
24/11/68	8·0	2·22	3·20	0·02	0·49
1/12/68	7·8	2·03	2·36	0·02	0·69
8/12/68	7·8	2·09	3·10	0·01	0·49
15/12/68	7·6	1·79	2·42	0·02	0·34
22/12/68	7·4	1·88	3·33	0·02	0·56
29/12/68	6·9	2·08	2·66	0·01	0·20
5/1/69	7·0	2·16	2·50	0·01	0·52
Final sample	7·9	1·86	3·26	0·02	0·36
Average		2·00	2·92	0·02	0·40

Table VII. Mallow molasses 1969/70

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Butyric acid*
12/10/69	7·8	0·48	1·06	0·01
19/10/69	7·9	1·48	1·40	—
26/10/69	8·0	1·86	1·33	0·02
2/11/69	7·8	1·82	1·44	0·04
9/11/69	7·9	1·20	0·80	0·01
16/11/69	8·5	0·98	0·85	0·02
23/11/69	8·4	0·88	0·99	trace
30/11/69	8·3	1·03	0·86	trace
7/12/69	7·9	0·99	1·11	—
14/12/69	7·9	0·97	0·99	—
21/12/69	7·5	1·05	0·69	—
28/12/69	7·8	0·96	1·07	trace
4/1/70	7·4	1·22	1·31	trace
10/1/70	—	1·31	2·50	trace
Average		1·16	1·17	

Table VIII. Thurles molasses 1968/69

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Propionic acid*	% *Butyric acid*
18/10/68	7·1	1·33	2·37	0·01	0·37
26/10/68	7·3	1·12	3·93	nil	0·73
2/11/68	6·8	1·37	3·51	nil	0·46
9/11/68	6·8	1·42	3·41	0·03	0·34
22/11/68	6·7	1·38	3·75	0·02	0·39
30/11/68	6·6	2·09	3·33	0·02	0·45
7/12/68	6·5	1·33	2·68	0·02	0·45
14/12/68	6·8	1·23	2·60	0·01	0·81
28/12/68	6·8	1·11	3·46	0·02	0·51
Average		1·38	3·23	0·01	0·50

Table IX. Thurles molasses 1969/70

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Butyric acid*
22/11/69	7·5	0·89	0·56	—
29/11/69	7·4	1·02	0·47	trace
6/12/69	7·4	1·11	0·90	—
19/12/69	7·4	1·11	2·49	—
25/12/69	7·5	0·82	1·10	—
1/1/70	7·5	0·95	1·24	—
Average		0·98	1·23	

Table X. Tuam molasses 1968/69

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Propionic acid*	% *Butyric acid*
9/11/68	7·0	2·06	2·61	0·02	0·98
16/11/68	6·9	1·73	2·66	0·01	0·47
23/11/68	6·6	1·77	2·61	0·01	0·38
29/11/68	6·6	2·37	2·40	0·01	0·47
7/12/68	6·5	2·09	2·77	0·01	0·38
17/12/68	6·4	1·97	2·56	0·01	0·62
Average		2·08	2·60	0·01	0·55

Table XI. Tuam molasses 1969/70

Week ending date	*pH*	% *Lactic acid*	% *Acetic acid*	% *Butyric acid*
2/11/69	6·5	2·03	1·10	0·05
9/11/69	7·0	1·33	0·91	—
16/11/69	7·2	1·27	0·70	—
23/11/69	7·0	1·18	1·01	trace
30/11/69	6·7	1·39	0·86	0·05
7/12/69	—	1·35	1·11	—
Average		1·43	0·96	—

The following tables XII and XIII show the calculated losses sugar % beet. These are calculated from the lactic acid found in molasses and allowing 0·31 grams of lactic acid for each gram of invert found in raw juice. In the tables we use a factor of 2 to calculate the diffusion sugar loss from the lactic acid formed in the diffusion.

Discussion

A considerably lower molasses lactic acid was found in 1969/70 than in the 1968/69 campaign, the greatest reduction from 2·00% to 1·10% being

Table XII. 1968/69

Factory	*Raw juice invert*	*Draft*	*Raw juice invert % beet*	*Lactic acid from invert % beet*	*Molasses % beet*	*Lactic acid from invert % molasses*	*% Lactic acid found in molasses*	*Lactic acid from sugar destruction % molasses*	*Estimated loss due to lactic acid formation % beet*
Carlow	0·090	125	0·113	0·035	3·47	0·99	2·21	1·22	0·042
Mallow	0·074	112	0·083	0·026	2·93	0·89	2·00	1·11	0·033
Thurles	0·096	114	0·109	0·034	3·09	1·10	1·38	0·28	0·009
Tuam	0·108	135	0·146	0·045	3·51	1·28	2·08	0·80	0·028

Table XIII. 1969/70

Factory	*Raw juice invert*	*Draft*	*Raw juice invert % beet*	*Lactic acid from invert % beet*	*Molasses % beet*	*Lactic acid from invert % molasses*	*% Lactic acid found in molasses*	*Lactic acid from sugar destruction % molasses*	*Estimated loss due to lactic acid formation % beet*
Carlow	0·093	128	0·119	0·037	4·01	0·92	1·490	0·54	0·046
Mallow	0·068	122	0·083	0·026	2·95	0·88	1·160	0·28	0·017
Thurles	0·08	119	0·095	0·029	3·26	0·89	0·983	0·09	0·006
Tuam	0·09	138	0·124	0·038	3·75	1·01	1·425	0·42	0·032

found in the Mallow factory (see Tables VI, VII, XII and XIII). Since the invert in raw juice was the same in this factory for both campaigns, the improvement indicates lower diffusion losses, which may be attributed to cleaner beet in the 1969/70 campaign.

The Thurles factory, even though with very low diffusion losses in 1968/69, showed a further improvement in 1969/70 (see Tables VIII, IX, XII and XIII).

The Carlow and Tuam molasses lactic acid figures were even lower in 1969/70 than in the previous year. Since the molasses % beet was higher in both factories in the last campaign than the previous one, however, the net diffusion losses were approximately the same (see Tables IV, V, X, XI, XII and XIII).

The volatile acids in all factories were far lower in 1969/70 than in 1968/69, with propionic acid not detectable in any of the 1969/70 samples. This improvement may be attributed to improved factory performance and to less infection at "cold points" such as press water or pulp water in the case of Tuam, where a Roberts battery is operated.

ACKNOWLEDGMENT

The authors wish to thank the personnel of the sugar factories for the samples supplied, and Mr. P. McHUGH, Miss M. COSTELLO and Mr. J. BYRNE for their assistance with the analytical work.

Correspondence

To the Editor,

The International Sugar Journal.

Dear Sir,

REDUCED BOILING HOUSE RECOVERY

It may be of interest to note a correction in the Reduced Boiling House Recovery formula as given on page 653 of the Cane Sugar Handbook, 9th Edition, by Dr. GEORGE P. MEADE. A treatment resulting in the above correction is attached.

The correction has been referred to Dr. MEADE and he has very kindly agreed that attention to it may be called in the *International Sugar Journal.*

Yours faithfully,

ABDUL KARIM
Laboratory Incharge,
Noon Sugar Mills Ltd.,
Bhalwal, Sargodha District,
West Pakistan.

The Reduced Boiling House Recovery Formula as published in the Cane Sugar Handbook is

$$R_{85} = \frac{100 - J(100 - R')}{5{\cdot}667\,(100 - J)}.$$

This formula is based on Virtual Molasses Purity[1]

$$M_v = \frac{100\,(100J - JR')}{(10{,}000 - JR')}$$

$$R_{85} = \frac{100}{85} \times \frac{100\,(85 - M_v)}{(100 - M_v)}.$$

Eliminating M_v,

$$R_{85} = \frac{100}{85} \times \frac{100\left[85 - \dfrac{100\,(100J - JR')}{(10{,}000 - JR')}\right]}{100 - \dfrac{100\,(100J - JR')}{(10{,}000 - JR')}}$$

which simplifies to

[1] "Cane Sugar Handbook", 8th Edition, p. 620.

$$R_{85} = \frac{100}{85} \times \frac{(850{,}000 - 85JR' - 10{,}000J + 100JR')}{(10{,}000 - JR' - 100J + JR')}$$

$$= \frac{100}{85} \times \frac{850{,}000 - 10{,}000J + 15JR'}{10{,}000 - 100J}$$

$$= \frac{850{,}000 - 8{,}500J - 1{,}500J + 15JR'}{85\,(100 - J)}$$

$$= 100 - \frac{15J\,(100 - R')}{85\,(100 - J)}$$

$$= 100 - \frac{J\,(100 - R')}{5{\cdot}667\,(100 - J)}$$

and not $\dfrac{100 - J\,(100 - R')}{5{\cdot}667\,(100 - J)}$

Improvement of bone char column performance by means of a recycle liquor stream

By B. SILBERSTEIN

(C.S.R. Research Laboratories, P.O. Box 39, Roseville, N.S.W., Australia, 2069)

IN normal factory operation of a char column, flow of the "raw liquor" feed is continued so long as the mean colour of the "fine liquor" product remains below a predetermined level. This level is usually set at approximately one tenth that of the feed, and at the end of the liquor running period approximately 90% of the colour passed through the char has been removed. At that stage, however, only a small proportion of the total decolorizing capacity of the char has been utilized. Some refiners take advantage of the remaining capacity by following the raw liquor feed with a darker, less pure, liquor stream through the char bed prior to sweetening-off and reactivation. This procedure reduces the production of low grade materials and results in savings in the overall operation of the refinery.

Another method sometimes employed for increasing the colour loading on the char is the use of a "recycle" liquor stream; here the flow of raw liquor is continued beyond the fine liquor cut-off point, and the darker effluent is collected and fed as a first course over the next char column (containing freshly revivified char). Raw liquor is then passed through the char beyond the fine liquor cut-off point, and the same quantity of dark effluent is collected, and fed as a first course, as before, to the next char column. This stream is termed "recycle" stream in this article.

The major benefit accrued from the use of recycle stream, with the attendant greater colour loading on the char, is a reduction in char usage. Char usage is defined in this context as the tons of char used per 100 tons (on a dry basis) of decolorized product. Char revivification is one of the most costly steps in the sugar refining process, and a reduction in char usage results in significant savings in the overall costs.

Previously, quantitative data on the merits of using a recycle stream have been difficult to obtain, owing mainly to limitations in the stability of raw liquor. For a given recycle ratio (quantity of recycle liquor per unit of total liquor fed) several runs are required before attainment of steady state conditions. If the normal contact time of five hours is maintained, it would take several weeks to obtain one point on the graph, by which time the raw liquor properties would have altered sufficiently to render future experimentation virtually meaningless.

The objective of this investigation was to develop a rapid testing technique in order that a reliable comparison of char column performance with and without a recycle stream could be made. The series of runs must be completed in six weeks or less, during which time the liquor properties would not alter, provided that the liquor was kept under refrigeration.

Experimental

Materials Used

Bulk samples of bone char and raw liquor were received from the C.S.R. Company's refinery at Sydney, Australia. Bone char for each run was carefully subsampled according to the methods described by Deitz and Carpenter[1]. The liquor was stored in a refrigerator at 40°F and drawn upon as required. The pH of the liquor was adjusted to pH 9·00 for the purpose of colour measurement. Its colour, as measured spectrophotometrically, was 1227 units[2].

Apparatus

A flow diagram of the apparatus used is shown in Fig. 1. It consisted of an all-glass jacketed column 1 in i.d. 12 in high, a constant temperature bath equipped with a recirculating pump, and an accurate positive displacement metering pump for the liquor.

Procedure

A subsample of char was poured into the column and placed under vacuum (27 in Hg). Hot water (at 80°C) was circulated through the water jacket for about three hours; a time switch was used to start the hot water flow at 6 a.m. each morning, and it

[1] *NBS Tech. Paper* (Bone Char Research Project), 1961, (62).
[2] Munday *et al.*: *I.S.J.*, 1969, **71**, 163.

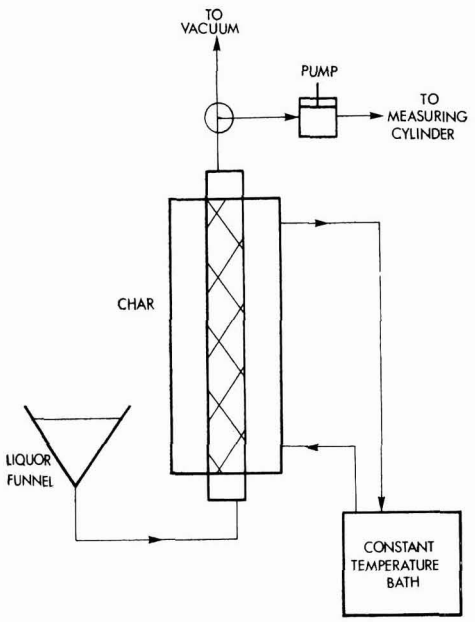

Fig. 1. Flow diagram

was usually possible to complete two runs during a working day. Boiled distilled water was poured into the liquor funnel and allowed to enter the char column; the char was completely air-free.

The water in the liquor funnel was then replaced by a predetermined volume of recycle liquor and the pump was started at a rate of 3·0 cm³/min. When the recycle liquor supply was exhausted, raw liquor was poured into the liquor funnel. The column effluent was discarded until it reached 30°Bx; a preset volume was then collected and labelled as product. A volume 15 cm³ in excess of the volume of recycle liquor originally fed to the column was collected and labelled as recycle liquor. The two lots of column effluent were thoroughly mixed, and 15-cm³ samples from each were taken for colour measurement. Six runs were completed for each combination of recycle liquor and product volumes, the recycle feed for each run comprising the recycle effluent from the previous run.

The very first run served the dual purpose of providing the first batch of recycle liquor, and defining the performance of the char with no recycle liquor stream. For this run the distilled water in the liquor funnel was replaced directly by raw liquor, and effluent was collected in separate measuring cylinders at 20 minute intervals, after first discarding the effluent of less than 30°Bx.

