THE International Sugar Journal

MARCH 1973

at all stages of sugar manufacture

- 150 years of experience in the construction of sugar machinery
- a large number of complete plants (cane and beet) installed in the whole world
- machinery whose sturdiness has acquired a world wide fame
- technological back-up of an important Research Centre

FIVES LILLE - CAIL

SUBSIDIARIES IN BELGIUM, SPAIN AND BRAZIL
AGENTS THROUGHOUT THE WORLD

7, rue Montalivet, 75 - PARIS 8e
Phone : 265.22.01 and 742.21.19
Telex : FIVCAIL 65 328

RENOLD LIMITED

serving the cane sugar industry

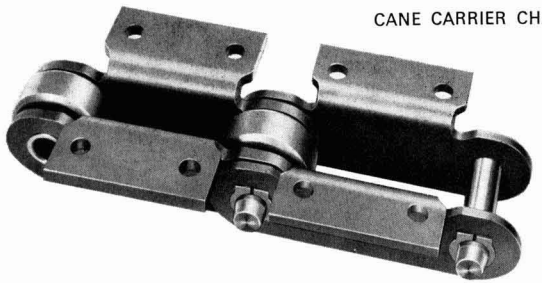
CHAINS FOR MECHANICAL HANDLING

Specialised Renold chains have been supplied to the cane sugar industry since 1920.

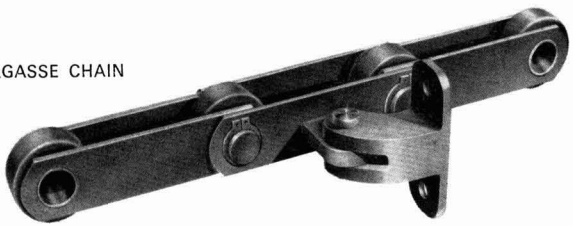
90 years of precision chain manufacture ensure a product combining high strength with compactness, minimum weight and low cost for long life and trouble free operation.

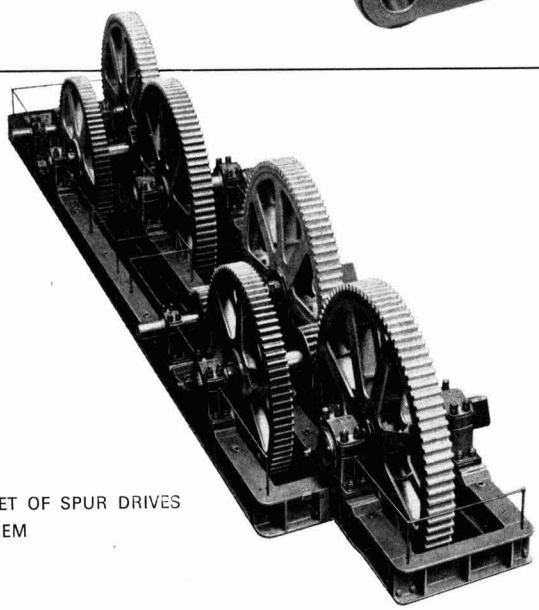
Precision power transmission chains and wheels are also available for all applications.

CANE CARRIER CHAIN



BAGASSE CHAIN





A LARGE SET OF SPUR DRIVES TO A TANDEM

POWER TRANSMISSION GEARING

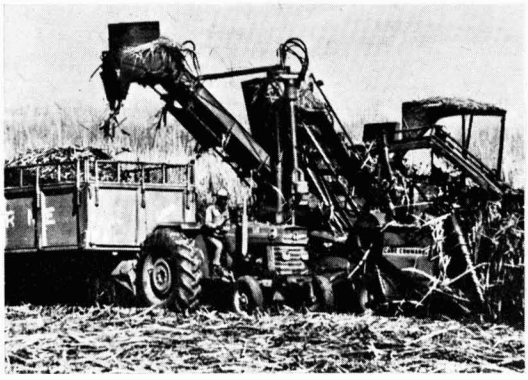
Spur gears up to 127mm circular pitch, 760mm face and 4700mm diameter can be supplied for heavy tandem drives. Other gear products include worm, spur, helical and bevel gear boxes and individual gears.

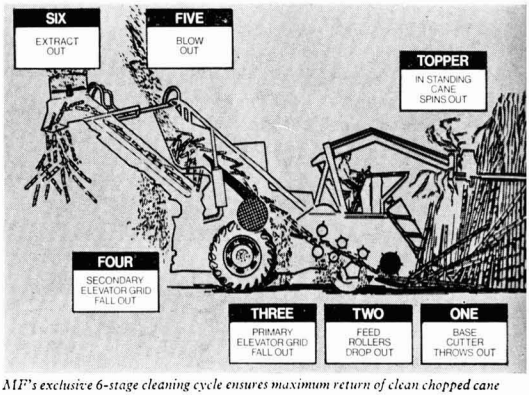
Other Renold group products:

Precision roller chains and wheels.
Hydraulic and mechanically operated variable speed systems.
Couplings, clutches and brakes.
Power transmission ancillaries.

RENOLD | HOLROYD | Crofts | CARTER HYDRAULIC INFINITELY VARIABLE SPEED DRIVES

RENOLD LIMITED
SALES DIVISION
MANCHESTER ENGLAND





MF's exclusive 6-stage cleaning cycle ensures maximum return of clean chopped cane

Great cane harvests start and finish with Massey-Ferguson

The MF sugar cane system provides you with methods and equipment to take you from land clearance and field preparation, through tillage and planting, to harvesting and transportation. The MF system, with the giant MF 201 cane harvester, gives improved productivity, beats labour shortages, and cuts down harvesting costs.

MF 20 cane planter—does six jobs at once. This machine opens the furrow, cuts the cane into lengths, dips them in protective fungicide, and then places them in the soil. At the same time, it sows fertiliser on both sides of the furrow, close enough to ensure healthy growth, but far enough to prevent the setts being scorched. Lastly, the MF 20 covers the setts with soil and presses it down. A single rotor MF 20 can plant up to 2 hectares per day; a two-man double rotor machine up to 4 hectares a day. (See top picture.)

MF 201—ton-a-minute cane harvester. This is the ultimate cane harvesting machine. Over 400 have been built in Australia and are now harvesting cane throughout the world, recording outputs up to 500 tons a day for as little as US $0.60 per ton.

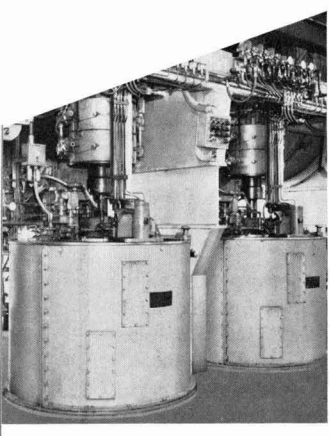
Write for more information now. If you would like to know how the MF sugar cane system can help you increase productivity and overcome labour shortages, contact your nearest MF dealer or write to: Marketing Development Department, Massey-Ferguson (Export) Ltd., P.O. Box 62B, Banner Lane, Coventry, CV4 9GF, England.

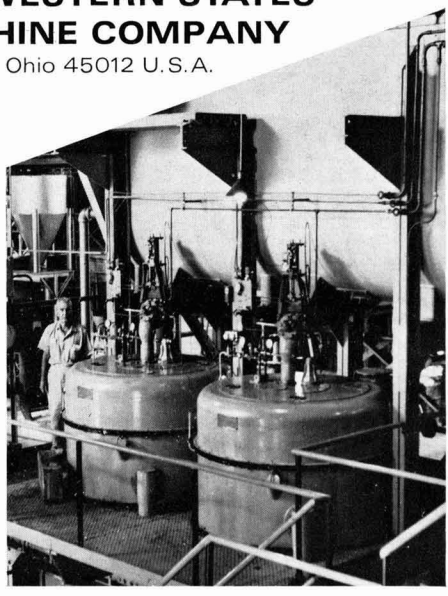
They will send you copies of the MF Systems Manual, literature on the MF 20 and MF 201, and the latest edition of Cane News.