Results and Discussion

1. *Char performance without recycle stream*

Seven samples altogether were taken in this test; the results of colour measurements and also the calculated mean effluent colour and char % are shown in Table I, where

S = weight of sugar solids decolorized

C = colour of effluent liquor, as defined by Munday *et al.*[2]

$$\bar{C} = \text{mean effluent colour} = \frac{\Sigma SC.}{\Sigma S}$$

$$\text{Char } \% = \frac{\text{weight of char}}{S} \times 100$$

Table I

Liquor sample No.	*Time (min)*	*S (g)*	*C*	$\bar{C}$	*Char %*
1	20	42·9	46·8	46·8	339
2	40	49·8	103·3	77·2	156·7
3	60	51·3	157·9	105·9	100·9
4	80	51·0	192·5	128·6	74·5
5	100	52·5	244·0	153.0	58·7
6	120	52·2	278·0	174·8	48·5
7	140	52·3	323·5	197·0	41·3

A regression analysis of the data led to the following regression equation:

$$\ln \text{ char } \% = 11{\cdot}4382 - 1{\cdot}46397 \ln \bar{C} \quad \ldots\ldots(1)$$

The regression coefficients accounted for 99·96% of the total sum of squares, and the coefficient of variation was 0·37%. This equation was used in the following section for predicting char % with no recycle liquor.

2. *Char performance with recycle stream*

Five series of runs were completed in which the quantities of recycle and product liquors were kept constant within each series and varied between series. It was considered that steady state conditions had been reached by the 4th run in each series, and liquor quantities and colours, and char weights, were averaged for the 4th, 5th and 6th run in each series. The results are reported in Table II, where

R, P = Mean weight of sugar solids in recycle stream, product streams, respectively

$\bar{C}_R$, $\bar{C}_P$ = mean colour of recycle stream and product stream, respectively

$$\text{Char } \% = \frac{\text{Mean char weight}}{P} \times 100$$

Char % no recycle = char % calculated from Equation 1 for a mean effluent colour of $\bar{C}_P$

I_P = index of performance

$$= \frac{\text{Char \% no recycle}}{\text{Char\% with recycle}}$$

Recycle ratio = Quantity of recycle liquor/quantity of feed liquor

$$= \frac{R}{F} = \frac{R}{R+P}$$

The relationship between these two variables is clearly linear, the regression equation being

$$I_P = 1 + 3{\cdot}03\,(R/F) \quad \ldots\ldots(2)$$

According to Equation 2 it is possible to obtain any desired improvement in performance by suitable

Table II

Series No.	Recycle liquor			Product liquor			Char					
	R	$\bar{C}_R$	Range C_R	P	$\bar{C}_P$	Range C_P	Mean weight, g	Weight range, g	Char %	Char % no re-cycle	I_P	Re-cycle ratio
1	85·0	127·2	125·5–128·8	131·2	54·0	53·5–54·5	157·0	155·5–159·7	119·5	269·5	2·26	0·393
2	85·1	218·5	211·2–227·2	224·1	91·0	90·8–91·3	155·3	153·7–156·7	69·3	128·5	1·86	0·275
3	129·4	161·6	154·6–169·4	176·3	64·3	57·8–70·6	156·3	155·7–158·5	88·7	208·7	2·36	0·423
4	131·2	213·1	200·2–228·4	216·3	76·7	75·8–78·0	155·4	152·0–158·3	71·9	161·2	2·24	0·378
5	129·7	257·7	256·6–258·7	280·4	98·8	92·7–108·2	156·2	156·1–156·3	55·7	111·3	2·00	0·316

choice of recycle ratio. For example, if it is desired to halve the char %, $I_P = 2$ and the recycle ratio required is $\frac{2-1}{3{\cdot}03} = 0{\cdot}32$.

Throughput rate

The use of a recycle stream will result in a lengthening of the liquor running period, and may lead, under certain conditions, to a reduction in product throughput rate. It would then be necessary to start more columns than under conditions of no recycling so as to maintain the same throughput from the char plant. When plant capacity is limited, it is desirable to determine the greatest improvement in performance possible, without reduction in throughput rate.

Let T = product throughput rate, tons/hr/column

$P, P_\circ$ = product throughput/cycle, with and without recycle stream, respectively, tons/cycle/column

R = recycle throughput/cycle, tons/cycle/column

$L, L_\circ$ = liquor running period, with and without recycle stream, hr/cycle

D = total down time/cycle, including column filling and discharging, sweetening-off, etc., hr/cycle

I_P = performance index = $P/P_\circ$

For a constant throughput rate,

$$T = \left(\frac{P_\circ}{L_\circ + D}\right) = \frac{P}{L + D}$$

$$\therefore I_P = \frac{P}{P_\circ} = \frac{L + D}{L_\circ + D} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

From Equation 2

$$I_P = 1 + 3{\cdot}03\,\frac{R}{R + P}$$

$$\therefore R = \left(\frac{I_P - 1}{4{\cdot}03 - I_P}\right) P$$

$$\therefore \frac{L}{L_\circ} = \frac{R + P}{P_\circ} \text{ (assuming constant liquor flowrate)}$$

$$= \frac{P}{P_\circ}\left(\frac{3{\cdot}03}{4{\cdot}03 - I_P}\right)$$

$$= \frac{3{\cdot}03 I_P}{4{\cdot}03 - I_P}$$

$$\therefore L = \left(\frac{3{\cdot}03 I_P}{4{\cdot}03 - I_P}\right) L_\circ \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Substituting Equation 4 into Equation 3 and solving for I_P,

$$I_P = \frac{4{\cdot}03\dfrac{D}{L_\circ}}{1 + \dfrac{D}{L_\circ}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Equation 5 gives the improvement in char column performance possible, as a function of total down time/cycle, when the throughput rate is kept constant. In normal factory operation the down time is commonly found to be equal to the liquor running period. Under these conditions, inclusion of a recycle stream would result in a doubling of column performance for the same throughput rate/column. The liquor running period (Equation 4) would be three times as long as for normal operation.

ACKNOWLEDGEMENTS

Permission to publish this paper by C.S.R. Co. Ltd. is gratefully acknowledged. The author also wishes to acknowledge the assistance of Mr. G. CORMACK in the experimental work, and the services of the Sugar Section Analytical Laboratory at C.S.R. Research.

SUMMARY

The advantages of using a recycle liquor stream in the decolorization of sugar liquor by bone char were evaluated in a laboratory test column. A quantitative relationship between improvement in column performance and recycle ratio was derived. It was shown that it is possible under certain conditions to obtain a considerable reduction in char usage whilst mainmaining the same throughput rate of product/column.

Cyprus sugar imports[1].—Official statistics of white sugar imports into Cyprus during 1970 and 1969 show an increase last year from 15,145 to 16,177 metric tons. The principal suppliers were the UK with 6083 tons (8193 tons in 1969), the USSR with 3249 tons (1396), Turkey with 1569 tons (700), Czechoslovakia with 1550 tons (1205), East Germany with 1502 tons (147), and Egypt with 1203 tons (nil). Imports from Yugoslavia were only 500 tons compared with 2001 tons in 1969, while Italy delivered no sugar in 1970 as against 1395 tons in the previous year.

[1] C. Czarnikow Ltd., *Sugar Review*, 1971, (1013), 39.

Sugar cane agriculture

The effect of asphalt barriers on the moisture and nutrients retention in rice and sugar cane fields and sand soils. C. C. WANG, K. Y. LI, C. C. YANG and F. W. HO. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–1969, 20–32.—Thin layers of asphalt were put down at depths of 50 cm, 75 cm and 100 cm in sandy soil in which cane was grown, adjacent to a normal or control area. The methods of recording moisture and nutrients are described. Higher cane yields and sugar yields with lower water consumption were obtained over the asphalt, that at the 75 cm depth giving the best results. It was considered that such asphalt barriers may not be economical on a large scale and that their life, judging from American experience, might be about 15 years.

* * *

Dieselization reduces railway operating costs. ANON. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–1969, 72–74. The Taiwan Sugar Corporation possessed 224 steam locomotives, as well as gasoline units, for its extensive railway system (used for cane transport as well as general goods and passenger carrying), some of the locomotives being old and inefficient. The results of coverting some to diesel locomotives and acquiring some new diesel locomotives from Japan are discussed. The diesels appreciably reduced operating costs.

* * *

Varietal procession of sugar cane in Taiwan. ANON. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1968–1969, 74–76. A chart illustrates vividly the succession of sugar cane varieties cultivated on a large scale in Taiwan since 1945 when some POJ or Javanese varieties were widely grown. In the 1950's the now famous N:Co 310 rose rapidly in popularity. At present the locally-bred variety F 146 (N:Co 310 × PT 43-5/2) is the leading variety.

* * *

Stubble mulch. ANON. *Producers' Rev.*, 1970, **60,** (4), 35.—The possible value of mulching under United States and Australian conditions are compared. Mulching as protection against wind erosion is important in many parts of North America. It will become more important in Queensland on the lighter soils of the newly farmed areas in the West as they become depleted of their original organic matter.

* * *

Smut disease and hot water treatment. ANON. *S. African Sugar J.*, 1970, **54,** 309.—Results of preliminary experiments are discussed which indicate that the hot water treatment as applied for ratoon stunting disease may be equally effective in eliminating cane smut, i.e. any spores that might happen to be present on the planting material at the time.

* * *

Studies on crop estimation and forecasting yield and quality of sugar cane. I. Correlation between leaf nitrogen and cane weight, sucrose content and purity coefficient of juice. U. S. SINGH, M. M. S. SAXENA and L. SINGH. *Indian Sugar*, 1970, **19,** 761–764. Results are reported of experiments carried out at the Sugarcane Research Station, Shahjahanpur, Uttar Pradesh, over a period of two years. Leaf N had a highly significant positive correlation with cane weight and exhibited a significant negative correlation with both sucrose percentage and purity coefficient of juice. However it was considered that N content of leaf may fruitfully serve as a tool for predicting yield and recovery of sugar before harvest with a considerable amount of precision. Leaf N at different stages of growth may also serve as a guide for the need for additional N fertilizer.

* * *

Effect of "Agallol" and pesticides on growth and yield of sugar cane. P. S. TOMER. *Sugar News* (India), 1970, **1,** (11), 29–30.—Experiments in dipping setts in "Agallol" and mixtures of "Agallol" with certain pesticides before planting are reported. "Agallol" plus "Telodrin" was regarded as the best dip, giving 36·5% germination as against 28·6% for the control.

* * *

Formulation of organic insecticides and their proper use in sugar cane. Z. A. SIDDIQI. *Sugar News* (India), 1971, **1,** (11), 31–32.—In this article some basic facts about insecticides and their formulations recommended for use in sugar cane are given. The information is intended for the benefit of local cane growers.

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Effects of soil fertility on yield and juice quality of sugar cane. H. K. PANDE and K. V. B. R. TILAK. *Exp. Agric.*, 1970, **6,** 205–211.—The work reported was carried out on the lateritic soils of West Bengal where no previous work of this kind had been done with sugar cane. Application of N (160 and 80 kg N/ha) and phosphate (80 and 40 kg P_2O_5) increased diameter and height of cane and number of shoots per metre of row and consequently the yield of millable cane. K did not affect growth and yield. Application of 80 kg P_2O_5/ha was beneficial only with 160 kg N/ha but 40 kg P_2O_5 proved effective with both 160 and 80 kg N.

Pre-harvest desiccation of sugar cane with "Paraquat" in Queensland. A. C. ARVIER. *Exp. Agric.*, 1970, **6,** 309–317.—Burning cane before harvest to get rid of trash is standard practice in Queensland. Frequently lush cane growth and weeds prevent effective burning. Experiments over 7 seasons to dry out cane foliage and weeds using bipyridylium desiccants showed that "Paraquat" was consistently more effective than "Diquat". Its use was accompanied by a slight drop in sugar content. It is suggested that, in some instances, spraying might be restricted to the periphery of a field where weeds normally thrive most.

* * *

Studies on the varietal susceptibility against red rot of some canes grown in Banaras district. S. K. BANERJEE. *Sci. and Cult.*, 1969, **35,** 211–212; through *Plant Breeding Abs.*, 1970, **40,** 725.—Four sugar cane varieties were tested for resistance to red rot (*Colletotrichum falcatum*). The variety Co 445 showed the greatest resistance.

* * *

Effect of salinity on the yield and chemical composition of some sugar cane varieties. T. HUSSAIN and M. RAMZAN. *Pakistan J. Soil Sci.*, 1969, **5,** (1), 40–45; through *Soils and Fertilizers*, 1970, **33,** 302.—In pot experiments with a non-saline sandy clay loam of pH 7·6 to which a salt mixture (NaCl, $NaHCO_3$, Na_2SO_4, $CaCl_2$ and $MgCl_2$) was added at 0·2%, 0·4% and 0·8%, yields were reduced by the 0·4% addition and the number of tillers decreased with increasing salinity.

* * *

Foliar diagnosis of the nutrient status of sugar cane in São Paulo. J. R. GALLO, R. HIROCE and R. ALVAREZ. *Bragantia*, 1968, **27,** 365–382; through *Soils and Fertilizers*, 1970, **33,** 422.—Leaf nutrient content varied with cane varieties and plant age but not with soil type. Of the 12 elements determined, N showed the least and Mo the greatest variation. Frequency distribution curves showed that most fields were low in K, Mg, N, S and Fe.

* * *

Extent of losses in sugar cane caused by red rot (*Physalospora tucumanensis*) and smut (*Ustilago scitaminea*). S. S. SANDHU, D. S. BHATTI and B. K. RATTAN. *J. Res.* (Ludhiana), 1969, **6,** 341–344; through *Rev. Plant Pathology*, 1970, **49,** 453.—In the Punjab, reduction in cane weight in four varieties caused by red rot was 12–41·5%. That due to smut was 70·7–75·3%. Details are given of the effects of the diseases on Brix and sucrose content.

* * *

Selection percentage as a method of evaluating parent material in a sugar cane breeding programme. O. GIMENEZ L. and J. A. MARIOTTI. *Rev. Ind. Agric. Tucumán*, 1969, **46,** 1–9.—This widely used method of sugar cane breeding is discussed with particular reference to conditions appertaining to Tucumán and the sugar cane varieties established there. Data obtained during the period 1961–65 were analysed. Selection at the single stool stage proved to be inadequate, 2 m wide clonal plots being better suited for the work.

* * *

Weed control at planting. A. W. FORD. *Cane Growers' Quarterly Bull.*, 1970, **33,** 143–144.—In the Herbert River district of Queensland late autumn and early spring rains, making mechanical cultivation difficult or impossible, may cause serious weed control problems. As only short-term weed control is required this may be achieved relatively cheaply with MCPA ("Methoxone") or the sodium salt of 2,4-D, spraying being confined to an 18-inch band over the row, 4 lb MCPA treating approximately 3 acres. The simple equipment needed is described.

* * *

Mechanical harvesting. ANON. *Australian Sugar J.*, 1970, **61,** 623.—The proportion of the Queensland cane crop cut by machines increased from 71·6% in 1968 to 84·9% in 1969. The 1969 season constituted a difficult "testing period" for the new types of machine because of extreme weather conditions.

* * *

The use of artificial light to induce flowering in sugar cane. E. PEREZ A. and H. J. ANTONI. *Rev. Ind. Agric. Tucumán*, 1969, **46,** 11–17.—An account is given of floral induction experiments with some ten varieties of cane carried out in the photoperiod houses of the Tucumán Agricultural Experiment Station. It was shown that it was possible to speed up and to increase the amount of flowering by this means.

* * *

Constant photoperiods and their application for floral induction in sugar cane. H. J. ANTONI and E. P. ANTICH. *Rev. Ind. Agric. Tucumán*, 1969, **64,** 19–25. Results of experiments are recorded. Two Tucumán varieties of cane were used, the one considered easy flowering and the other difficult. Results indicated that the most efficient treatment was when a great number of inductive cycles are found between 12 hr 15 min and 12 hr 10 min; also, it was found possible to apply inductive cycles of constant length during all the treatment.

* * *

Studies on sampling for the evaluation of yield in sugar cane. J. A. MARIOTTI and O. GIMENEZ L. *Rev. Ind. Agric. Tucumán*, 1969, **46,** 37–45.—The estimation of yields in large experimental plots with small samples forms the basis of the work. A 30-stalk sample from well-developed stools is adequate, there being no need or justification for a larger sample (50 stalks). Sampling of this kind is useful where a large number of trials have to be carried out in a relatively short time, but not when special accuracy is required.

* * *

Foliar diagnosis and the fertilizing of sugar cane. II. F. A. FOGLIATA and R. A. DIP. *Rev. Ind. Agric. Tucumán*, 1969, **46,** 45–71.—Results are given of experiments carried out over a period of 5 years on

the soil known as "argiudol" with the sugar cane variety C.P. 48-103. It was found that positive results were only obtained in the case of N, the negative results in the case of P and K being probably due to the fact that there are already adequate reservoirs of these elements in the soil in question.

* * *

Research on the heterogeneity of growth of sugar cane on a plantation at Richard-Toll (Senegal). R. BARAN and D. BLONDEL. *Agron. Trop*, 1970, **25,** 561–573. Patches of cane were characterized by reduced growth and lighter colour. It was found that this was not due to salinity but to reduced water supply of the cane caused by soil or sub-soil characteristics affecting irrigation.

* * *

Brak, a threat to our irrigation schemes. M. HENSLEY. *S. African J. Sci.*, 1970, **66,** (6), 180–181.—The significance of brak (or salty soil) in soils in irrigation areas throughout the world is discussed, as are the different types of brak soil. The problem in South Africa is discussed with notes on prevention and reclamation. The need for more research on the subject in South Africa is urged.

* * *

Phytophagous insect pests in Papua and New Guinea. ANON. *Papua and New Guinea Agric. J.*, 1969, **21,** (2), 50–75.—Sugar cane pests are separately listed (pp. 62–64). Scientific and common names (where known) are given along with brief notes and names of localities where the insect has been collected. Some 40 different insects are dealt with.

* * *

Sugar cane (in Sarawak). ANON. *Ann. Rpt., Research Branch, Dept. Agric.*, 1968, 71.—Further investigations are reported on the suitability of sugar cane as the basis of a cottage industry in Sarawak. The collection of 34 cane varieties (local, Australian and Indian) has been built up to allow of the establishment of duplicate plots, including one on a peat soil.

* * *

Hormones and sugar cane. Influence of indole-3-acetic acid on metabolism of glucose in sugar cane cuttings [or setts]. U. S. SINGH. *Sugar News* (India), 1970, **1,** (12), 21–25.—An account is given of investigations to determine the influence of indole-3-acetic acid on the metabolism of glucose in sugar cane cuttings or setts, so that its action on germination may be further elucidated. It had a marked influence on the metabolism of glucose in the cutting, the degree depending upon the concentration used and the time of soaking,

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Effect of hot water treatment with different varieties of sugar cane in controlling ratoon stunting disease. J. DA CRUZ F. *Brasil Açuc.*, 1970, **75,** 223–227.. Planting material of 8 different varieties was subjected to hot water treatment, at a temperature of 50·5°C for 2 hours. One variety (Co 419) appeared to be affected by the treatment, showing reduced germination and number of stalks.

"Cigarrhina" pest of sugar cane in Santa Catarina (Brazil). J. FERNANDES. *Brasil Acuc.*, 1970, **75,** 228–231.—Results of inspection of two sugar estates, Adelaide and Tijucas, and the incidence of the two pests *Mahanarva indicata* and *Sphenorhina liturata* var. *ruforivulata* are discussed. Notes on their ecology are included.

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"Cigarrhina" pest on sugar cane estates in Santa Catarina (Brazil). P. GUAGLIUMI. *Brasil Açuc.*, 1970, **75,** 350–354.—Impressions of a visit by a well-known entomologist to observe the pest (*Mahanarva*) on two estates (Adelaide and Tijucas) are recorded. Suggestions for control or reducing the incidence of the pest are made.

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Performance of Co canes in the Chambal Commanded area (Rajasthan). N. S. PARIHAR and N. MUKERJI. *Indian Sugar*, 1970, **19,** 811–814.—With the establishment of various irrigation projects in the area, the potentiality of profitable sugar cane cultivation has been greatly increased. The introduction of superior new varieties and their behaviour in trial plots at the Agricultural Research Station, Borkhera, Kota, is discussed. One table shows data relating to germination, tillering and millable cane. Another deals with juice analysis and general agronomic and botanical characters.

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Green manuring in standing sugar cane. G. N. MISRA, R. S. PANDEY and S. SINGH. *Indian Sugar*, 1970, **19,** 817–820.—Trials with four leguminous green manure crops, grown as intercrops, are reported. In some instances the cane was adversely affected, especially in regard to tillering. Guar, turned under at the age of about 70 days, not not later, increased cane and gur yields per ha.

* * *

Review of the 4-year research program of the Taiwan Sugar Experiment Station. K. C. LIU. *Taiwan Sugar*, 1970, **15,** (2), 3–11.—The main object of the 4-year research programme is to adapt sugar research to the rapidly changing conditions in Taiwan and to overcome the main obstacles facing scientists at the Station. It is discussed under the following headings: establishment of research targets; simplification of organization; improvement of research facilities; development of research workers; expansion of research activities; promotion of research cooperation; improvement of communication; and strengthening of research service.

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Some problems of T.S.C. [Taiwan Sugar Corporation] deep wells. L. S. KUO. *Taiwan Sugar*, 1970, **15,** (2), 12–16.—The Corporation owns 824 deep wells, nearly all used for cane irrigation. Problems in recent years have been concerned with the lowering of the static water level, caused mainly by the increased density of wells, infiltration of saline water, deposition of iron compounds and the presence of gases, causing corrosion of metal casings and shafts. Problems and remedial measures are discussed.

Sugar beet agriculture

Response of sugar beet to soil drainage and aeration. J. SHALHEVET, H. ENOCH and S. DASBERG. *Israel J. Agric. Res.*, 1969, **19**, 161–170; through *Soils and Fertilizers*, 1970, **33**, 302.—Experiments showed that crop yields increased with water table depth, most of the increase occurring between depths of 20 and 60 cm. Compared with conditions without a water table, a higher water table resulted in a greater decrease (60%) in the Fe content and an increase (2-fold) in the NO_3 content of leaves as well as a 35% decrease in the Na and K contents of roots. Rates of O_2 diffusion increased with distance from the water table.

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Beet and cane culture on Portugal's Atlantic Islands. M. R. BULL. *Sugar y Azúcar*, 1970, **65**, (3), 37–50. Sugar beet was introduced to the Azores late last century after the failure of citrus caused by disease. Early trials proved satisfactory, climate and soil being well suited to the crop. Today sugar beet is the fourth most important crop grown, mainly by small farmers. Lupins are commonly cultivated as green manure and the Government gives assistance with fertilizers and in other ways. Most of the pulp is fed to milk cows. Sugar cane was introduced to Madeira from Sicily as long ago as 1452. It was the main crop for several centuries. Cane is grown on small terraced fields where irrigation (from mountain streams) presents no problem. The crop (49,961 tons of cane in 1966) is processed into sugar and alcohol at a factory in Funchal.

* * *

Electro-chemical thinning of sugar beet. S. W. R. COX and K. A. MCLEAN. *J. Agric. Eng. Res.*, 1969, **14**, 332.—A single-row prototype electro-chemical beet thinner has been developed and its performance compared with that of a conventional thinner as well as with high-quality manual thinning. The thinner applies a fan of viscous contact herbicide to unwanted seedlings when actuated by an electronic sensing and control system.

* * *

Space planting and mechanical means of stand reduction. J. J. NIEDERER. *Sugar Beet J.*, 1970, **33**, (2), 4–8.—Chemical weed control and specific herbicides for weeds in sugar beet have opened the way to planting to stand or mechanical thinning. Good weed control is essential for these operations. Advice is given on soil treatment prior to sowing, setting up or maintenance of planting drills and on screens, pressure regulators, pressure gauges and nozzles of sprayers.

Nitrogen and how much is needed for sugar beets. E. C. VARSA. *Sugar Beet J.*, 1970, **33**, (2), 11–13. Results are given of extensive nitrogen soil tests. Good correlation exists between the spring test and the response of sugar beets to fertilizer nitrogen. It was found that there is little likelihood of satisfactory response from sugar beets to additional fertilizer nitrogen if the spring test shows more than 20 lb of residual nitrogen per acre and an increasing likelihood of reduced sugar recovery if this value is greater than 30 lb.

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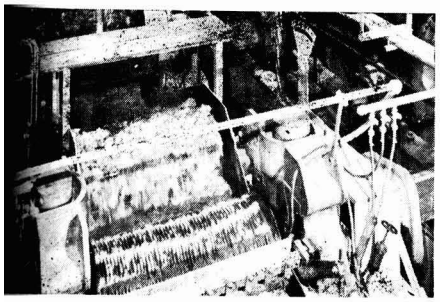
Use of herbicides in sugar beet. ANON. 1968–69 *Rpt. Norfolk Agric. Sta.*, 1969, 23–28; through *Weed Abs.*, 1970, **19**, 151.—Results of trials with various herbicides are given, including "Chlorpropham", "Fenuron", "Pyrazone", "Endothal", "Propham", "Medinoterb Acetate" and "Lenacil". The results of using mixtures of some of these products are included. Dry weather following spraying reduced the value of some of the trials. Knot grass (*Polygonum aviculare*) and chickweed (*Stellaria media*) were susceptible to "Propham", while speedwell (*Veronica* sp.) was susceptible to "Pyrazone".

* * *

Chemical thinning of sugar beet. K. A. MCLEAN. *J. Agric. Eng. Res.*, 1969, **14**, (2), 147–153; through *Weed Abs.*, 1970, **19**, 153.—The machine used was a modified 5-row reciprocating thinner in which the thinning blades were replaced with dribble bars accommodating six 1/32-inch jets spaced 1·2 inches apart, the dribble bars reciprocating 2 in above the rows. "Preeglone-Extra" (0·9 lb "Diquat-dibromide" + 0·9 lb "Paraquat dichloride"/gal) was used as the herbicide, with the addition of 0·5% "Cellofos B 3500" thickening agent to prevent splashing on neighbouring beet plants. In field trials, chemical thinning compared favourably with mechanical thinning. It was felt that it could be more accurate than mechanical thinning and would not involve root disturbance to remaining seedlings.

* * *

Sugar beet, a promising crop of Marathwada. L. SREENIVAS, U. S. UPADHYAY and B. O. PATIL. *Indian Farming*, 1969, **19**, (2), 20–21; through *Field Crop Abs.*, 1970, **23**, 350.—Beet trials over two years in the Marathwada region of Maharashtra, in India, are reported. Yields and sugar content compared well with those recorded for temperate countries, the average sugar content being 15·36%.



Cane sugar manufacture

Colour improvement in sugar. Trial of SO_2-saturated water as bleaching agent—a practical substitute for "Blankit". M. SINGH, R. C. BHANDARI and R. K. SRIVASTAVA. *Indian Sugar*, 1970, **20,** 135–139.—Water saturated with SO_2 gas containing about 10–12% SO_2 was found in tests to be a more efficient decolorizing agent than sodium hyposulphite ("Blankit") when added to massecuite in the vacuum pan. Brilliant ISS and 30-grade white sugar resulted despite low mixed juice purities (72–82).

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Use of PVC in (the) sugar industry. A. K. DEVARAJAN. *Proc. 2nd Conv. S. Indian Sugar Cane & Sugar Tech. Assoc.*, 1970, 152–153.—The applications and advantages of PVC (polyvinyl chloride) pipes in the sugar factory are discussed.

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New sugar installation for Guatemala. ANON. *Sugar y Azúcar*, 1970, **65,** (6), 28–31.—Information is given on the equipment installed in Guatemala's thirteenth sugar factory, Ingenio Santa Ana, which was completed comparatively recently and has a crushing capacity of 4000 t.c.d. with a refinery designed to process 300 tons of raw sugar per day.

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Philippines sugar nearing 1972 goal. ANON. *Sugar y Azúcar*, 1970, **65,** (6), 32–35.—A survey is presented of 7 new cane sugar factories completed or under construction in the Philippines with the aim of expanding sugar production to 2,500,000 tons of sugar a year in 1972.

* * *

Economic aspects of cane diffusion in Egypt. H. M. EL-ZEINI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Diffusion Symposium), 1–13.—The Egyptian system of continuous diffusion replaces three mills of a conventional six-mill tandem, in respect of sucrose extraction. With proper preparation by cane knives and the first mill, primary extraction is 70–80%, and subsequent diffusion by the Egyptian system yields a mixed juice 1·2–1·8 units higher in purity than given by a milling tandem. The moisture content of the bagasse from the diffuser is reduced in the subsequent two mills, this reduction being their only function since sucrose extraction is not carried out in them. It is anticipated that moisture reduction technique improvements will shortly permit elimination of one of the two post-diffuser mills. The diffuser requires little power, not exceeding 1·5 hp/ton of cane, while the cost of repairs and maintenance is almost negligible. The author questions the economics of installing additional mills in a new factory when a diffuser will provide better extraction of purer juice, and he considers that diffusion is the process of the future.