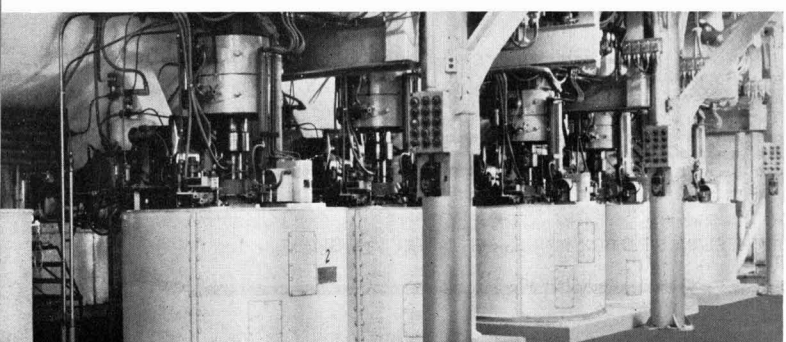
MF
Massey Ferguson

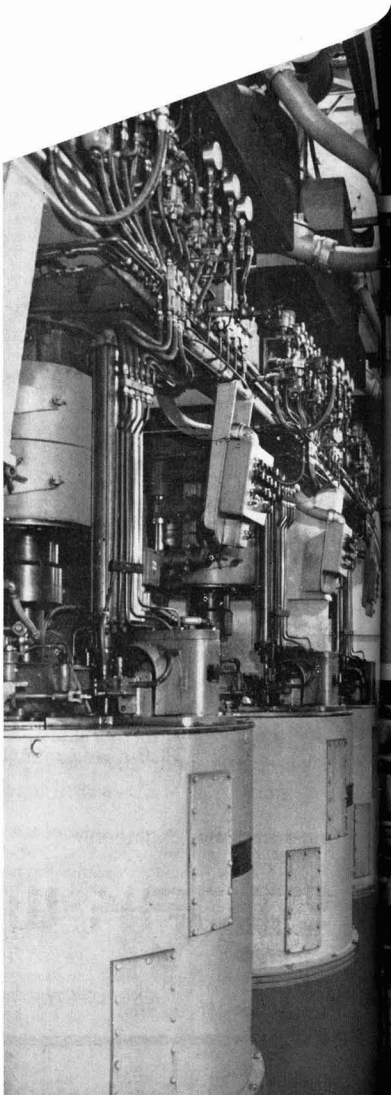
Western States 'Thinking Power' at work in profitable centrifugals like these

ROBERTS STEVENS
THE WESTERN STATES MACHINE COMPANY
Hamilton, Ohio 45012 U.S.A.



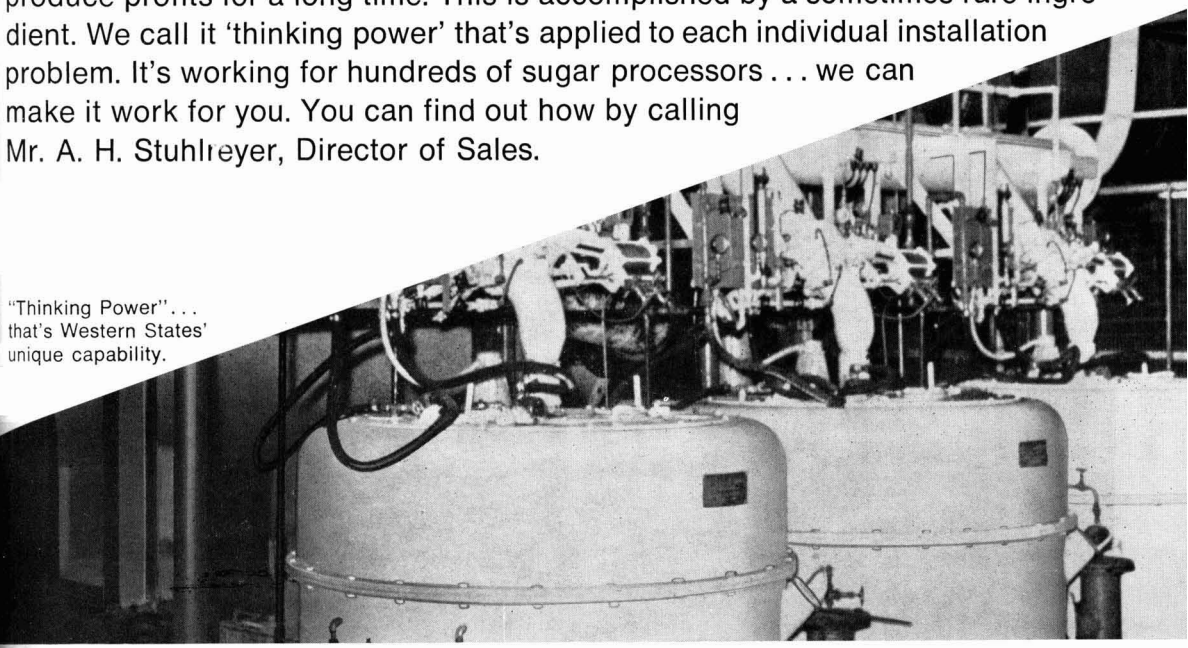


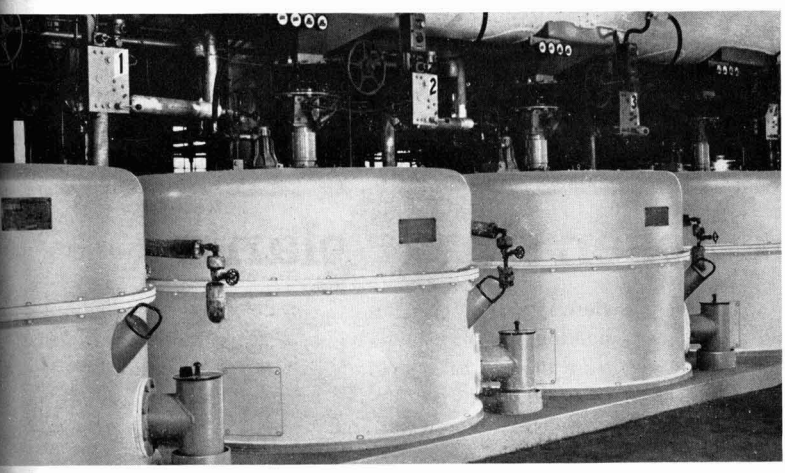


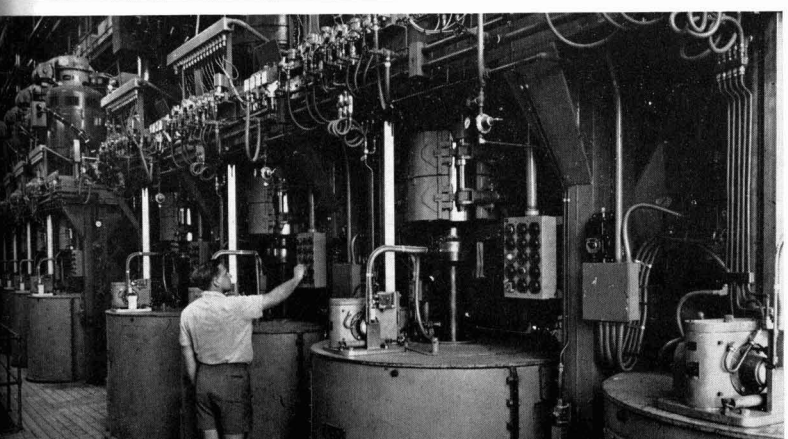


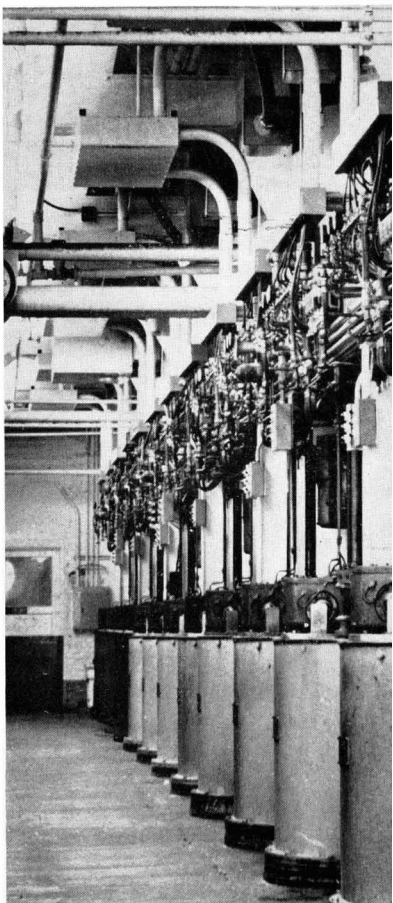
Western States centrifugals have a history of producing profits . . . they should, because our number one goal is to design and build centrifugal stations that produce profits for a long time. This is accomplished by a sometimes rare ingredient. We call it 'thinking power' that's applied to each individual installation problem. It's working for hundreds of sugar processors . . . we can make it work for you. You can find out how by calling Mr. A. H. Stuhlreyer, Director of Sales.

"Thinking Power"... that's Western States' unique capability.