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Cane diffusion and the problem of starch. H. M. EL-ZEINI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Diffusion Symposium), 14–26.—Deterioration of older varieties had led to their replacement by N:Co 310; this variety yields a high content of starch in its juice which gave problems owing to its inclusion in the *A*- and *B*-sugar produced by phospho-sulphi-defecation. Maintaining a diffusion temperature of 70–72°C, amylase in the juice destroyed starch extracted from the cane, but the problem remained of starch extracted by the first mill in primary juice. The juice was heated to 40–45°C, a fertilizer-grade superphosphate suspension added to raise the P_2O_5 content from 80–120 to 350–400 p.p.m., and the temperature raised to 70–72°C. The phosphate aids the activity of the natural amylase content and the juice pH (5·4–5·7) is ideal for its action. Increasing the time of retention in the phosphating tanks by 8–10 minutes, and in the sulphitation towers by 30%, gave a substantial reduction (up to 50%) in the starch content.

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Experience with the mills-diffuser system in the Cuban sugar industry. A. VALDÉS, S. ORTEGA and V. CRESPO. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Diffusion Symposium), 27–68.—A De Smet diffuser was installed in 1968 at Central Gregorio Arlée Mañalich in Havana province, and an account is given of the unit, auxiliary plant, and problems met and overcome. The diffuser permitted record cane throughput while achieving reduced extraction up to 96·5% with 55% primary extraction and 30% imbibition. With 59% primary extraction and 25% imbibition, 97% reduced extraction was achieved. The fall in purity between primary and mixed juice was normal and molasses purity was appropriate to juice purity. The loss of pol in filter cake was low owing to partial clarification in the diffuser. There were no serious operating difficulties, the most important losses arising when there was an interruption in cane supply so that the diffuser and press-water clarifier had to be liquidated, and operation of the factory was put out of synchronization. Mechanically the diffuser presented no problems; however, there were a great number in connexion with transporting the diffuser bagasse to the d[illegible]ng mills.

Technical-economic evaluation of the application of diffusion in Central Gregorio A. Mañalich. M. VÁZQUEZ T. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Diffusion Symposium), 69–97.—Comparisons have been made between operation of the factory's five-mill tandem in 1964–68 and operation in 1969 and 1970 when the 2nd and 3rd mills were replaced by a De Smet diffuser. Better extraction is given by the diffuser and, had the extraction efficiency attained in 1969 been achieved in 1964–68, would have provided an additional 543–1223 metric tons of sugar valued at $41,898–$94,367. The diffuser is able to handle its designed capacity of 4000 t.c.d., while steam consumption is raised by about 10%. Maintenance of the mills requires more work and greater cost than required by the equipment forming the diffuser system.

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Cleaning by mechanical means of flow tubes in evaporators, heaters, pans and boilers. M. H. R. NEVILLE. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 1–14.—The Flexible Drives (Gilmans) Ltd. equipment for scale removal from tubes is described and its action discussed. Methods of scale removal from tubes are summarized and the advantages of mechanical cleaning with flexible shaft equipment explained. Comments on such mechanical cleaning by users of the equipment in a number of sugar factories are reproduced, and reference made to cleaning of different kinds of tubed plant.

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Use of cationic resins in the process of juice purification with magnesium oxide. I. GALBÁN, R. PÉREZ, S. MARTÍNEZ and A. ROMERO. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. section), 17–49. Contact with cationic resins lowers juice pH and induces inversion if contact time allows this. Use of a static resin bed for juice treatment permits shorter contact times than a batch system where resin is added to the juice, and mechanical damage to the resin during its separation is also avoided. The static bed system was employed for tests using the strongly acidic "Kastel 300" and weakly acidic "Zerolit 226" resins for reduction of the pH of MgO-clarified juices. Such juices of pH 9·5–9·7 were passed through the resins and thus acidified, and were then mixed with untreated juice to produce a juice of neutral pH. To prevent precipitation of $CaSO_4$ and $MgSO_4$ in the resin on regeneration with sulphuric acid, the exhausted resin was first treated with NaCl solution to exchange the Ca and Mg for Na; the resin could then be regenerated with H_2SO_4. With the "Kastel" resin inversion was rapid, requiring high juice velocity (30 hr^{-1}), cooling of the juice and rapid neutralization. Only 25% of the total juice volume needed to be treated to obtain a combined juice pH of 7, whereas with the "Zerolit" 85% needed treatment. The pH in this case never went below 4 and inversion velocity was much lower. With the "Kastel" resin the working cycle was 1 hour so that there were several beds undergoing regeneration for each "working" bed; with the "Zerolit" the working cycle was 10 hours and only two beds were needed. The NaCl treatment removed all the Mg but only half the Ca from the "Zerolit" resin; this could be fully removed by alternate treatment with NaCl- and Mg-containing solutions; the "Zerolit" resin is recommended for use in the process.

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Study and utilization of various modern crystallization apparatus. P. DEVILLERS and C. CORNET. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 66–81.—In order to study pan work, a system has been developed for separating and examining the crystal content of a massecuite. In this the sample is treated in a laboratory centrifugal and the sugar affined, without any remelting, by mixing with a refined sugar syrup of 67°Bx. After again centrifuging, the sugar obtained is dried with alcohol. The operative conditions are maintained constant for all samples so that the sugar from different factories are comparable. The samples are analysed for massecuite purity or molasses purity, refractometric Brix, crystal content % massecuite, crystal M.A. and C.V. and finally crystal appearance, according to the method of HILL[1]. The method has permitted comparison of crystallization in the classical batch pan with that in the Fives Lille-Cail continuous pan. It has also permitted study of the conglomerate-forming process, and conditions for improved sugar quality by full seeding of strikes of low supersaturation are discussed.

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Separation of extraneous matter by a system of hydrocyclones in series. R. DE LA TORRE, E. NAVARRETE and D. GÁLVEZ. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 83–119.—Experiments were carried out at Central Patria in 1969 and Central Héctor Molina in 1970 on the separation of solids from cane juice by means of hydrocyclones. Two-stage treatment was used, with 2 and 1 units, respectively, in 1969 and 6 and 4 units in 1970. Primary units were nominally of 220 g.p.m. capacity (actually 47% higher) and secondary units of 90 g.p.m. The primary units were supplied with mixed juice at a pressure of at least 75 p.s.i., the fall in pressure being 50 p.s.i. The primary overflow is sent to liming, while the underflow (18–20% of the mixed juice) falls to a tank from which it is pumped at not less than 60 p.s.i. to the secondary units. The underflow from these is either mixed with clarifier mud for filtration, or screened to remove bagacillo, the dirt content removed by decantation and the decanted juice returned to the primary hydrocyclone feed; the latter system was found to be preferable. In 1969 the secondary overflow was returned to the primary feed and in 1970 was sent to liming. Use of the hydrocyclones was found to extend considerably the interval between cleaning of the clarifiers, and also increased clarifier capacity by 25%. Efficiency of the hydrocyclones was adversely affected by the uneven feed and the importance of maintaining a

[1] *I.S.J.*, 1965, **67**, 201.

constant feed is emphasized. Reducing sugars were less in the 4th and 5th compartments of the clarifier, indicating less sucrose destruction. A 12-14% reduction was found in the insolubles content of the sugar produced, as well as 9–11% less ash in sugar, less ash in the molasses, and the sugar suffered less deterioration in storage. Further work is to be done with different equipment with which it is hoped to separate particles down to 10 microns and thus improve process efficiency.

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Optimization of the number of evaporator effects with respect to capacity and steam economy in the sugar industry. B. B. PAUL. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 120–133. Investigations carried out in sugar factories in India on the optimization of the number of effects, as regards capacity and steam economy, are described. Based on the results obtained from these investigations, it is recommended that, at those mills having quadruple-effect evaporators where it is wished to increase equivalent crushing capacity, the evaporator should be converted to a vapour cell and triple effect; where it is also required to improve steam economy, the evaporator should be arranged as a pressure vessel with a quadruple-effect, with super-position of a valve between the first and second vessels and separate steam outlet connexions in the second vessel.

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Manufacture of bagasse for diffusion by immersion and flotation. P. NEUVILLE. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 134–143. The discontinuous system of bagasse diffusion practised in Egypt for over 50 years depended on the flotability of the diffused bagasse which, in turn, depended on the suitable arrangement of the crushers and adequate work by the mills (*see I.S.J.*, 1970, **72**, 164). The practice followed to achieve this flotability and the theoretical conditions for manufacture of such bagasse are described.

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The effect of the vacuum pan with central steam entry, multiple feed and low hydrostatic head for low-grade massecuites on the exhaustibility of final molasses. B. B. PAUL. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 144–150.—The desired characteristics of a vacuum pan for low-grade massecuites are listed and a brief description given of a pan design intended to meet these requirements[1]. Features of the design are: central steam entry, multiple syrup feed, tapered upper tube plate and low hydrostatic head. The effect of these characteristics is examined by studying the boiling of strikes using the same seed and syrup feed to the new pan and a Hamill pan, also of low-head design, and it is concluded from the tabulated results that the new design invariably gives better molasses exhaustion.

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Studies of various factors involved in increased total losses and increased undetermined losses, and suggestions for keeping these low. R. B. L. MATHUR. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 151–183.—A general survey is made of circumstances leading to losses in the cane sugar factory, (with recommendations on their minimization), ranging from the supply of dirty cane to dropping of thin massecuites and unsanitary conditions in the factory. Reference is made to the author's work on the separation of insoluble non-sugars by centrifugation of *B*-molasses, and to the importance of adequate instrumentation and maintenance of constant vacuum and steam pressure.

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Evaluation of calcium hypochlorite as a disinfection agent in cane juices. M. BOFFIL C. and R. FUENTES S. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 202–232.—Experiments were made to determine the effectiveness of $CaOCl_2$ as a germicide, using it in the strength normally applied in sugar factories, i.e. as a solution of 11 kg in 100 gal of water, equivalent to 29 g/litre. Aliquots were added to juices, and the samples incubated at 35°C, microbial counts being made at intervals. It was found that the concentrations currently used in the Cuban mills (about 93 p.p.m. in last mill juice, diluted to 11·6 p.p.m. by the time it has been returned to mixed juice) had an instantaneous effect at the last mill but none on the mixed juice. Only if the concentration was raised 24 times was it possible to detect germicidal action in the mixed juice. If the concentration was raised 8 times, germicidal action was observed where the microbial population was in its logarithmic growth phase.

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Purification of juice with magnesium oxide. III. E. CARDET C. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 233–255.—Production of direct white sugar by clarification of cane juice with magnesium oxide was studied on the factory scale at the ICIDCA experimental mill, Central Pablo Noriega, during the 1969 crop. The sugar produced was closest to the standard (b) of the Codex Alimentarius, but its colour was very high. The principal difficulty was the poor quality of the MgO obtained by calcination of magnesite, which caused interruptions to the filtration process. The purity also was exceptionally low for juice intended for white sugar manufacture. The most substantial modification to the process was the neutralization of juice with phosphoric acid, because the resin station had not been completed. For the process to be successful it is essential to have high quality magnesium oxide and high purity juice.

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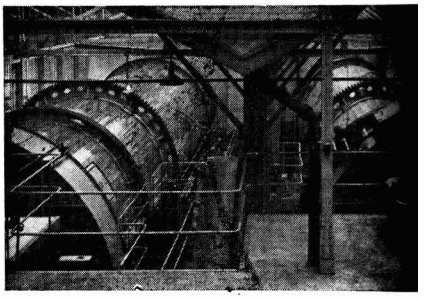
Protective paints in the sugar industry. H. M. EL-ZEINI. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Manuf. Section), 402–410.—The importance of protection of steel surfaces against corrosion and erosion in sugar factories is emphasized and a report presented of experience with several new protective paints at Nag-Hamadi sugar factory. Maintenance and repair costs can be reduced by judicious use of such paints and their utilization should be the subject of appropriate study.

[1] *I.S.J.*, 1970, **72**, 308

Beet sugar manufacture



Results of microbiological control of thick juice in storage. V. M. PRIIMAK, V. K. MISHINA and A. I. DONETS. *Sakhar. Prom.*, 1970, **44**, (8), 25–27.—Details are given of the sterilization processes carried out in a 498-cu.m. metal tank and feed line before thick juice was stored for 188 days under a surface layer of paraffin. Determination of the bacterial counts in the thick juice after storage revealed numbers of thermophiles, lactic acid and slime-forming bacteria of the *Leuconostoc* type below the permissible maximum. The thick juice was of 69·5°Bx and pH 9·0 at 20°C.

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Automatic A1-EP4M density meter for milk-of-lime. A. D. NESTEROV and V. O. OBMENIN. *Sakhar. Prom.*, 1970, **44**, (8), 28–29.—Details are given of an automatic density meter which operates on the basis of the difference in pressure head between the milk-of-lime in a measuring chamber and a standard sample in a chamber provided with two diaphragms and a pneumatically-operated converter which transmits a signal to the indicator. Since the two liquids are at constant column height, the pressure difference will be a direct measure of density. Temperature compensation is provided. Accuracy is 2·5% within a density range of 1·00–1·25 g/c.c.

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Application of an induction meter to alkalinity measurement in sugar juices. S. ZAGRODZKI and S. M. ZAGRODZKI. *Zucker*, 1970, **23**, 504–508.—Measurement of 1st carbonatation juice alkalinity in terms of conductivity using an induction meter is explained. Based on excitation of an alternating current in the juice stream, the system involved pumping the juice at a linear flow rate greater than 1 m/sec under controlled temperature conditions along a tube, one section of which acts as the secondary winding of a transformer. Before and after the transformer section is an electrode section; the intensity of an induced current flowing through the transformer section between the two electrodes is measured by a galvanometer. Further studies with 2nd carbonatation juice demonstrated the applicability of the induction meter to continuous indication of juice purity, variations in which were reflected in differences in the meter readings.

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The "greats" of the beet sugar industry. W. VON PROSKOWETZ. *Zucker*, 1970, **23**, 509–513.—The author gives details of the most important beet sugar manufacturing companies outside the Communist bloc and of the largest individual beet sugar factories, showing slicing capacities, campaign lengths, white sugar production, number of factories in each company, the slicing capacities of the individual largest factories and their campaign production.

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A modified "Desal" process for the treatment of beet diffusion juice. F. POLLIO and R. KUNIN. *Listy Cukr.*, 1970, **86**, 114–120.—See KUNIN: *I.S.J.*, 1970, **72**, 177.

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Effect of evaporator station arrangement on size of heating surface and steam and coal consumption. S. ZAGRODZKI. *Gaz. Cukr.*, 1970, **78**, 181–185.—Of the evaporator arrangements examined earlier[1], the best as regards coal and steam consumption is a quadruple-effect evaporator with thermo-compression, where pan vapour is used to heat the raw juice. This arrangement uses least heating surface, the requirements being the same as with quadruple-effect evaporation with thermo-compression but without pan vapour bleeding. To be able to maintain low coal and steam usage and yet satisfy demands for greater electrical power output, it is recommended to use high-pressure boilers (operating above 70 atm with steam superheating to above 480°C). For optimum evaporation, 2nd carbonatation juice should be brought to an alkalinity below 50 mg CaO/100°Bx by means of NaOH or with a cation exchange resin in Na^+ form, although ammoniacal treatment is considered the best method. Heat transfer in evaporators can be raised by means of forced circulation in each effect, particularly the last effect, and by maintaining a juice flow above 1 m/sec and a juice Brix above 60°, provided the heating surfaces are free of scale.

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The KC-2 industrial flow-type pH meter. W. STANKIEWICZ. *Gaz. Cukr.*, 1970, **78**, 185–187.—The pH meter described is provided with a calomel reference electrode housed separately from the main flow chamber to which the housing is, however, connected. NaCl solution drips freely from a tank via a capillary tube and pipette through the housing to the link section, where a porous glass partition blocks its flow into the main chamber and likewise prevents the juice entering the reference electrode chamber. The juice flows up through the main chamber, provided with a self-cleaning antimony electrode, and flows out near the top. The electrical system includes

[1] *I.S.J.*, 1971, **73**, 000.

a voltage compensator, transistorized amplifier and ambient temperature compensator. No compensation is provided for juice temperature, although readings are based on the values at 20°C. The readings varied from —0·5 to +0·2 units with 1st and 2nd carbonatation juice, compared with —0·12 to +0·3 for a Hartmann & Braun instrument with 1st carbonatation juice and 0·0–0·6 with 2nd carbonatation juice. A Pye "Dynacap" pH meter gave values fluctuating from —0·1 to +0·9 units with 1st carbonatation juice.

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Boiling-out an evaporator without halting beet flow. B. KUTERMANKIEWICZ. *Gaz. Cukr.*, 1970, **78,** 188–190. The system described, which has been applied successfully at Chybie sugar factory (Poland) and is claimed to reduce campaign length and losses and increase sugar yield while not necessitating any shut-down, involves boiling-out each evaporator effect in turn with a mixture of sodium carbonate, sodium hydroxide and sodium triphosphate in given proportions depending on the effect, followed by treatment with HCl of given concentration, again according to the effect, and finally rinsing with water and a weak solution of sodium carbonate. The complete treatment takes 11–12 hr per effect.

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Investigations of the oxygen content of diffusion juices. G. POLLACH and H. KLAUSHOFER. *Zucker*, 1970, **23,** 537–539.—Injection of air at regular intervals into the tower diffusers at two Austrian sugar factories in order to inhibit growth of the strongly anaerobic thermophile, *Clostridium thermohydrosulfuricum*, led to a study of the effect of various factors on the oxygen content of the diffusion juice. Although the juice in the lower section of each diffuser has a constantly low oxygen partial pressure (0–3 mm Hg), indicating the absence of bacterial effect on the pO_2 value (measured with an oxygen electrode as used by CLARK[1]), one of the juices in the upper section showed the same low partial pressure despite aeration, while that in the other diffuser showed a considerable increase, as would be expected; the value in this juice tended to fall to zero with anaerobic infection. Where SO_2 was used to treat the recycled water used in diffusion, the pO_2 of the water (0–2) was about the same as of the juice (2), while that of the press water was much higher (20–50). However, when treatment was stopped for 2 hr, the pO_2 of the diffusion water rose (30–40) as did that of the press water (100–110), whereas the juice pO_2 increased only slightly (5). The same behaviour was found with samples from the middle of the tower. The oxygen introduced with the water, it is suggested, is consumed by beet constituents and their derivatives, since disinfection before the test resulted in a negative bacterial count. From further experiments to find a reason for the fall in oxygen in diffusion, raw and press juices and in diffusion and press water it was concluded that enzyme systems retain at least some of their activity, even at high temperature, such systems having been found earlier to be responsible for considerable drops in oxygen in potatoes subjected to treatment with pure nitrogen.

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Method for mathematical determination of the amounts of sugar that can be crystallized in white sugar vacuum pans. J. MANINA. *Zucker*, 1970, **23,** 539–544.—The quantity of crystallized sugar produced in a given boiling time is given by $W'.N'.(c' - c).k$; W' is the amount of water evaporated; N' is the so-called "non-sugar factor", which for purities between 70 and 100 has a value of $\left(\frac{\text{purity} - 60}{10}\right)^{2.5}$; $(c' - c)$ is a concentration factor which is the difference between the slopes of two lines of a sugar-water graph which link the origin with two successive points corresponding, respectively, to a given temperature, purity and saturation, and to the same factors after further evaporation; and k is an empirical crystallization factor calculated from analytical data. The inter-relationships between the first three factors is demonstrated in graph form, and practical application of the formula is explained by means of worked examples.

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Heat-moisture characteristics of processes in beet piles. M. Z. KHELEMSKII, V. Z. ZHADAN and A. A. MOVCHAN. *Pishch. Prom.*, 1969, (10), 13–17.—Investigations showed that air ventilating beet piles can, in its upward path, absorb heat and moisture released during respiration of the beets (loss of 1 g of sugar is accompanied by the liberation of 3·95 kcal of heat). At high values of the heat:moisture ratio in the air stream (above 2500 kcal/kg), the relative humidity of the air will be sufficiently low (75%) as to cause withering of the beets in the upper section of the pile, while at low values (e.g. 690) release of moisture from the air will cause the beets in the upper zone to "sweat". Increase in the natural flow of air in beet piles may occur through ducts provided for forced air cooling; during frosty weather this could mean a sufficient drop in natural air temperature, particularly where ground level metal ducts are used, to freeze the beets which will subsequently thaw when the air temperature rises and finally will start to rot. Hence, it is recommended to seal the ducts temporarily when forced ventilation is not being used.

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Crystallization of sugar from green syrup purified by the electro-ion exchange method. A. P. KOZYAVKIN and L. D. BOBROVNIK. *Pishch. Prom.*, 1969, (10), 22–24.—Experiments on cooling a factory massecuite and an artificial massecuite from 64°C to 49°C at the rate of 2·5°C/hr showed that their supersaturation curves were different and that the specific crystallization rate and crystal volume were greater for the artificial massecuite, obtained from green syrup demineralized by electrodialysis, than for the factory massecuite, all other conditions being equal. The differences are attributed to a smaller crystalliza-

[1] JENSEN: *Laboratorium*, 1963, (3), 1–7.

tion inhibiting effect of the non-sugars in the electrodialysed product than of those in normal factory products. The melassigenic properties of the non-sugars in electrodialysate were found to be smallest at 70% demineralization, no further improvement being effected by increasing demineralization to about 93%. Treatment of electrodialysate with anion exchange resin reduced the saturation coefficient by 0·1–0·15 and the standard molasses purity by 2–3 units, which could bring about an increase in sugar yield of 0·83% on weight of beet compared with a normal 3-massecuite system.

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Mass transfer in a pre-scalder and certain mass transfer processes in a KDA tower diffuser. N. S. KARPOVICH and V. M. LYSYANSKII. *Pishch. Prom.*, 1969, (10), 55–59.—Investigations at a number of Soviet sugar factories have shown that the total draft of a KDA tower diffuser may be increased by 27–36% as a result of pre-scalding. In the pre-scalder, which is separate from the tower, up to about 25% of the cossette sugar may be extracted, particularly under conditions of direct flow and at a pre-scalder draft of the order of 400%. From the results of the investigations, the patterns of mass transfer in both pre-scalder and tower have been determined, and three typical process patterns, differing in the sections of the diffuser where the mass transfer coefficients are greatest, cossette length, juice draft and ranges of values of the mass transfer coefficient, are described and the losses given for each system. The aim is to provide a means of determining those conditions where sugar losses are minimal, particularly having regard to pre-scalder operation, for which cossette and juice sampling is considered necessary as a means of control.

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Candle filters for check filtration of juices and syrup. I. Z. GERCHIKOVA, YA. YA. LAZHKE and YU. A. SEMENTSOV. *Sakhar. Prom.*, 1970, **44,** (9), 18–20. Details are given of a Soviet candle filter which is used at a Latvian sugar factory for check filtration of 1st and 2nd carbonatation juice, sulphitation juice and sulphited remelt liquor, the factory being used for processing of raws during the inter-campaign period. Advantages of the filter are given as well as some operational data on throughput and 1st carbonatation juice treatment.

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Survey of the operation of sugar factory lime kiln operation (in the USSR). N. P. TABUNSHCHIKOV and L. D. SHEVTSOV. *Sakhar. Prom.*, 1970, **44,** (9), 20–27. Various aspects of the subject are surveyed, particularly limestone and fuel consumption and charging and discharging.

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Use of chloride of lime for treatment of beet after washing. V. Z. NAKHODKINA and O. M. SOROKINA. *Sakhar. Prom.*, 1970, **44,** (9), 31–32.—Tests were conducted on treatment of beet, after washing, with chloride of lime in order to reduce the bacterial content of the water adhering to the beet. While 0·004% chloride of lime (on weight of beet) had only slight bacterial effect, 0·008–0·01% chloride of lime (containing 25% active chlorine) had maximum effect (up to 72–73·3% reduction) on mesophiles, thermophiles and moulds in cossettes taken from before the scalder; 0·02% chloride of lime (22% a.i.) eliminated all the thermophiles, but these are admitted to be the least harmful bacteria in a sugar factory. It is claimed that the costs of equipment and materials would easily be offset by the reduction in sugar losses.

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Corrosion of power plant equipment. P. T. DUNAEV. *Sakhar. Prom.*, 1970, **44,** (9), 38–40.—To combat oxidation corrosion of steel tubes in power plant boilers and prevent oxide-ammonia corrosion of ferrous metals, the use of deaerators for feed water is recommended. Attention is also called to the creation of soluble copper complexes where feed water is treated with phosphate. The water should have a minimum alkalinity (against phenolphthalein) of 0·1–1 meq/litre, particularly where there is danger of contamination with factory effluent.

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Coverless storage of sugar beet in Kirgiziya. F. N. DOBRONRAVOV and F. I. KHAMAZA. *Sakhar. Prom.*, 1970, **44,** (9), 43–44.—Reference is made to the spraying of beet piles with milk-of-lime and subsequent storage without covers, whereby the temperature was kept 1·2–4·5°C lower than in control piles with covers. Over 68 days daily weight and sugar losses were lower than in the control.

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Suggestion for construction of a pilot-plant electrodialyser. R. BRETSCHNEIDER and P. KADLEC. *Listy Cukr.*, 1970, **86,** 131–138.—Details are given of a proposed pilot-scale electrodialyser design for a nominal throughput of 1 m^3 of juice per hour although capable of being easily scaled up or down if required. Diagrams are given as well as flow-sheets showing possible application of the unit for 1st carbonatation juice treatment in one or two stages. Results are given of tests on types of spacer for the electrodialyser, showing that a PVC spacer with twelve 2·7-mm perforations per cm^2 was preferable to a labyrinth type, since it gave smaller pressure losses and allowed about 90% of the membrane surface to be used.

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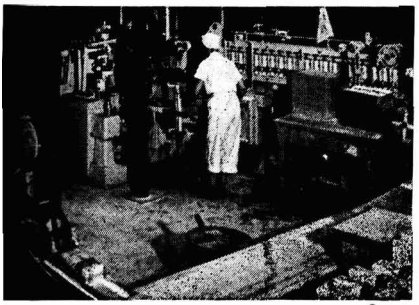
Dissociation of non-sugar in strongly acid conditions and new concepts of the application of ion exchange resins on the H-OH cycle for demineralization. P. BALDASSARI. *Ind. Sacc. Ital.*, 1970, **63,** 123–126. Analysis of the non-sugar content of beet juice adjusted to pH 1 showed a total of 902 meq % non-sugars of basic compounds and 423·03 meq % for acidic compounds, i.e. a ratio of 1:0·47. Thus, demineralization with a mixture of resins of equal cation and anion adsorption capacities implies a waste of the latter and it may thus be achieved at lower cost and higher efficiency by adjusting the resin proportions to the actual duty.



Sugar refining

Sugar refining in Portugal. J. F. FALSTEAD. *Sugar y Azúcar*, 1970, **65**, (4), 38–40.—A survey is given of the Portuguese sugar refining industry and of the four refineries now producing granulated sugar (in contrast to areado, previously the major product in Portugal[1]). Process modifications made necessary by the changeover to granulated sugar production have been designed by Tate & Lyle Technical Services Ltd.

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Investigation of the physico-chemical properties of Inzensk kieselguhr. V. A. KOLESNIKOV and V. A. MAKSYUTOV. *Sakhar. Prom.*, 1970, **44**, (5), 19–21. Investigations have shown that kieselguhr from Inzensk (in the USSR) has a number of physico-chemical and filtering properties which are not as good as those of "Hyflo-Super Cel". Details are given of the test results.

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Aspects of white sugar conditioning and storage. F. M. CHAPMAN. *Paper presented to the 20th Tech. British Sugar Corp.*, 1970.—The subject of white sugar conditioning to exhaust the film of white molasses surrounding the crystal and reduce the moisture content (from 0·06% on leaving the granulator to 0·01% when completely conditioned) is discussed in some detail. Plant used at the St. Lawrence refinery of Canada & Dominion Sugar Co. Ltd. for refined sugar conditioning is then described. Various aspects of white sugar bulk storage are considered, followed be descriptions of various types of silos and reference to certain factors that need to be borne in mind, including insulation, cold spots, micro-organisms, and particularly charging and discharging arrangements and silo wall stresses.