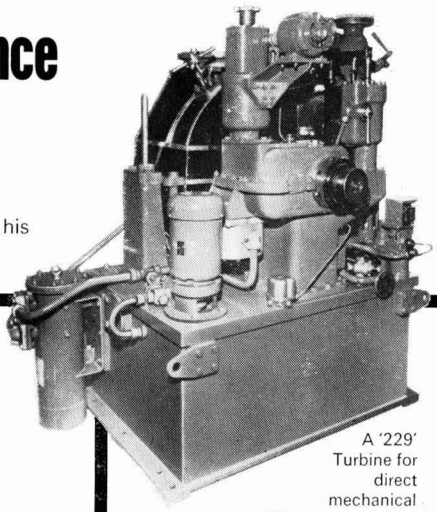


BROTHERHOOD '229'

alias

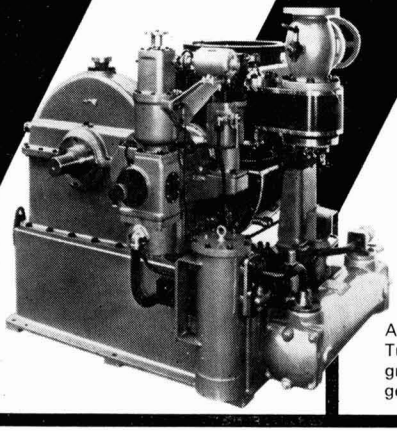
60 years of sugar mill experience

Brotherhood Turbines of proven design, built to suit your own plant.
The '229' range incorporates world-wide experience of mill turbine operation.
Component standardisation increases availability of stock parts for off-the-shelf spares service to customers.
Off-the-shelf spare service relieves customer from tying up capital in his own stores.
Please send for publications SMT/66 and SMT/70.



A '229' Turbine for direct mechanical drive

- True interchangeability
- Low cost
- Short deliveries
- Minimum site spares
- Minimum operating and servicing trainings
- Rugged reliability



A '229' Turbine with integral hardened and ground gears for mechanical or generator drive.

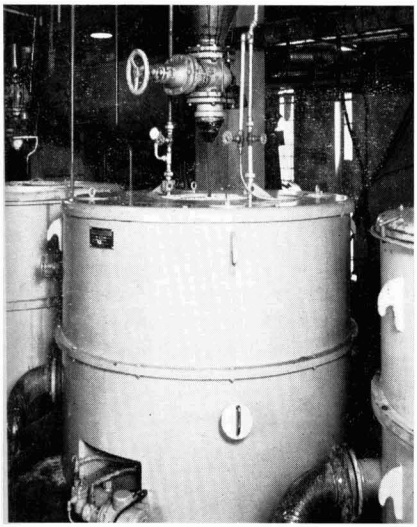
PETER BROTHERHOOD LIMITED

Peterborough, England Tel. 0733 71321 Telex: Brotherhd Pboro 32154
London Office: Dudley House, 169 Piccadilly, London, W1. Tel: 01-629 7356/7/8.

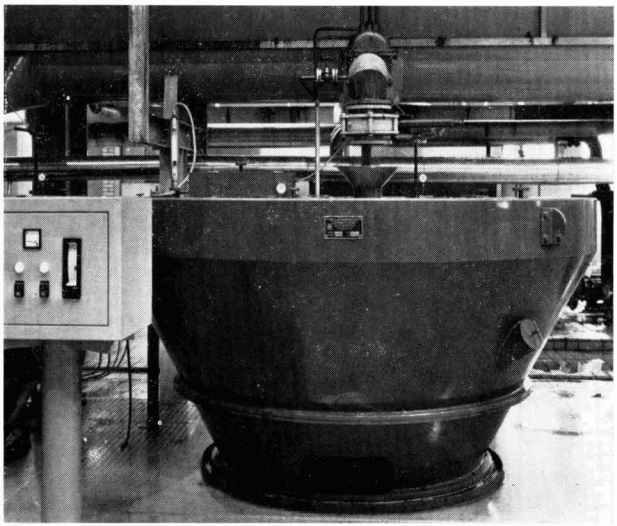
MANUFACTURERS OF STEAM TURBINES COMPRESSORS SPECIAL PURPOSE MACHINERY

P5051

Hein, Lehmann-KONTI Pacemaker in Centrifugal Construction



HL-KONTI Centrifugal 1956



HL-KONTI Centrifugal 1973

Nowadays the continuous operations centrifugals have established a firm foothold in all modern sugar factories. From the inception we have spearheaded the development and design of the continuous centrifugal.

HL-KONTI for Low-Grade Massecuites

The first HL-KONTI series of continuous centrifugals established a new high standard of efficiency in handling low-grade products and in addition creating considerable savings in power consumption and operational maintenance costs.

HL-KONTI for High-Grade Massecuites

The curing of high-grade massecuites was a further step forward in the development of the HL-KONTI continuous centrifugal and more and more factories are taking advantage of this facility.

HL-KONTI with Large Size Casing

The first HL-KONTI's with large size casings were introduced in 1968 enabling our customers to reduce crystal damage to a minimum and further reducing maintenance.

The HL-KONTI is considered a pioneer by the sugar industry which looks forward to the next important step in continuous centrifuging.

HEIN, LEHMANN
AKTIENGESELLSCHAFT

Dept. MT
D-4000 Duesseldorf 1, P.O.B. 4109
Telex 8 582 740 hl d

STUMM

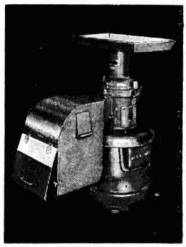
Member of the STUMM-Group

No Cane Testing Laboratory is complete without one, or both, of these 'JEFFCO' machines

Approved by Leading Sugar Cane Research Centres

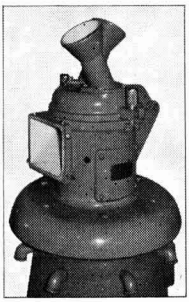
"JEFFCO" CUTTER-GRINDER.

This is used to reduce cane samples into a fine condition to facilitate determination of fibre content, etc. The ground cane is retained in a receiving bin which is sealed to minimise windage and resultant moisture loss. The juice is evenly spread throughout the product.



MODEL 265B

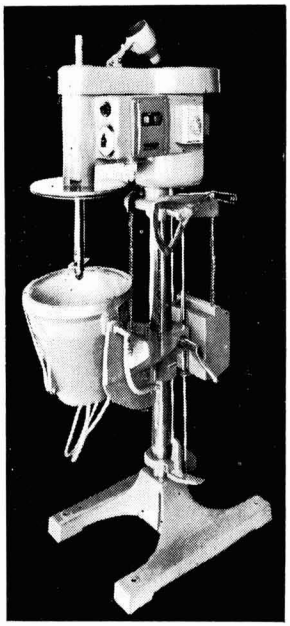
(illustrated at left) will grind prepared cane or that which has come from a pre-breaker. It will also take full stalks including the tops and roots. The opening through which the cane is fed is 6″ dia. (152 mm.) Powered by 10 h.p. motor.



MODEL 265 B.M.

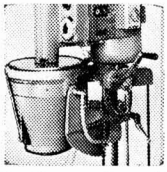
(the head of which is illustrated at left) is identical to the Model 265B except that it has two smaller inlet funnels and will only handle stalks. Inlet diameter 2½″ (63 mm.). It is fast in operation. It has a water inlet on top so that the machine can be flushed out at the end of tests while still running. This shows machine without receiving bin.

At left is illustration of internal cutting arrangement. The cutters which are mounted on a vertical spindle perform a scissors action with the four blocks in the head of the machine. Screen plates with holes of various sizes are available.

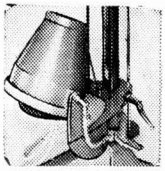


The JEFFCO model 291 Wet Disintegrator

(at left) converts a measured quantity of cane and water to a well-nigh liquid condition. It operates with a 10 h.p. motor, has a 9 litre capacity bowl which has a water jacket to enable temperature control. Bowl tilts for easy emptying. It has a timer which cuts the machine off automatically at preselected time.



Bowl in operating position



Bowl in emptying position

DIMENSIONS

Cutter-Grinder.

Packed 29″ x 51″ x 53″ = 45′ 5″ Cubic. (1.285 Cubic Metres.)
Weight 1100 lb. (499 kg.)

Wet Disintegrator.

Packed 23″ x 38″ x 73″ = 37′ Cubic. (1.047 Cubic Meters.)
Weight 728 lb. (330 kg.)

AUSTRALIAN MADE

JEFFRESS BROS. LTD. ENGINEERS

351 MELTON ROAD, NORTHGATE, BRISBANE Q4013, AUSTRALIA

More sugar in the bag -thanks to the DDS-Cane Diffuser.