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Some improvements in the design and operation of coal-fired boilers. J. X. SHUM. *Proc. 43rd Congr. S. African Sugar Tech. Assoc.*, 1969, 159–176.—Problems experienced in the operation of coal-fired boilers at Hulett's South African Refineries Ltd. and the methods used to overcome them are discussed. They include superheater tube chokes and failure, economizer tube chokes (overcome by installing flyash arresters), coal grade variation, maintenance of accumulator pressure within pre-set limints, and clinkering, which was prevented by adding copper oxychloride to the coal; this had the advantage of reducing tube fouling by making any deposit easily friable as well as breaking the clinker down into small pieces.

Sugar cooled by a Jetstream conveyor. A. R. DOMÍNGUEZ. *Sugar y Azúcar*, 1970, **65**, (5), 27.—The cooling conveyor described was designed and built by the Jetstream Conveyor Co. and operates on the fluidization principle. Low-pressure air is introduced into a pressurized plenum chamber and flows up through orifices in a horizontal plate or "deck". The air jets include a horizontal component which moves the sugar sideways along the conveyor deck and a vertical component which lifts the sugar and floats it in the air stream. In tests, raw sugar was cooled from 116–122°F to 94–96°F and the moisture content reduced from 1·81–2·56% to 1·07–1·85%. (In other tests it was found possible to dry and convey raw sugar at an angle of 15° to the horizontal without increasing the air pressure in the plenum.) Wet refined sugar was cooled from 110–142°F to 100–118°F with a drop in moisture content from 0·884–1·34% to 0·246–0·968%. The terminal velocity of the sugar along the conveyor (greater than 1000 ft/min) is such that the sugar leaves the conveyor in the same manner as when discharged from a slinger.

* * *

Use of granular carbons in refining. D. L. SKORBUN. *Sakhar. Prom.*, 1970, **44**, (7), 30–33.—Various aspects of granular carbon application are discussed. A number of difficulties have been caused in the USSR by the sharp drop in alkalinity when treating syrup with AGS-3 granular carbon. Large quantities of soda ash have been needed to restore the alkalinity level; however, milk-of-lime settlings have proved more economical, while being less melassigenic than soda ash and causing less invert formation. AGS-4 carbon, to which Mg is added, does not offer the same difficulties since all treated products are maintained slightly alkaline. Practical experience with bone char filters modified for use with granular carbon has shown that conversion of the filters is not necessary. Details are given of a rotary furnace for carbon regeneration in which the carbon is roasted at 700–800°C. Since the residue retained by a fine screen used to separate the fine particles of regenerated carbon amounted to 8–10% by weight of the total carbon, it was decided to remove the screen and feed all the carbon to the filters. A hydraulic conveying system for the carbon, based on a system used at Charkassk refinery, is also described and its advantages discussed.

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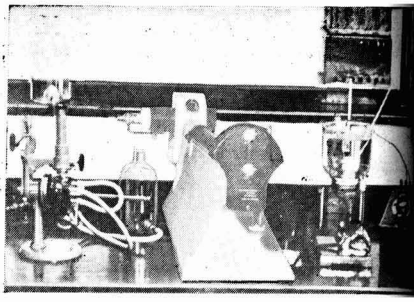
[1] *I.S.J.*, 1970, **72**, 191.

Laboratory methods & Chemical reports



Importance of "hardness" in the process of sugar manufacture. R. VELÁZQUEZ R. *Bol. Azuc. Mex.*, 1970, (244), 14–16.—"Hardness", i.e. the concentration of Ca and Mg in juices, is important in sugar manufacture because of scale formation and the ash content of the sugar produced. Methods for determining total hardness, Ca and Mg (by difference) using soap titration and EDTA are described.

* * *

Sugar solution purification by ion exclusion. K. ČÍŽ, V. ČEJKOVÁ and V. HOBÍKOVÁ. *Listy Cukr.*, 1970, **86**, 109–113.—A KCl-sucrose solution was used to determine optimum ion exclusion conditions with each of two different cation and one anion exchange resins. Ion exclusion was then conducted on raw sugar solution, thick juice, molasses and sweet water. Reasonable results were obtained with molasses solutions, although complete non-sugar removal was not achieved in any instance. Where sweet water had a low sugar content (less than 10% by weight), ion exclusion gave good salt separation. Since the process involves elution with water, the treated material will become diluted, which could pose problems with recycling.

* * *

Sucrose inversion rate and formation of HMF. Note 1. Quantitative study of the phenomenon in a medium acidified with citric acid. F. TATEO. *Ind. Alim.*, 1970, (64), 63–67.—Details are presented of experiments in which sucrose solutions adjusted to various pH levels with citric acid were kept at 20°C, and the degree of inversion measured after 10 days. It was greatest at pH 2·2, the lowest level employed, and this and pH 3·0 were used for subsequent experiments where the solutions were kept at 75°C and the rates of inversion measured. Inversion was practically complete within 60 min at pH 2·2, but was only 27·5% complete at pH 3·0. When HCl was used for pH adjustment instead of citric acid, inversion was more rapid, reaching 100% after only 40 min at 75°C. Hydroxymethyl furfural was measured spectrophotometrically at 285 nm and its formation was found to be influenced by pH and the acid used parallel to the degree of inversion.

* * *

Volumetric estimation of phosphate in technical sugar solutions using ion exchange resin. N. A. RAMAIAH and S. K. SRIVASTAVA. *Sharkara*, 1970, **12**, 12–17. A method for quantitative determination of phosphate in cane juice is described which involves removal of interfering organic anions and colour by treating a 200-ml sample of mixed juice with dry lead subacetate after pH adjustment to 11–11·5 with NaOH. After filtration, 100 ml of the filtrate is passed through 50 ml of "Amberlite IRA-900" strongly basic anion exchange resin in OH^- form; this adsorbs the phosphate and inorganic anions, which are then eluted with 0·5N HCl. The eluate is made alkaline to phenolphthalein with N NaOH and back-titrated with 0·01N HCl and the difference in titre between end-points with phenolphthalein and methyl red indicators recorded; this difference corresponds to the phosphate content. Results for phosphate added to juice were compared with values obtained by the uranyl acetate method. Reasonably close agreement was obtained, the uranyl acetate method giving slightly lower values than did the ion exchange method.

* * *

Determination of the polarization of consumption sugar. W. SCHIEBEL. *Zucker*, 1970, **23**, 545–547.—In the conventional method of polarization measurement, in which the solution is made up to a given volume, inaccuracies may arise as a result of an indistinct meniscus and volume contraction as well as difficulty in obtaining a thoroughly mixed sample. To avoid this, the author suggests weighing out the solution water instead of filling to the mark. From tests involving refined sugar of about 100°S a graph was drawn showing a linear relationship between weight of water and polarization for each sugar content in the range 98–101% at 1% intervals (as well as 99·5%). Since the weight of water used will govern the polarimeter reading, a nomogram has been prepared from the test data and is reproduced for use with the modified method, which does not require clarification with lead acetate.

* * *

Spectroscopic determination of betaine in sugar factory products. V. PREY, H. SCHINDLBAUER and S. PIEH. *Sucr. Belge*, 1970, **89**, 449–454.—A new method is described in which the absorption at 1335 cm^{-1} in the infra-red band of the spectrum due to trimethylamine is measured by means of the frustrated multiple internal reflexion (FMIR) technique using a spectrometer provided with a germanium crystal in the liquid cell. The reading taken from a standard curve has to be corrected for variation in sucrose content, the factor being given by $(51\text{-}P) \times 0{\cdot}12$, where P is the molasses polarization and 51 is the polarization as a percentage of the value found for the authors' model molasses. Standard deviation of the method is $\pm$ 2%. Comparison of values found by this method

with results given by the method of CARRUTHERS & OLDFIELD[1] showed a relative difference ranging from −7·5 to + 6·6%.

* * *

The chemical nature of sucrose caramelization products. Z. P. MIROSHNIKOVA, G. A. CHIKIN and N. M. TOBOLINA. *Sakhar. Prom.*, 1970, **44**, (9), 10–15.—A caramel product obtained by heating sucrose was subjected to column chromatography on anion exchange resin to separate it into its two components, caramelan and caramelen (it was concluded that caramelin was absent since this is insoluble in water whereas the product obtained was easily soluble). After separation and purification, the melting points of both components were measured, being taken as that point at which there was sharp increase in the colorant volume. From three measurements two values were obtained for each: for caramelen 153·5° and 154°C, and for caramelan 122·5° and 138°C (the second value in each case being that obtained twice). From u.v. measurements the substances were found to be homogeneous; i.r. measurements showed them to be unsaturated carbonyl compounds containing a large number of OH groups of varying basicity and capable of forming heterocyclic compounds. The keto-group contained in them exists in open-chain form.

* * *

Measurement of small quantities of sugar in evaporator station condensates by VPF-VTI flame photometer. D. A. STOLYAR, A. A. ANDRYUKHIN and N. YU. TOBILEVICH. *Sakhar. Prom.*, 1970, **44**, (9), 33–34. The flame photometric method devised for sugar determination in condensate is based on entrainment by low- and medium-pressure steam of moisture droplets as well as dissolved substances. The total content of indicator (Na^+, K^+ and Ca^{++}) in the saturated steam, S_p (mg/litre), is given by $\frac{W}{100} S_r$, where W is the steam moisture content and S_r is the total indicator content in the thick juice (mg/litre). Hence, the entrainment coefficient, K, is given by $\frac{S_p}{S_r}$. The sugar content in reheat steam condensate, G_p, is given by KG_r, where G_r is the sugar content in the thick juice. Thus, determination of the indicator content will permit calculation of the condensate sugar content down to 0·0005–0·0001%, depending on the value of K. Accuracy is ± 4%.

* * *

Determination of the explosive dimensions of sugar particles. A. V. DAN'KO and A. M. KOSTENYUK. *Sakhar. Prom.*, 1970, **44**, (9), 15–18.—By means of a method used earlier[2], the lower explosive concentration limit of sugar dust in air was found to increase with particle size, and with particles of below 60 nm had a minimum value of 37·5 g/cu.m., which agrees closely with the value found by JACOBSON & NAGY[3]. No explosions were observed with particles larger than 200 nm; even with particles of 120 nm there was long delay between electrical discharge and any explosion which was furthermore weak. Below 120 nm a fall in particle size caused more active ignition, the particular size governing the flame spread. Of significance in the determination of the lower explosive concentration limit is the content of highly dispersed dust in the air-dust mixture, as found by SCHNEIDER[4]. Values of the limit are tabulated for various size fractions on the basis of SCHNEIDER's work. The presence of sugar crystals (0·5–1·5 mm) had an inhibiting effect on flame spread, although flame spread and explosion were completely checked only when therd was more than 99% of large crystals present. An empirical formula has been developed from oscillograms relating dust-air ignition time to mean dust particle size. A value of 2·65 millisec was extrapolated for the length of the flame induction period in a dust-air mixture with the smallest possible particle (~ 0).

* * *

Determination of colloid content by NFM nephelometer. S. E. KHARIN and S. T. KRYLOV. *Sakhar. Prom.*, 1970, **44**, (9), 34–37.—Nephelometric measurement of light scatter in blue, green and red light was used to determine the reversible colloid content in diffusion juice samples after precipitation and peptization. The formulae required for calculation of the final values are presented as well as tables of data and graphs relating the reversible colloid content in different diffuser sections to temperature. Some measurements were also made of thick juice reversible colloid content. The total determination process, including withdrawal of sample and calculations, takes only 30 min.

* * *

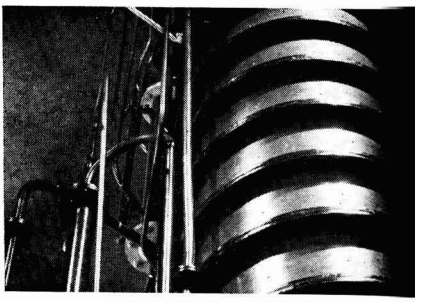
Determination of the value of hydraulic resistance in a 90° tube bend applicable to sugar factory products. Z. S. SHLIPCHENKO and G. E. RUDENKO-GRITSYUK. *Pishch. Prom.*, 1969, (10), 107–110.—Investigations were conducted on molasses flow at varying viscosities through a pipe system as used in earlier experiments[5]. The relationship between local flow resistance and Reynolds' number in the range 8–20,000 was determined in the case of a 90° bend. With steady (laminar) flow, total flow resistance was found to undergo a change from linear to transient state at much lower values of Reynolds' number than in the absence of local resistance as caused by the bend. The transient zone (Re = 100–12,000) results from the simultaneous action of viscosity and forces of inertia, and the local resistance in the 90° bend is given by $\frac{380}{\mathrm{Re}} + 1$.

* * *

Beet molasses formation and composition. XI. Optical rotation of the salt associates of various carbohydrates. G. VAVRINECZ. *Zeitsch. Zuckerind.*, 1970, **95**, 471–474. See *I.S.J.*, 1971, **73**, 90.

[1] *I.S.J.*, 1961, **63**, 103–104.
[2] DAN'KO & KOSTENYUK: *I.S.J.*, 1970, **72**, 247.
[3] *Food Tech.*, 1962, **16**, (2).
[4] *Zucker*, 1969, **22**, 473–479; *I.S.J.*, 1970, **72**, 149.
[5] *I.S.J.*, 1963, **65**, 243.

By-products



Study on Brazilian molasses; production of food yeast. T. C. FARAH. *Brasil Açuc.*, 1970, **76**, 90–105.—Experiments are reported on yeast production from molasses samples from factories of Rio de Janeiro State. Methods for analysis of the molasses are discussed as are the preparation of fermentation media, yeasts used, and inoculum preparation. Conditions for the experiments are tabulated and the influence of a number of factors studied, e.g. sugar content, pH, temperature, aeration, etc. Satisfactory results were obtained with normal molasses but certain abnormal molasses gave inadequate yeast production; this could be corrected by addition of nitrogen and other nutritional salts.

* * *

Preliminary work on obtaining secondary acetates from bagasse cellulose. G. AGUILAR N. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 40–52.—A close analogy was found between the products of acetylation of wood and bagasse pulps, and the characteristics of the cellulose acetates obtained were in line with values reported in the literature. Cellulose acetates obtained from bagasse pulp prepared by nitric acid pulping were of better quality then those obtained from pulp obtained by pre-hydrolysis-sulphate pulping.

* * *

Effect of ultra-violet radiation on furfural. M. D. GONZÁLEZ, J. LODOS and Y. KOZLOV. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 111–132.—The destruction of furfural by radiation when in solutions of 10^{-1} to 10^{-5} moles/litre in methanol, ethanol, carbon tetrachloride and cyclohexane was investigated. The U.V., I.R. and luminescence spectra are presented of the products which are solids at the high concentrations. It is suggested that in the last case, a polymer has been formed which does not possess the furane ring and in the formation of which oxygen has taken part. The structure of the polymer is similar to that of auto-oxidized furfural and other known furanic polymers.

* * *

Drying and briquetting of bagasse. E. BATLLE C. and J. A. ESPINOSA H. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 133–144. Advantages and disadvantages of bagasse storage in bales and briquettes are summarized, based on literature data and industrial experience in Cuba. The use of briquetting is considered a probable solution to the problem of decreasing labour, handling and transportation costs of bagasse as a raw material for cellulose production and a study of the operation of such a system is recommended.

* * *

Influence of bagasse compaction in briquettes on the characteristics of alkaline pulping. E. BATLLE C. and J. A. ESPINOSA H. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 145–155. Bagasse pulp was prepared, using the soda process, in 15- and 350-litre digesters, the bagasse having been briquetted. No ill effects were observed in pulping or pulp characteristics at loadings up to 173 kg/m³. Study of the use of bagasse briquettes in stationary digesters using the cold soda process is recommended.

* * *

Effects of bagasse preparation for paper production. V. GUINART D. and E. BATLLE C. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Bagasse By-Prod. Section), 174–192.—The effects of bagasse preparation in the sugar factory and its depithing were studied by preparation of pulp from bagasse produced in different factories in each of which conditions of milling were varied. Pulps from bagasse from the same factory showed little difference and it is concluded that the depithing process compensates for variations in milling. Differences were noted, however, in mechanical properties of bagasse pulps from factories using the same mill tandem combinations, and it is deduced that this is due to the individual component characteristics and not their overall action.

* * *

Study on the influence of different parameters on the processes of autolysis with yeast cream. T. SAIS H. and R. SOTOLONGO. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Ferment. By-Prod. Section), 1–36. Yeast autolysate is a material required for development of *Leuconostoc mesenteroides* and preparation of dextran. Experimental work is described on conditions for autolysis, using an imported baker's yeast and yeast produced in Cuba, varying the concentration, pH, temperature and time.

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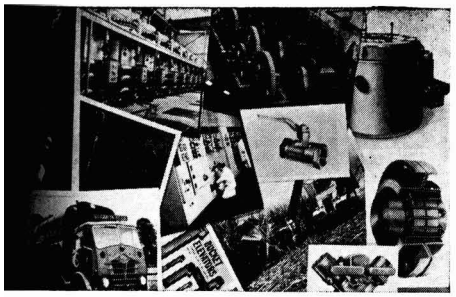
Production of biomass from wort-molasses mixtures. V. SILLINGER and O. ALMAZÁN. *XXXIX Conf. Asoc. Técn. Azuc. Cuba*, 1970, (Ferment. By-Prod. Section), 143–157.—Details are given on experiments on the supplementing of worts with molasses for their fermentation to produce *Torula* fodder yeast.

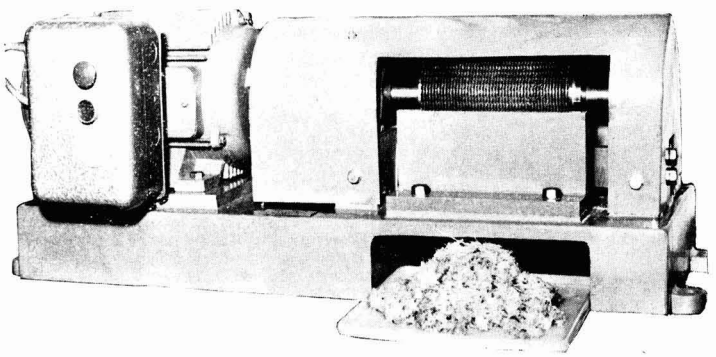


Trade notices

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.

The "Cutex" laboratory cane shredder. The Sugar Manufacturers' Supply Co. Ltd., 196–204 Bermondsey St., London S.E.1, England.

The well-known "Cutex" laboratory cane shredder has been re-designed so that, instead of being connected by flexible coupling to an electric motor, it is now directly coupled to its motor (a 1·5 kW totally-enclosed, squirrel cage, fan-cooled unit operating from a 3-phase A.C. supply) on the same bed-plate. The starter is already wired to the motor and is mounted on the side of the motor casing to form a compact unit, so that the only connexion necessary is from the mains supply to the starter. Cane stalks are held against the hardened steel teeth of the rotating cutter of the shredder, and the disintegrated cane falls into the container below, which has a capacity of about 1·5 kg.



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Single- and multi-stage turbines. Peter Brotherhood Ltd., Peterborough PE4 6AB, England.

Peter Brotherhood two- and three-stage steam turbines are produced in the power range 500–4000 bhp with output speeds up to 2000 rpm. They are axial-flow, impulse types in which the rotor is machined from a solid gashed forging of heat-treated 3% chromium-molybdenum alloy steel and is designed for sub-critical operation. Speed control can be local or remote, security devices being provided for over-speed, low oil pressure and back pressure. These turbines are designed for use as cane mill or generator drives, while Brotherhood single-stage turbines are designed specifically for application as cane mill drives where size, high starting torque, simplicity, reliability and low first costs are important factors. The Brotherhood SS MD turbines now being produced cover the range 200–3000 bhp with output speeds in the range 800–2000 rpm. They are of the overhung rotor type, which has the advantages of considerable reduction in the number of wearing parts, simple robust design and suitability for quick starting. Maximum steam economy is achieved by means of two rows of moving blades provided on the rotor, although a single row is fitted where the process heating demands are greater than the power requirements. Details of both single- and multi-stage turbines are available in brochure form, Publication SMT/66 (available in Spanish as well as English) for single-stage models and SMT/70 for the multi-stage turbines.

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Grapples. Mennesson & Cie, Distillerie du Mont-Cotton, Bagnols-sur-Cèze (Gard), France.

Mennesson grapples, which can be used to lift a wide variety of materials, incorporate a patented system whereby each of the four grab sections is provided with its own hydraulic jack driven by an electric motor common to all four jacks which are attached to the motor casing. Thus, the sections exert a regular and progressive pressure, even with an irregular load, on the material being handled and form a true basket. A safety device prevents any abnormal strain. The material is truly picked up as with the hand. The capacities of grabs already installed at cane and beet sugar factories range from 0·4 to 12 m^3; their duties at these factories cover beet, pulp and beet washer stone handling and, of course, cane handling. The 12 m^3 grab is located at Onetto factory in Brazil, while one of 8 m^3 capacity has been installed at Tolong factory in the Philippines. Leaflets describing the grabs are available from the manufacturer.

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

A number of new features and improvements to the MF 201 "Cane Commander"[1] are announced as well as extended warranty cover. This self-propelled chopper harvester has been modified, as a result of operating experience in Australia and elsewhere, to give it greater strength, permit easier operation and reduce maintenance. The topper boom lift speed has been increased by 25%, the blower has greater air intake and there is now a choice of topper knives. Other changes involve the gathering walls, elevator, control platform and the rewind, which is now hydraulic instead of electric.

The MF 201 is one of two Massey-Ferguson machines (the other is a MF 81-5) planned for use on a 2000 ha cane estate in the Malagasy Republic, where Massey-Ferguson harvesters have already been in operation for some years.

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PUBLICATIONS RECEIVED

WATER TREATMENT. Werkspoor Water N.V., 14 De Boelelaan, P.O. Box 7811, Amsterdam, Holland.

Werkspoor Water N.V. was formed in 1970 by amalgamation of water treatment interests of three Dutch companies whose combined expertise is now available in the form of consulting and contracting engineers. The company provides plant and equipment for multi-cell electrodialysis, evaporation, softening, demineralization, scavenging of organic matter, pH control, flocculation and sedimentation of impurities, filtration, and other forms of treatment for drinking, process and boiler feed water, as well as domestic and industrial waste water. Information on these services is contained in a series of leaflets and brochures available from the company at the above address.

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COCKSEDGE AUTOMATIC LIME KILN PLANT. Cocksedge & Co. Ltd., P.O. Box 41, Greyfriars Road, Ipswich, IP1 1UW England.

A new leaflet illustrates the completely automatic lime kiln plant of 200 cu.m. capacity, installed at the Roosendaal factory of Suiker Unie in Holland; this is controlled by one operator per shift and produces a constant density milk of lime at 315–340 litres/min. Similar kilns from 60 to 300 cu.m. capacity are installed all over the world, in factories of daily capacity from 1000 to 6500 tons beet. Features of the plant are low maintenance costs, accurate process control and reliable operation. The plant offers precise density control with continuous recording and visual display of its operation.

* * *

THE HONIRON HI-EXTRACTION PROCESS. Honiron, 570 Auhi Street, Honolulu, Hawaii, USA.

A report by J. FARMER, Research and Development Director of Honiron (formerly Honolulu Iron Works Co.), was presented to the 29th Meeting of the Hawaiian Sugar Technologists, coincident with the unveiling of a model of the "Hi-Extractor". The report gives an account of the design of this cane diffuser and its ancillary equipment which is in greater detail than has appeared elsewhere[2]. The unit can process up to 140 tons/hour with a retention time of 15 minutes.

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HEAVY DUTY STEEL CHAINS FOR CONVEYORS AND ELEVATORS. Ewart Chainbelt Co. Ltd., Derby, England.

Catalogue No. 440, Section IX, has recently been reprinted and brought up to date. It is in English, French, German and Spanish and gives full dimensional data, loadings and weights of the range of chains covered, with metric equivalents also tabulated. The catalogue also provides illustrations of the various types of chain and components, and notes the materials of construction.

* * *

NEPTUNE "KOLTEK" CONTROL VALVES. Neptune Measurement Ltd., P.O. Box 2, Dobcross, Oldham, Lancs., England.

This leaflet describes the "Koltek" valves which are built in stainless steel and are especially suited to industries where hygienic requirements are important. They may be manually or automatically operated, the latter by a pneumatic cylinder. Limit switches are fitted to detect each operating position of the valves and the control system can be arranged to ensure that any electrical or pneumatic disturbance does not alter the valve positioning.

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LIQUID METERS. Oy. Fima Ltd., Traktoritie 6, Helsinki 70, Finland.

A range of liquid meters, manufactured by OT Tehdas Oy. but exported by the above company, operates on the rotary piston principle and provides clean, accurate, sturdy and efficient measurement of liquid quantity, recorded either by a mechanical counter or by an additional electronic impulse transmitter. They are of use in measuring juice, water, etc., and can be fitted to a bulk road tanker for volume input and output measurement, or used for measurement into storage tanks, for mixing of different liquids, etc.

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HEATHKIT 1971. Heath (Gloucester) Ltd., Gloucester, GL2 6EE England.

The Heathkit catalogue for 1971 includes a range of kits for construction of many types of equipment including stereo and high-fidelity tuners, amplifiers, etc., and automobile and amateur radio equipment. It also contains a large number of kits for equipment of use in industry, including meters, oscilloscopes, a spectrophotometer, and an analogue computer, etc.

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Senegal refinery and sugar factory order.—Maschinenfabrik Buckau R. Wolf AG have received an order from Senegal for the supply of a cane sugar refinery having a capacity of 200 tons/day and a raw sugar factory of 3000 t.c.d. capacity in the vicinity of Richard Toll. Construction of the refinery is the first phase of the project; between completion of the refinery (planned for February 1972) and construction of the raw sugar factory, the refinery will process imported cane raws, producing loaf and cube sugar as well as fine-grade refined sugar. Expansion of both refinery and factory is provided for.

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Czechoslovakia to supply cane mill[3].—An order for the supply of a 6-mill Skoda tandem to Haft Tappeh sugar factory in Iran has been obtained by Technoexport. The tandem, to be supplied on a turn-key basis, will have a capacity of 6000 t.c.d. and will raise the capacity to 12,000 t.c.d. by the 1972 season.

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Sugar silo order for UK firm.—It is announced that The Tills Engineering Co. Ltd., a subsidiary of Tate & Lyle Refineries Ltd., has received an order worth £30,000 from Needlers Ltd., confectionery manufacturers, for the supply and installation of two 35-ton elevated silos for granulated and mineral water sugars, together with pneumatic conveying lines and four internal subsidiary feed hoppers. Two further feed hoppers and ancillary equipment may be supplied later. The installation will double Needlers' sugar storage capacity.

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Erratum.—The pressure given in line 13 of column 1 on p. 30 of our January issue is incorrectly given as 40 p.s.i. and should be 140 p.s.i.

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[1] *I.S.J.*, 1970, **72**, 285.
[2] *ibid.*, 1968, **70**, 244; 1969, **71**, 116, 348; 1970, **72**, 122.
[3] *Czechoslovak Heavy Ind.*, 1971, (4), 28.