Plain talk from an old-timer in the trade.
Many plant-managers the world over praise this technical wizard as an instrument to improved production and profits. Compared to orthodox milling, the DDS-system means a giant step forward in efficiency and throughput.

Dry figures supply the proof.

In an overseas plant five regular mills would produce 31,900 tons of sugar during 5860 milling hours...
In comparison four mills plus one DDS-Cane Diffuser actually extracted 47,700 tons of sugar during the same time interval.

Another amazing accomplishment of the DDS-System.

LEVERANDØR TIL DET KGL DANSKE HOF

AKTIESELSKABET DE DANSKE SUKKERFABRIKKER

A/S DE DANSKE SUKKERFABRIKKER · 5 Langebrogade · DK-1001 Copenhagen K
Denmark · Teleph.: ASTA 6130 · Telegr.: Sukkerfabrikker Copenhagen
Telex: 27030 DANSUK DK

Published by
The International Sugar Journal Ltd.
23a Easton Street, High Wycombe,
Bucks., England.
Telephone: **High Wycombe 29408**
Cable: **Sugaphilos, High Wycombe**

* * *

Annual Subscription: £3.00 or $10.00 post free

Single Copies: 40p or $1 post free

International Sugar Journal

March 1973

Contents

SOMMAIRES : ZUSAMMENFASSUNGEN : SUMARIOS

La théorie de l'extraction dans les diffuseurs. 1ère partie. G. V. GENIE. *p.* 67–70

Après un bref aperçu des travaux théoriques concernant la diffusion, effectués par SILIN, OPLATKA et BRÜNICHE-OLSEN, particulièrement au sujet de l'application de la loi de FICK, l'auteur examine le mécanisme de l'extraction du sucre de la cossette de betterave, en accordant une attention particulière à la convection, à l'épaisseur du film de jus et à la distance entre cossettes. L'auteur divise les diffuseurs continus en deux classes: ceux où le jus et les cossettes (ou la bagasse) sont en contact permanent, et ceux où il y a séparation périodique, comme dans le diffuseur de type RT. Pour les besoins des calculs on introduit un paramètre θ qui est la perte en sucre du matériau extrait par unité de volume, ramenée à la différence de concentration initiale du jus à l'intérieur et à l'extérieur du matériau.

* * *

Procédés pour déterminer et réduire la détérioration des résines décalcifiantes en service. 1ère partie. J. F. T. OLDFIELD, C. W. HARVEY et M. SHORE. *p.* 70–74

On décrit des procédés pour déterminer les capacités et l'importance des fuites des résines utilisées par la British Sugar Corporation pour réduire la teneur en calcium du jus leger et pour établir le nombre de grains brisés, ainsi que l'étendue et le type d'empoisonnement; les détails d'une méthode de nettoyage par l'hypochlorite de soude d'une résine empoisonnée sont donnés. Les effets de la concentration en hypochlorite et du procédé de nettoyage sur la résine utilisée à Peterborough sont discutés.

* * *

La détermination de l'humidité du sucre brut. N. R. PIPER. *p.* 74–78

Quatre méthodes de mesure de l'humidité du sucre brut sont comparées, mais on ne trouve pas de relation précise qui permettrait de calculer une valeur d'humidité à partir d'une autre. La détermination des teneurs en humidité du sucre brut par titrage d'après Karl Fischer au cours du séchage à l'étuve révèle que l'humidité extérieure est complètement éliminée au cours de la première heure, alors que l'humidité intérieure reste essentiellement inchangée tout au long de la période de séchage. La surestimation de l'humidité extérieure par le séchage à l'étuve résulte en premier lieu de la volatilisation au cours de séchage de matériaux, autres que l'eau, contenus dans le sirop.

Theorie der Extraktion in Saftgewinnungsanlagen. Teil I. G. V. GENIE. *S.* 67–70

Nach einem kurzen Ueberblick über die von SILIN, OPLATKA und BRÜNICHE-OLSEN durchgeführten theoretischen Arbeiten über die Extraktion, besonders hinsichtlich der Anwendung des FICK'schen Gesetzes, untersucht der Autor den Mechanismus der Zuckerextraktion aus Rübenschnitzeln. Hierbei geht er vor allem auf die Konvektion, die Stärke der Saftschicht und den Abstand zwischen den Schnitzeln ein. Er teilt die kontinuierlichen Extraktionsapparaturen in zwei Klassen ein: (a) in diejenigen, bei den Saft und Schnitzel (oder Bagasse) dauernd miteinander in Berührung stehen, und (b) in diejenigen, bei denen eine periodische Trennung erfolgt wie bei der RT-Diffusion. Für die Berechnung wird ein Parameter θ eingeführt, nämlich das Verhältnis aus dem durch das extrahierte Material pro Volumeneinheit verlorenen Zucker und dem anfänglichen Konzentrationsunterschied zwischen dem Saft innerhalb und ausserhalb des Schnitzelmaterials.

* * *

Methoden zur Ermittlung und Verringerung der Kapazitätsminderung von Enthärtungsharzen im Betrieb. Teil I. J. F. T. OLDFIELD, C. W. HARVEY und M. SHORE. *S.* 70–74

Für die von der British Sugar Corporation zur Verringerung des Calciumgehaltes im Dünnsaft verwendeten Harze werden Methoden zur Bestimmung der Kapazität und des Durchbruchs sowie zur Ermittlung der Zahl der zerbrochenen Harzkügelchen und des Ausmasses und der Art des Faulens beschrieben. Einzelheiten werden mitgeteilt über eine Methode zur Reinigung von "gefaultem" Harz mit Hilfe von Natriumhypochlorit. Der Einfluss der Hypochloritkonzentration und des Reinigungsverfahrens auf das in der Zuckerfabrik Peterborough benutzte Harz wird diskutiert.

* * *

Die Bestimmung der Feuchtigkeit in Rohzucker. N. R. PIPER. *S.* 74–78

Beim Vergleich von vier Methoden zur Bestimmung der Feuchtigkeit in Rohrzucker konnte keine exakte Beziehung gefunden werden, die es erlauben würde, einen Feuchtigkeitswert aus einem anderen zu errechnen. Die Bestimmung der Rohrzuckerfeuchtigkeit nach der Karl-Fischer-Titration während der Trocknung im Trockenschrank liess erkennen, dass die äussere Feuchtigkeit vollständig innerhalb der ersten Stunde entfernt wurde, während die innere Feuchtigkeit über die gesamte Trockenperiode im wesentlichen unverändert blieb. Ein zu hoher Wert für die äussere Feuchtigkeit bei der Trockenschrank-Methode erklärt sich in erster Linie dadurch, dass sich während des Trocknens ausser dem Wasser im Sirupfilm auch andere Substanzen verflüchtigen.

Teoría de extracción en difusores. Parte I. G. V. GENIE. *Pág.* 67–70

Después de un examen breve del trabajo teórico sobre difusión realizado por SILIN, OPLATKA y BRÜNICHE-OLSEN, sobre todo en que concierne el aplicación del ley de FICK, el autor considera el mecanismo de extracción de azúcar de cosetas del remolacha, con atención especial a convección, al espesor del capa de jugo y al alejamiento entre cosetas. Separa difusores contínuos en dos clases: ellos en que el jugo y las cosetas (o bagazo) estan todavía en contacto, y otros en que hay separación periódica, por ejemplo le difusor tipo RT. Para fines de calculación un parametro θ se introduce que es el azúcar perdido por el material extraído por unidad de volumen, relatado a la diferencia inicial de concentración entre el jugo en el interior y al exterior del material.

* * *

Procedimientos para asesar y reducir el deterioro en servicio de resinas para descalcificación. Parte I. J. F. T. OLDFIELD, C. W. HARVEY y M. SHORE. *Pág.* 70–74

Procedimientos para determinar la capacidad y niveles de escape de resinas empleado por la British Sugar Corporation para reducir el contenido de calcio en jugo clarificado se describen tanto como ellos para asesar la proporción de gotas rotas de resina y el alcance y natura de la materia sucia. Se presentan detalles de un método para limpiar resina sucia usando hipocloruro de sodio. Los efectos de la concentración del hipocloruro y del procedimiento de limpieza sobre la resina empleado a la fábrica a Peterborough se discuten.

* * *

La determinación de agua en azúcar crudo. N. R. PIPER. *Pág.* 74–78

El autor comparó cuatro métodos para determinar agua en azúcar crudo, pero no pudó descubrir ninguna relación que permitía calcular un valor de agua de un otro. Determinación por el método KARL FISCHER del contenido de agua en azúcar crudo a intervales mientras que se seca en un estufa señaló que el agua externa se elimina completamente en la primera hora, mientras que el agua interna siguió siendo esencialmente lo mismo durante el período entero de secado. Estimación en valor excesivo del agua externa por secado en estufa resulta ante todo de la volatilización de otras sustancias que agua del sirope durante el secado.