World sugar production estimates 1970/71[1]

	Campaign	Estimate 1960/71	1969/70
		(*metric tons, raw value*)	
BEET SUGAR			
EUROPE			
Belgium-Luxembourg	Sept./Jan.	606,000	687,184
France	,,	2,755,553	2,783,331
Germany, West	,,	2,100,220	2,119,909
Holland	,,	715,000	780,800
Italy	July/Oct.	1,225,000	1,415,554
Total E.E.C.		*7,401,773*	*7,786,778*
Austria	Sept./Jan.	330,979	357,162
Denmark	,,	297,777	311,111
Finland	,,	60,600	55,754
Greece	July/Oct.*	192,028	149,422
Ireland	Sept./Jan.	153,128	150,137
Spain	July/March	874,000	770,869
Sweden	Sept./Jan.	223,889	210,589
Switzerland	,,	59,477	62,900
Turkey	Aug./Feb.	643,000	544,922
United Kingdom	Sept./Jan.	1,009,296	955,650
Yugoslavia	Aug./Jan.	458,300	568,152
Total West Europe		*11,704,247*	*11,923,446*
Albania	Aug./Jan.	17,000	16,000
Bulgaria	,,	235,000	220,000
Czechoslovakia	Sept./Jan.	780,000	731,500
Germany, East	,,	500,000	450,000
Hungary	,,	258,344	449,371
Poland	,,	1,649,000	1,527,000
Rumania	Aug./Feb.	380,000	438,037
USSR	Sept./Jan.	9,500,000	9,049,991
Total East Europe		*13,319,344*	*12,881,899*
Total Europe		25,023,591	24,805,345
OTHER CONTINENTS			
Afghanistan	Nov./Feb.	9,000	7,901
Algeria	June/Nov.*	10,000	9,980
Azores	June/March	11,000	10,000
Canada	Oct./Dec.*	107,200	136,574
Chile	April/June†	224,800	226,419
China	Jan./Dec.†	800,000	750,000
Iran	Oct./March	560,000	508,889
Iraq	,,	5,000	5,000
Israel	May/July†	35,000	32,225
Japan	Oct./Feb.	337,903	330,217
Lebanon	June/Nov.*	10,000	10,000
Morocco	May/Aug.†	160,000	155,325
Pakistan	June/July†	16,900	25,776
Syria	May/June†	30,000	30,000
Tunisia	May/April	5,975	5,790
United States	July/June	3,039,053	3,077,154
Uruguay	May/April	45,000	34,857
Total Other Continents		5,406,831	5,356,107
TOTAL BEET SUGAR		30,430,422	30,161,452
CANE SUGAR			
EUROPE			
Spain	March/Sept.	50,000	42,811
NORTH AND CENTRAL AMERICA			
British Honduras	Dec./June	62,500	67,882
Costa Rica	,,	150,000	145,000
Cuba	Aug./July	5,750,000]	8,533,312
Dominican Republic	Nov./Sept.	1,000,000	1,043,257
Guadeloupe	Jan./June†	178,900	172,804
Guatemala	Dec./June	207,200	184,976
Haiti	,,	68,000	65,000
Honduras	,,	70,000	70,000
Martinique	Jan./June†	35,000	29,010
Mexico	Nov./July	2,383,000	2,365,207
Nicaragua	Dec./June	150,000	142,000
Panama	,,	86,200	78,406
Puerto Rico	Jan./July†	417,800	417,847
Salvador	Nov./June	140,200	118,750
USA—Hawaii	Jan./Dec.†	1,104,000	1,054,208
Mainland	Oct./June	1,157,000	971,560
West Indies—Antigua‡	Jan./June†	15,200	4,407
Barbados‡	,,	167,600	157,459
Jamaica‡	,,	426,700	376,403
St. Kitts‡	,,	35,600	27,202
Trinidad‡	,,	238,800	219,965
Total North and Central America		13,843,700	16,244,655
SOUTH AMERICA			
Argentina	July/Dec.*	995,776	997,757
Bolivia	May/Sept.†	125,482	123,939
Brazil‡	June/May	4,960,000	4,332,940
Colombia	Jan./Dec.†	787,100	677,000
Ecuador	June/Jan.	300,000	270,000
Guyana‡	Oct./June	396,200	316,127
Paraguay	July/Nov.*	53,723	47,103
Peru‡	Jan./Dec.†	750,000	750,000
Surinam	Aug./May	12,896	13,177
Uruguay	May/April	10,000	10,144
Venezuela	Sept./Aug.	475,000	443,000
Total South America		8,866,177	7,981,187
AFRICA			
Angola‡	May/March	70,000	62,131
Cameroun	April/Sept.*	10,000	9,000
Congo (Brazzaville)	May/Nov.*	90,000	95,283
Congo (Kinshasa)	,,	48,000	45,000
Ethiopia	Nov./June	123,000	109,632
Ghana	April/Sept.*	24,000	22,000
Kenya	July/June	150,000	135,000
Madeira	March/Sept.*	3,457	3,337
Malagasy Republic	July/June	115,000	100,000
Malawi	May/Nov.*	20,000	20,094
Mali	April/Sept.*	5,000	5,000
Mauritius‡	July/Jan.	610,776	708,056
Mozambique	May/Nov.*	260,000	230,000
Nigeria	,,	27,700	30,480
Réunion	June/Jan.	210,628‡	282,991
Rhodesia	May/Nov.*	145,000	130,000
Somalia	Dec./April	50,000	46,000
South Africa	May/April	1,550,000	1,653,791
Sudan	Dec./June	110,000	100,000
Swaziland	May/Dec.*	170,401	165,200
Tanzania	July/June	100,000	95,000
Uganda	,,	170,000	164,901
UAR (Egypt)	Dec./June	515,000	491,050
Zambia	May/Nov.*	44,000	33,767
Total Africa		4,621,962	4,737,713
ASIA			
Afghanistan	Oct./April	12,000	11,000
Burma	Nov./April	95,000	90,000
Ceylon	Nov./June	11,000	10,000
China	Jan./Dec.†	2,350,000	2,250,000
India, excl. khandsari	Oct./July	4,422,000	4,711,773
Indonesia	May/Dec.*	776,448	807,005
Iran	Oct./April	61,000	60,266
Japan & Ryukyu Islands	Nov./June	310,000	303,219
Nepal	Oct./April	10,000	10,000
Pakistan	Nov./May	564,400	748,389
Philippines	Nov./July	2,310,000	1,972,083
Taiwan	Nov./June	800,000	614,943
Thailand	Oct./April	470,000	476,197
Total Asia		12,191,848	12,064,875
OCEANIA			
Australia	May/Dec.*	2,590,000	2,275,000
Fiji	,,	383,000	322,000
Total Oceania		2,973,000	2,597,000
TOTAL CANE SUGAR		42,546,687	43,668,241
TOTAL BEET SUGAR		30,430,422	30,161,452
TOTAL SUGAR PRODUCTION		72,977,109	73,829,693

[1] F. O. Licht, *International Sugar Rpt.*, 1971, **103**, (6), 1–4.

* 1970, 1969

† 1971, 1970

‡ tel quel

Brevities

UK sugar production 1970[1].—The 1970 campaign ended with a total of 6,310,000 tons of beet delivered to the factories, more than 370,000 tons better than the preceding year but below the five-year average. Sugar content was above average at 17·03% for the season and resulted in a sugar production of 895,000 tons, white value, the second highest figure on record. The average yield of beet per acre was 14·31 tons, 0·68 tons/acre better than in 1969 but lower than the five-year average of 15·51 tons/acre. Dried beet pulp amounted to 582,000 tons while molasses production was 168,000 tons.

* * *

UK sugar refiners' margin.—An agreement has been reached between Government Departments and Tate & Lyle Ltd. revising and extending the latter's undertaking to limit the difference between the prices at which they purchase raw sugar and sell refined sugar. The undertaking will now apply to bulk refined sugar, and the refiners' margin, which is also observed by the other UK refiners, will be limited to £16·566 per ton for sugar in 1 cwt paper sacks, to £21·866 per ton for sugar in 2-lb packets and to £14·366 per ton for sugar in bulk tankers. These margins are all subject to variation in relation to changes in the indexes of costs relating to employees' wages and salaries, the cost of coal and materials used in mechanical engineering, and in the contract price of molasses.

* * *

Dominican Republic sugar crop[2].—The customary yearly sugar crop Presidential Decree for 1971 has been issued by the President of the Dominican Republic. The crop has been fixed at 1,260,400 short tons of which 466,480 tons have been earmarked for export to the US and 205,280 tons for export to the World Market. A total of 150,000 tons has been assigned to local consumption and the balance will be held in reserve for further allocations to the US and World Markets.

* * *

South African sugar production 1970/71[3].—All sugar mills in the Republic of South Africa have now ceased crushing operations for the season. Production during the 1970/71 season is estimated at 1,398,890 metric tons of sugar made from 12,143,897 tons of cane. Output declined 9·1% from the level for the 1969/70 season, when 1,539,014 tons of sugar was made from 14,021,242 tons of cane. The sucrose content of the cane was higher in the current season than in 1969/70 and, although production in 1970/71 was 140,000 tons lower than that of last season, the cane to sugar ratio was the best since 1966/67. Local demand for sugar remained buoyant, while exports during 1970 totalled 741,987 tons, which compares favourably with the 664,726 tons exported in 1969.

* * *

Argentina sugar production targets and prices[4].—The 1971 sugar production quota has been fixed at 1,100,000 tons, compared with 850,000 tons in 1970. The minimum prices for raw sugar and cane with 12% sugar content have been fixed at 0·60 new peso per kg and 31·50 new pesos per ton, respectively.

* * *

Nigerian cane sugar project[5].—The Savannah Sugar Co. Ltd., in cooperation with the Commonwealth Development Corporation (Nigeria) Ltd., the North Eastern State and Federal Governments, is investigating the possibility of establishing a sugar cane plantation in the Numan area of the North Eastern State. Should the feasibility report prove favourable—and it is hoped that it will do so—the sugar plantation when established is likely to cover between 10,000 and 20,000 acres.

Indonesia sugar industry development programme.—The World Bank has commissioned a consortium, made up of Bookers Agricultural and Technical Services and Tate & Lyle Technical Services Ltd., to work out a 10-year development programme for the Indonesian sugar industry. The Booker Group has indicated that the programme will have as its primary aim the re-establishment of an efficient sugar industry in Java where 55 sugar factories produce only 600,000 tons per annum, compared with the total capacity of 2,000,000 tons of sugar which they once had. In addition, the consortium is to look into the possibility of growing sugar cane on other Indonesian islands.

* * *

Colonial Sugar Refining Co. Ltd. sale of Fiji properties[6]. The Government of Fiji has negotiated an agreement with the CSR Company for the transfer of almost all its land holdings to the Government in April 1973. It involves about 77,000 acres of freehold land and further large areas leased by CSR. Pending formal approval, details of price are withheld. A Select Committee, chaired by Lord DENNING, recommended in March 1970 that CSR's 98% holding in South Pacific Sugar Mills Ltd. should be purchased by the Government of Fiji.

* * *

New Guinea sugar industry possibility[7].—No firm decision as to whether a cane sugar industry could be established in the Markham Valley will be made until March 1972. By then, results of further observations of sugar cane on a 100-acre experimental block will be known. Trial plantings in the Markham Valley area of the Morobe District are being carried out by the Department of Agriculture, Stock and Fisheries to ascertain if sugar cane could be established as a commercial industry in the Territory of Papua and New Guinea.

* * *

Yugoslavian sugar factory expansion[8].—The sugar factory at Banat has re-started operations after an 8-months shut-down for expansion work which has raised the daily slicing capacity from 2000 to 6000 tons of beet.

* * *

Peru sugar production 1970[9].—Production of sugar in Peru in 1970 is reported officially at 792,000 tons, compared with 632,000 tons in 1969.

* * *

Hungary sugar expansion[10].—Because of the shortfall in sugar production in 1970, when Hungarian sugar factories produced only something under 300,000 tons of sugar from 2·3 million tons of beet grown on an area of 73,000 hectares, considerable quantities of sugar will have to be imported in 1971 to cover the country's needs. It has therefore been decided to increase the beet area to 90,000 ha and to aim at a higher beet yield per hectare. Modernization of agricultural methods, particularly involving greater use of mechanization, and the use of large-scale operation to reduce costs are to be undertaken.

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[1] *British Sugar Beet Review*, 1971, **39**, 116.
[2] *Lamborn*, 1971, **49**, 32.
[3] *Standard Bank Review*, March 1971, 43.
[4] *Bank of London & S. America Review*, 1971, **5**, 147.
[5] *Standard Bank Review*, March 1971, 19.
[6] *The Times*, 6th March 1971.
[7] *Producers' Review*, 1970, **60**, (11), 63.
[8] *Zucker*, 1971, **24**, 29.
[9] *Bank of London & S. America Review*, 1971, **5**, 170.
[10] *Zucker*, 1971, **24**, 174.

From "Illustrated Sydney News", Sept. 4th, 1868

Mr. Meares' Steam Sugar Mill, Macquarie River

IN 1868 Mr. MEARES, A CANE GROWER OF PORT MACQUARIE, N.S.W., BUILT HIS OWN RAW SUGAR FACTORY.

TO EXTRACT THE JUICE FROM THE CANE HE USED A THREE ROLL MILL, THE ROLLER AXES BEING HORIZONTAL BUT ALL LYING ABOVE ONE ANOTHER IN A VERTICAL PLANE. WHOLE STICK CANE WAS MANUALLY FED INTO THE TOP PAIR OF ROLLS, RECEIVED BY A MAN ON THE OTHER SIDE, AND REVERSED THROUGH THE BOTTOM PAIR. THE MILL WAS DRIVEN BY A 12 h.p. STEAM ENGINE WHICH WHEN REQU'RED, ALSO DROVE A CENTRIFUGAL MACHINE.

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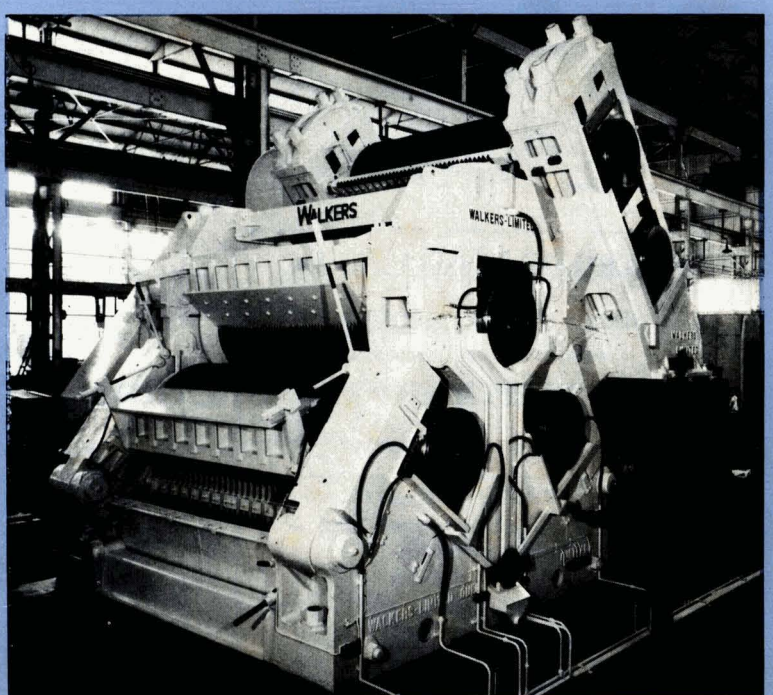

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