THE
INTERNATIONAL SUGAR JOURNAL

VOL. LXXV MARCH 1973 No. 891

Notes & Comments

World sugar balance 1972/73

F. O. Licht KG recently published[1] their first estimate of the world sugar balance for the crop year September 1972/August 1973 and this is reproduced below with comparative figures from the two previous years:

	1972/73	1971/72	1970/71
	(*metric tons, raw value*)		
Initial stocks	16,628,604	18,980,540	21,247,410
Production	76,474,094	73,517,937	72,773,685
Imports	24,927,670	24,211,268	23,573,451
	118,030,368	116,709,745	117,594,546
Exports	24,787,000	24,078,591	24,038,018
Consumption	77,533,962	76,002,550	74,575,988
Final stocks	15,709,406	16,628,604	18,980,540
Production increase or decrease	+2,956,157	+ 744,252	—1,572,607
(%)	+ 4·02	+ 1·02	— 2·12
Consumption increase	+1,531,412	+1,426,562	+2,285,850
(%)	+ 2·01	+ 1·91	+ 3·16
Final stocks % consumption	20·26	21·88	25·45

An important aspect of the new estimate is that the initial stock at 1st September 1972 is some 900,000 tons higher than the final stock figure for 31st August previously estimated by Licht when preparing their balance for 1971/72; this is due to publication of official figures which have shown the earlier estimates to have been too low.

Thus, in spite of an aticipated shortfall of over a million tons between production and consumption in 1972/73, the end-year stocks are set at a figure previously thought to be the level of the initial stocks. This was the major factor responsible for the reduction of the London Terminal market price of raw sugar from its record peak of £105 in mid-January.

As may be seen, the estimates show a continuing fall in world sugar stocks but at a lower rate. The shortfall in production has decreased from 2·5 to 1·1 million tons and it would not take a very marked expansion of sugar production to catch up. However, the rate of consumption increase is clearly affected by the high prices and for the two years 1971/72 and 1972/73 is set at about 2% in place of the 4% which has been the average rate of increase in the past 25 years. When high prices have held down consumption in the past, a return to lower levels has stimulated an above-average consumption increase which has brought it to the figure which would have been attained with a steady 4% growth. We would suppose, therefore, that consumption will rise to meet any likely increase in production during the next two or three years, the price being dependent on the mutual balance between supply and demand.

* * *

World raw sugar price

After reaching the record level of £105 per ton on the London Market, the world raw sugar price eased as a result of profit-taking, and then was affected by the indications of higher-than-anticipated stocks in Licht's new balance for 1972/73. Prices sank to the still high level of £93 per ton but have subsequently recovered to £100. E. D. & F. Man, in their newsletter of the 31st January, write: "It now seems to be generally accepted that there is a shortage between estimated availability and estimated requirements of a million tons or more. This time last year we estimated a shortage of something like three quarters of a million tons and that gap was bridged by sellers finding considerable quantities of spare sugar and buyers reducing their stocks to an incredibly low figure. It does not seem to us that these two possibilities can be repeated this year to the same extent, so a third factor will have to come in, namely reduction of purchases owing to price. Because we are so convinced that this factor will have to emerge, we see prices inevitably going up, even if the market does have set-backs from time to time.

"It is wrong to be mesmerized by £100 per ton, for one must bear in mind devaluation, inflation and the fact that a very large part of the consuming public are in the habit of paying this sort of price every year. We do not expect to see buyers refusing to pay £100 or £110 because they feel the price is too high. We therefore expect higher prices to be paid."

[1] *International Sugar Rpt.*, 1973, **105**, (2), 1–3.

International Sugar Organization

Towards the end of January an Advisory Group of the International Sugar Organization met in London to discuss and advise on the draft of a new Agreement prepared by the Secretariat of the ISO to replace the current Agreement which expires in December of this year. The draft is concerned with the mechanics of operation of the Agreement but not prices and quotas which will be key topics for negotiation during the Conferences to be held in Geneva in May and September/October. The current Agreement has worked well, helping to raise prices from the depressed levels of 1964–68 yet protecting importing members from having to buy all their requirements at the ruling high prices.

But C. Czarnikow Ltd. comment[2] that: "in the light of the knowledge which has been gained over the past four years it is possible to indicate areas in which (the Agreement) might have been improved and it is to be hoped that some attention will be given to these in the draft document. In particular it might be worth considering whether basic export tonnages need to be fixed for a period of five years or whether there might be a possibility of adjusting them year by year in the light of performance. Furthermore, the difficulty the beet sugar producers have in estimating production a year ahead has been clearly demonstrated and it might be worth considering whether the ISA year needs to correspond to the calendar year or whether it would not be more reasonable to revert to the pre-war Agreement's September/August year".

* * *

UK sugar refining margin

Sharp differences of opinion existed between Britain and France over the application of EEC sugar regulations to the UK after its entry into the Community; these differences emerged during the prior discussions on harmonizing existing arrangements and the EEC rules for the new members and it was not found possible to agree on the refining margin. France argued that British practices may give a competitive edge to British refiners which may hinder French exports to the UK market in 1973, and it is believed that France hopes that these will be increased as much as possible before the Commonwealth Sugar Agreement and the Community's own sugar régime come up for review in 1974–75.

The Community refining margin is currently set at 1·86 units of account per 100 kilos (one unit equals the old value of the US dollar), while that in the UK was 3·90 units, so France argued that the British margin should be reduced to the Community figure. Britain pointed out, however, that the two figures are calculated differently and the EEC, depending on beet sugar production, gives a very low margin for cane sugar refining which, however, does not cause too much distortion within the EEC because only a small tonnage of cane sugar is processed. British refiners, on the other hand, process a great deal of raw cane sugar and the EEC margin would make this uneconomical, so harming the refiners and also making it impossible for them to continue refining of raws imported under the Commonwealth Sugar Agreement, for which the UK has a continuing commitment.

In addition, Community refiners gain a higher margin for cube sugar which accounts for a substantial part of their output, in contrast to the UK, so that the figure of 1·86 units per 100 kg does not truly represent their margin.

Agreement was reached just before the 1st February, however, (when the EEC Common Agricultural Policy applied in the UK) which will permit the British refiners to continue to process Commonwealth raws. Details have not been fully disclosed but it appears that the margin agreed, although lower than 3·90 units, is adequate and will safeguard the suppliers of sugar under the C.S.A.

* * *

UK Sugar Board

Following the rise in the world market price of raw sugar, the distribution payments by the Board were raised from £48 to the record level of £54 per ton with effect from the 18th January 1973. With the subsequent fall in the London price from £105, the distribution payment was also reduced, to £42 per ton, from the 23rd January.

Hitherto sugar distribution payments have been the means whereby the Sugar Board has disposed of surpluses accumulated from its trading activities in sugar imported under the terms of the Commonwealth Sugar Agreement. Of recent months they have also served as the vehicle for the special payments made by the Government to reduce the rise in the price of sugar in the United Kingdom. They have, therefore, fluctuated in accordance with changes in the level of the world price of sugar.

With the adoption by the United Kingdom on 1st February 1973 of the Common Agricultural Policy for sugar of the European Economic Community, it will no longer be possible for the Board to dispose of its trading surpluses, if any, in this way. Ministers have, however, already announced that the consumer subsidy will continue until the end of June 1973, and distribution payments will continue to be made for this purpose. However, they will consist of the exact consumer subsidy at the time and will no longer vary with changes in the price of sugar on the world market.

The Minister of Agriculture, Fisheries and Food has therefore made Orders setting distribution payments, as from 1st February 1973, at a rate of £15 per ton of refined sugar. From this date, distribution repayments will be payable to the Sugar Board at the same rate on United Kingdom exports of sugar, invert sugar, caramel, and on syrups and treacles which are not packed for retail sale.

---

[2] *Sugar Review*, 1973, (1110), 9.

Theory of extraction in diffusers

Relation between time, convection, juice draft and sugar extraction in intermittent continuous diffusers

By G. V. GENIE, Dr. Sc.
(Consultant, Chaumont-Gistoux, Belgium)

PART I

Introduction

MOST present day continuous diffusers were empirically developed by engineers who are naturally inclined to consider mechanical and other technical problems preeminent. But a diffuser is not merely a conveyor of beet cossettes, crushed cane or juice nor a heat exchanger and sugar extraction obeys physical laws which should be known and kept in mind while designing a diffuser if optimum results are to be obtained. If extraction were a critical process, this would of course be obvious but, as a matter of fact, it is so easy a process that, even if these laws are overlooked, the device is still able to produce an acceptable juice. This probably explains why so little fundamental work has been done up to the present in the field and why diffusion remains possibly the least understood process in sugar manufacture. But as most technical problems have now been solved and all present continuous diffusers have reached about the same efficiency, the competition between the various designs will become sharper. It is greater understanding and better satisfaction of the physical requirements in sugar extraction that will decide the choice between present designs or new ones which may supersede them in the next twenty years.

Milestones in the mathematical study of the sugar diffusion process are the works of SILIN, OPLATKA and BRÜNICHE-OLSEN. SILIN[1] applied FICK's first law to the cossettes, which for simplicity he considered to be of cylindrical shape, and introduced their length in metres per hundred grams, which is still known today as the "Silin number". His theory was of course rather crude and could be open to much criticism now, but we must bear in mind that he was a forerunner and that for the time it was a useful piece of work which has rendered great service to the sugar industry. OPLATKA developed a sound theory based on the integration of FICK's second law in a Fourier series of which a second integration makes an exponential series[2]. His work is highly complicated but it is a masterpiece of mathematical work which possibly did not receive from the industry the attention it was worth. A critical review of this previous work and including VAN GINNEKEN's early theory will be found in BRÜNICHE-OLSEN's 450-page book[3].

BRÜNICHE-OLSEN made the most exhaustive study of the diffusion process with a considerable amount of both mathematical and experimental work. The thoroughness of his work makes the book sometimes difficult to read, as every detail is carefully examined and discussed at length. BRÜNICHE-OLSEN starts from the same exponential series as OPLATKA, but restricts it to the first term, claiming that he is not interested in the early part of the extraction and that the series converges very quickly for immersions of long duration. As a consequence, the exponential series collapses to a simple exponential function on which BRÜNICHE-OLSEN builds all his theory.

This is a very dangerous simplification because it involves the unexpressed condition that the extraction has reached a steady state and all subsequent conclusions of the author are subject to that restriction. In the writer's opinion, the extraction of sugar from cossettes or crushed cane cannot be considered as a steady process; moreover, the less steady it is, the more efficient is the extractor.

Further, BRÜNICHE-OLSEN denies in his book the validity of FICK's law for thin slices of beet or for technical cossettes. He suggests that the experimental deviations from this law are caused by the non-homogeneity of the beet tissue and the same explanation appears for the cane tissue in a later extension of his work to cane diffusion[4]. We have shown in a recent paper[5] that these deviations are only apparent and can be quite easily explained by an insufficient juice convection in spite of the careful experimental procedure and the many precautions of the author. But we think that it was an almost unavoidable consequence of the premises from which he started, for the Fourier series integration of FICK's law is only valid when an infinite convection is secured, which is impossible both in the laboratory and in industrial practice.

This drawback, combined with the fact that, as stated above, the series converges very slowly for short immersions, makes this type of solution of the diffusion equation suitable only when dealing with substances diffusing very slowly, but *not* for sugar out of beet or cane. Fortunately there is another way to integrate FICK's law which is much more convenient for non-steady conditions and for immersions of short duration. Moreover it is suitable for both infinite convection and no convection at all. As it has already been published elsewhere[6], we shall not repeat here this method which involves advanced mathematics, nor shall we discuss the validity of FICK's law which we consider to be valid for practical sugar extraction, although it is now a recognized fact that this is not a diffusion process[7], provided the

[1] *Comptes rend. V Congr. Int. Ind. Agric.*, 1937, **1**, 534–536.
[2] OPLATKA: *Sugar*, 1952, **47**, (10), 43–45.
[3] "Solid-Liquid Extraction." (Nyt Nordisk Forlag, Copenhagen) 1962.
[4] BRÜNICHE-OLSEN: *Sugar Tech. Rev.*, 1969, **1**, 3–42.
[5] GENIE: *Zucker*, 1972, **25**, 117–122.
[6] *idem*: *ibid.*, 1970, **23**, 409–412.
[7] RATHJE: *Zeitsch. Zuckerind.*, 1970, **95**, 410–413.

coefficient of diffusion is replaced by a mass transfer coefficient[5].

For completeness let us mention that, in addition to its purely mathematical integrals, FICK's law can also be integrated in several ways by means of a digital computer. While the mathematical integration is possible only for one cossette of simple geometric form and initial sucrose distribution, the computer can deal simultaneously with several cossettes of any conceivable form and initial sucrose distribution, so the practical conditions for sugar extraction from technical cossettes can be approached very closely. Moreover the computer does not only give the mean concentration but can draw diagrams of the lines of equal concentration at any required instant of the extraction[8].

Two years ago, on behalf of a large sugar company, we wrote for that purpose a subprogramme for use in RAX (Remote access computing system) on a IBM 360/50 computer which, called as required by a simple main programme specific to each problem, allowed solving of most of the questions arising in practical diffusion. This subprogramme—which could also be used in conversational mode—had 454 lines Fortran IV and occupied an area of 41,386 bytes. The results were most interesting, but the method was very expensive as the computing time could exceed ten minutes and many diagrams were plagued by transmission errors, which made them unusable, on account of the bad quality of the telephone lines. When better working conditions are secured, a computer is certainly the most convenient instrument for the study of the diffusion process.

Mechanism of sugar extraction

It is difficult to understand the process of diffusion, just looking at a diffuser from the outside as do most sugar technologists. Although it may seem peculiar, this becomes much easier if one imagines what happens to a beet cossette of limited understanding going *through* the diffuser. For such a cossette there is no evidence whatever of juice draft, counter-current or diffuser type; it only "feels" the temperature and the sugar content of the surrounding juice. When entering the diffuser its sugar concentration is homogeneous and the concentration gradient nil (here, for simplicity we consider the cossette as a ribbon and we disregard the extraction of non-sugars). If the surrounding juice has a lower concentration, the cossette quickly loses sugar from its surface and a fairly high concentration gradient is generated, which moves slowly as a decreasing wave toward the centre of the cossette until it runs against the corresponding gradient coming from the opposite side. At that point both gradients exactly cancel each other and beyond that point they substract from each other.

In simpler words, it is the concentration gradient that moves the sugar and as the sugar moves, the concentration gradient decreases, moving less sugar and so on. As a consequence the cossette tends to reach a new equilibrium at a lower homogeneous concentration and the gradient slowly fades away. But this takes a lot of time and meanwhile the concentration of the surrounding juice may have changed. If it has decreased, a new similar gradient has been generated near the surface and moves toward the centre of the cossette, increasing the sugar transfer in the opposite direction.

If, on the contrary, the concentration of the surrounding juice has increased, a negative gradient is generated which works against the preceding one and slows the sucrose transfer from the deep cossette layers. This succession of slow moving gradients and the time required for them to reach the centre explains the part played in sugar diffusion by the thickness of the cossettes, which are constantly running after an equilibrium they never reach. The very object of a diffuser is to generate gradients of concentration and to keep them as high as possible inside the extracted material; the better it does it, the better its efficiency.

It is important to note that there is always a *time lag* between what the conditions prevailing at the surface require and what is actually happening inside the cossette. This can be compared to a Napoleonic battle when orders had to be despatched by messengers on horse; the changing situation on the battlefield could make them inadequate before they were received. A short upward drift of the concentration of the surrounding juice can interfere for an appreciable extent of time with an efficient sugar extraction. On the other hand the displacement of sugar inside the cossette continues even if the juice has been removed.

The change of concentration of the surrounding juice, which governs the gradient of concentration and thus the flow of sugar out of the extracted material, is the result of two opposing effects. The sugar coming out of the cossette itself or of the neighbouring ones increases the juice concentration, while the juice movement decreases it on account of the countercurrent principle. But neither in time nor in space are these effects consistent because the packing of the cossettes is heterogeneous.

Let us first examine what happens in the juice under stationary conditions. If a cossette is brought in contact with motionless juice, the initial concentration gradient existing at the interface moves in both directions while decaying in a perfectly symmetrical manner if the juice layer has the same thickness and the same diffusion coefficient as the cossette.

This is not true, however, firstly because the diffusion coefficient in the juice is higher and secondly because a certain amount of convection is always present. Both effects destroy symmetry, depressing the concentration gradient on the juice side and increasing it on the cossette side. If the convection is infinite, the concentration gradient remains nil in the juice and is exactly doubled in the extracted material. As a result, assuming a constant concentration of the flowing juice, twice as much sugar is extracted out of the cossette, at least at the beginning.

[8] GENIE: *Zucker*, 1971, **24**, 223–227.

The thickness of the juice layer also plays an important part in the extraction. The average ratio of juice layer to cossette thickness can be deduced from the juice draft, but this is of course a purely theoretical view as the actual distance between two cossettes ranges from nil, when they touch each other, to very large values, and it is this actual distance, *not the average one*, that determines the extraction. Where the cossettes are very close to each other much sugar is diffused into a relatively small volume of juice, which cannot flow on account of the tight packing, with the result that its concentration increases quickly, preventing any further extraction.

Where the cossettes are very far apart, a comparatively smaller amount of sugar is diffused into a large volume of juice, the concentration of which increases relatively slowly. But on account of the channelling effect caused by the loose packing, this juice is quickly removed *even before it has extracted a sizeable part of the available sugar*. Next to that fundamental imbalance inherent to the extracted material comes any inconsistent circulation of juice or cossettes in the diffuser itself, which can bring richer juice in contact with more exhausted material with the result that the sugar extraction is not only stopped but even reversed.

A perfect countercurrent can never be achieved in diffusers, all of which are more or less subject to that mixing effect to a degree depending on their design and also on their actual load. As a consequence the extraction of sugar out of cossettes or crushed cane is not at all a smooth process and it is only in the long run that the extracted material becomes statistically fully exhausted. This is clearly emphasized by the theoretical calculations, which show that the duration of practical diffusion is much longer than it should be on a basis of the mass transfer coefficient measured in the laboratory.

It is the writer's opinion that a better knowledge of the extraction process could result in continuous diffusers and slicing machines of improved design which would ultimately allow the retention time to be cut, possibly by half. Even more striking results have been obtained lately in the filtration of carbonatation juice; why should our continuous diffusers require as much time today as diffusion batteries of fifty years ago?

Principles of calculation

There are two kinds of continuous diffuser: those which are truly continuous and in which the juice and the cossettes or the bagasse are permanently in contact and those in which the juice and the cossettes are periodically separated and which are in fact mechanically operated batch diffusers. The continuousness of such diffusers is of course only apparent and, while the name "stepwise diffusers" used by BRÜNICHE-OLSEN is possibly more correct, we shall hereafter call them *intermittent* diffusers, to stress the fact that there is only an intermittent contact between the juice and the extracted material. To the true continuous diffusers belong for instance the BMA tower diffuser and the DDS trough diffuser; to the intermittent type belong the RT and other rotary diffusers. The distinction is however not absolute as there are a few intermediate designs such as, for instance, the De Smet diffuser. As explained above, the working of a diffuser can be separated into two effects:

(*a*) a kind of "pumping" of the sugar out of the extracted material by means of a gradient of concentration which acts in appearance* as a force moving the sugar to the boundary inside the material.

(*b*) a displacement of the extraction juice for which a juice of lower concentration is substituted in order to keep the gradient of concentration as high as possible.

In continuous diffusers both actions are performed simultaneously whereas in intermittent diffusers they are—at least theoretically—performed one after the other. There is no fundamental difference in the calculation of both types but, on account of this separation of the two effects, the problem is a little easier with the intermittent diffusers and should therefore be taken up from that end. An intermittent diffuser can be defined mathematically by two sets of equations, corresponding to the effects (*a*) and (*b*), which we call respectively diffusion equations and transfer equations. The scope of this paper is to deal only with the first group, i.e. the diffusion equations governing the sugar displacement to the boundary in the extracted material.

As a general rule, the practical units used by sugar technologists such as Brix, draft, Silin number, etc. are quite inadequate for scientific purposes and the first step toward a logical study of a problem is to define other *natural* parameters. It is difficult to explain what these really are but it is easy to sense them in the mathematical treatment. If this leads to complicated functions, frequently polynomials (but not series) in which the same symbol appears simultaneously at different places an under various irreducible arithmetic forms such as powers, roots, etc. with plenty of odd coefficients, the parameters are surely inadequate as Nature does not use that kind of function. With the "natural" ones the equations remain rather simple at all stages of the mathematical treatment and generally have a clear physical interpretation, even at extreme limits. It is sometimes very difficult in a practical problem to find out which one is the "natural" parameter but, when it is found, half the work is done. In our diffusion problems the "natural" parameter is simply the sugar lost by the extracted material per unit of area and per unit of initial difference of concentration on both sides of the boundary. This parameter has the dimension of a length and, when expressed as such, the diffusion equations are simple and have obvious physical interpretations. As for practical purposes it is necessary to relate the sugar extraction not to the *area* of the extracted material but to its *weight*, we must introduce an "economic" parameter which is the

* No force is involved in diffusion which is simply the macroscopic statistical aspect of random molecular motions.

ratio between the volume and the area of the extracted material. This second parameter, hereafter called ε, has also the dimension of a length and the quotient of both, hereafter called Θ, is dimensionless. Θ is thus the loss of sugar of the extracted material *per unit of volume* related to the initial difference in concentration of the juice inside and outside the extracted material. From there the way is open to all practical units when the density of the extracted material is known, provided corrections are made for marc or fibre content. Similarly the juice draft, hereafter called S, should be expressed as the ratio of the volumes of juice outside and inside the extracted material as it is in these volumes that the sugar expands like a gas, whereas the weight ratio used by sugar men has no physical meaning*.

* The true "natural" measure of juice draft is actually the coefficient of expansion $S/S + 1$.

(*To be continued*)

Procedures to assess and reduce the deterioration of decalcification resins in service

By J. F. T. OLDFIELD, C. W. HARVEY and M. SHORE
(British Sugar Corporation Ltd., Research Laboratories, Colney, Norwich)

Paper presented to the 21st Technical Conference, British Sugar Corporation Ltd., 1972

PART I

Introduction

THE use of a cation exchanger in the sodium form to exchange thin juice calcium for sodium and so reduce scaling of evaporator tubes is probably the most common full-scale application of ion exchange in the sugar industry.

The lime salts achieved in the UK practice are generally lower than the levels normally reported by continental European or American factories.

Several British factories have operated for a whole campaign without boiling out evaporators and some factories can produce thin juice with a calcium content of about 15 ppm without calcium exchange. Even at these low levels, when achieved directly in carbonatation, scaling can still be a problem. Other factories have moderately high lime salts by UK standards and decalcification plants have been installed at 10 of the British Sugar Corporation factories commencing with the plant at King's Lynn in 1964.

Except for an experimental Imacti continuous decalcification plant at Ely factory all the installations are of the batch type. They are basically very similar and the operating procedures and specifications of the newest automated installations have been developed in the light of experience with the earlier plants.

Decalcification of the juice is accomplished using a strongly acidic cation exchanger in the sodium form but not all the installations use the same type or make of resin and individual columns in certain of the earlier installations were charged with resins from competitive manufacturers to obtain comparative data on their behaviour in service.

At the end of each campaign a representative sample of freshly regenerated and washed resin is taken from each column at each installation and this is then compared, by means of a series of standard tests, with a sample of the same resin taken when each column received its initial charge. Over several years the results of this periodic assessment have shown which resin characteristics are of prime importance.

Loss of exchange capacity of the resin with consequent decrease in cycle times is one of the most serious changes in resin characteristics and operation is even more impaired when this is accompanied by a high calcium leakage to give above-average lime salts in the treated juice. Physical loss of resin due to the formation of fines by attrition followed by their loss during back-washing will also lead to a loss of column capacity. Where the fines are not removed their presence may cause an increase in resistance to flow through the column, which is generally shown by an increase in the pressure drop across the column.

Procedures for the measurement of resin capacity and leakage levels, and for assessment of the amount of broken resin beads and the extent and type of fouling, together with details of a method for the clean-up of fouled resin have been developed. The clean-up procedure has been applied in factory practice. Some of the materials responsible for the fouling have been tentatively identified and measures to minimize this occurrence are suggested.

Assessment of Resin Deterioration

Determination of resin capacity

Resin as supplied by the manufacturer has hardly any exchange sites in the calcium form whereas it is never economically feasible to regenerate used resin so fully as to remove calcium completely. The exchange capacity and low leakage characteristics of virgin resin are therefore superior to those of regenerated used resin. In all the comparisons reported in this paper this effect was avoided by exhausting both new and used resins completely with calcium chloride solution followed by regeneration by the standard technique as recorded in the Appendix.

While the softening of thin juice is analogous to water softening, the two systems are not identical even apart from the presence of sugar. In the softening of sugar juices resin capacities are considerably lower than those found in water treatment practice because of the relatively high concentration of potassium, which can be up to 30 to 50 times the calcium level, in the unsoftened juice. The high potassium level forces the exchange equilibrium away from complete calcium removal so that the residual calcium in treated juice is far higher than in softened water. The figures for plant design are determined by direct experiment with the liquors which are to be treated and strongly acidic cation exchangers, such as "Amberlite IR 120" and "Zerolit 225", regenerated with 15 lb of salt per ft^3 will give[1] an exchange capacity of 1·2 lb CaO per ft^3.

It would appear that the determination of resin capacity could be carried out using essentially a scaled-down version of the factory operating procedure and exhausting the resin with a synthetic thin juice made up to contain typical amounts of calcium, sodium and potassium. Capacity determinations carried out in this way proved time-consuming owing to the large volumes of synthetic solution required even when the resin volume was only 10 cm^3 and also, with this amount of resin, consistent regeneration could only be obtained when the ratio of regenerant to resin was greater than used in the factory.

Table I. Capacities of factory resin as percentage of new resin capacity

Factory	*Column No.*	*Date Installed*	*Capacity* 1970 (%)	*Capacity* 1971 (%)
Allscott	1	1969	100	98
Cantley	1	1966	81	82
,,	2	1966	84	88
,,	3	1966	89	94
Felsted	1	1967	68	78
,,	2	1967	72	66
Ipswich	1	1966	67	63
,,	2	1966	76	60
King's Lynn	2	1964	74	73
,,	3	1968	71	74
Peterborough	1	1969	80	22
,,	2	1969	80	44
,,	3	1969	80	24
Spalding	1	1968	81	83
Wissington	1	1970	—	92
York	2	1968	87	82

Comparative values of the resin capacities were therefore obtained by exhausting the resin with calcium chloride solution using the simplified procedure described in the Appendix and the results obtained for the 1969/70 and 1970/71 campaign resin samples are recorded in Table I.

The same resin was employed in the plants at Allscott and Peterborough and these were both installed immediately prior to the 1969/70 campaign. It can be clearly seen that, while there had been little change in the capacity of the Allscott resin, the capacity of the Peterborough resin had fallen to an unacceptable level.

Determination of resin leakage

Concomitant with the decrease in resin capacity at Peterborough during the 1970/71 campaign the calcium content of the softened juice rose from the expected minimum of about 6 ppm to 15–20 ppm.

The leakage of Peterborough resin from the 1970/71 campaign was compared with that of new resin. After exhaustion with a calcium chloride solution contining 500 ppm calcium, the samples of new resin and Peterborough resin were regenerated by the standard procedure as recorded in the Appendix.

Thin juice, containing 33 ppm calcium, was applied to 10 cm^3 resin columns at stepwise decreasing flow rates and the calcium contents of the series of treated juices are reported in Table II.

Table II. Effect of juice flow rate on calcium leakage from Peterborough resin

Calcium content of treated juice (ppm)

Flow rates, cm^3/min	*Peterborough resin* 1970/71 *campaign*	*New resin*
12	17	3
3	14	3
1·3	11	3
12	20	3

The results confirm the factory experience of high calcium leakage from the Peterborough resin.

The calcium leakage from the Peterborough resin increased with increasing juice flow rate while the leakage from the new resin remained constant, indicating, for the Peterborough resin, an increase in the time required for the exchange reactions between the resin and juice.

Calcium leakage may also be caused by formation of complex calcium ions which are not taken up by the resin[2] but this was not occurring with this thin juice as shown by the low calcium leakage from the new resin.

Determination of the extent of resin fouling

The exchange reaction between the sodium ions attached to the sulphonic acid functional groups on the polystyrene resin matrix and the calcium ions in solution is very rapid as is the rate of diffusion of ions in and out of the resin bead and also the rate of diffusion of ions through the resin matrix.

[1] Carruthers and Oldfield: *I.S.J.*, 1960, **62**, 323.
[2] Bouchard: *Ind. Alim. Agric.*, 1970, **87**, 855–858.

Around each bead there is a static layer of water held by friction through which ions pass by diffusion. The diffusion rate is independent of the nature of the resin and, in the case of strongly acidic resins, it is less than the rate of diffusion of ions into and through the resin itself and will control the rate at which the ion exchange reaction proceeds.

If juice flows past the beads so slowly that the rate of arrival of new ions is similar to the rate of diffusion through the static film then the resin is always virtually at equilibrium with the solution but an increase in the flow rate will give an increase in leakage and a decrease in the effective capacity of the column. In practice the juice flow rate is such that "film diffusion kinetics" do not significantly affect the capacity of the resin or the quality of the softened juice[3].

The high leakage rate exhibited by the Peterborough resin possibly results from either fouling of the pores in the resin matrix or coating of the resin bead with fouling material, or a combination of both effects decreasing the rate of diffusion of ions into the resin matrix so that this then controls the rate at which the ion exchange reaction proceeds.

An indication of the extent of fouling of the resin was obtained by measuring the time taken to exhaust half the measured capacity of freshly regenerated resin when mixed, by stirring, with a solution of calcium chloride. The method, which is described in the Appendix, is similar to that used by SMALL[4] to measure the extent of poisoning of cation exchange resins by surface-active agents.

The results of the determination of the time taken to reach half capacity ($t_{\frac{1}{2}}$) are recorded in Table III and the values obtained should be compared with a half time of 4 minutes obtained for new samples of all the different types of decalcification resins in use by the British Sugar Corporation.

Table III. Time to exchange half measured capacity—1970/71 campaign resin samples

Factory	*Column No.*	*Date installed*	$t_{\frac{1}{2}}$ *(minutes)*
Alscott	1	1969	4
Cantley	1	1966	4
,,	2	1966	3
,,	3	1966	5
Felsted	1	1967	5
,,	2	1967	28
Ipswich	1	1966	4
,,	2	1966	11
King's Lynn	2	1964	4
,,	3	1968	4
Peterborough	1	1969	>60
,,	2	1969	>60
,,	3	1969	>60
Spalding	1	1968	4
Wissington	1	1970	5
York	2	1968	4

From the results it is clear that all the resin in the Peterborough installation at the end of the 1970/71 campaign was severely fouled while Felsted column 2 resin and Ipswich column 2 resin also showed symptoms of fouling.

It should be noted that because $t_{\frac{1}{2}}$ is referred to the measured capacity of each resin sample rather than the measured capacity of new resin, the values given in Table III will only indicate the type of fouling which affects diffusion of ions and not the type of fouling which denies access of ions to the sulphonic acid groupings; the latter type of fouling causes an absolute rather than an effective loss in capacity.

Development of a Resin Clean-Up Procedure using Sodium Hypochlorite

Capacity measurements on the Peterborough resins after the 1969/70 campaign showed that after operating for only one campaign the resin capacity had decreased by 20%. During the 1970/71 campaign investigation of complaints of high calcium leakage and poor column performance at Peterborough showed that at mid-campaign the capacity of the resin, measured on a grab sample (Dec. 1970), had decreased by a further 6% and, so that any necessary remedial action could be taken soon after the end of the campaign, development work on a clean-up procedure was carried out on this sample of resin.

It was not possible to remove fouling material from the Peterborough resin by regeneration with either excess of the standard 10% brine regenerant, or with increasing concentrations of brine, including saturated brine. Treatments of the resin with either hydrochloric acid or sodium hydroxide proved equally unsuccessful as did elution of the resin with a solution containing 5% sodium hydrosulphite and 5% sodium hexametaphosphate which is used to remove possible iron fouling[5].

Alkaline brine solutions have been used to clean up poisoned resins[6] and a value of 4 minutes for $t_{\frac{1}{2}}$ was measured on Peterborough resin after it had been first soaked for 24 hours in a solution containing 10% sodium chloride and 10% sodium hydroxide and then regenerated by the standard method. There was no increase in capacity however.

Poisoned anion exchange resins may be cleaned by soaking in a solution of sodium hypochlorite, containing about 2% available chlorine, but this can also lead to chemical attack on the resin[1,6,7,8]. When the mid-campaign sample of Peterborough resin (Dec. 1970) was soaked in 12% sodium hypochlorite solution at room temperature the almost black resin was bleached until it became visually somewhat lighter in colour than new resin; at the same time the capacity recovered to about 96% of that of new resin and a value of 4 minutes was obtained for $t_{\frac{1}{2}}$.

Effect of sodium hypochlorite on resin strength

A comparative assessment of the resistance to breakdown of resin beads may be obtained, as detailed in the Appendix, by determination of the percentage by weight of broken beads produced as a result of

[3] ARDEN: "Water Purification by Ion Exchange" (Butterworth, London) 1968, 43–44.
[4] *J. Amer. Chem. Soc.*, 1968, **90**, 2217–2222.
[5] FISHER: US Patent 3,262,883 (1966).
[6] ARDEN: "Water Purification by Ion Exchange" (Butterworth, London) 1968, 98.
[7] LASKONI *et al.: Sbornik Prikl. Khim.*, 1966, **39**, (5), 1203–1206.
[8] HOFFMAN: *Z. Chem.*, 1969, **9**, (7), 273.

SIEMENS

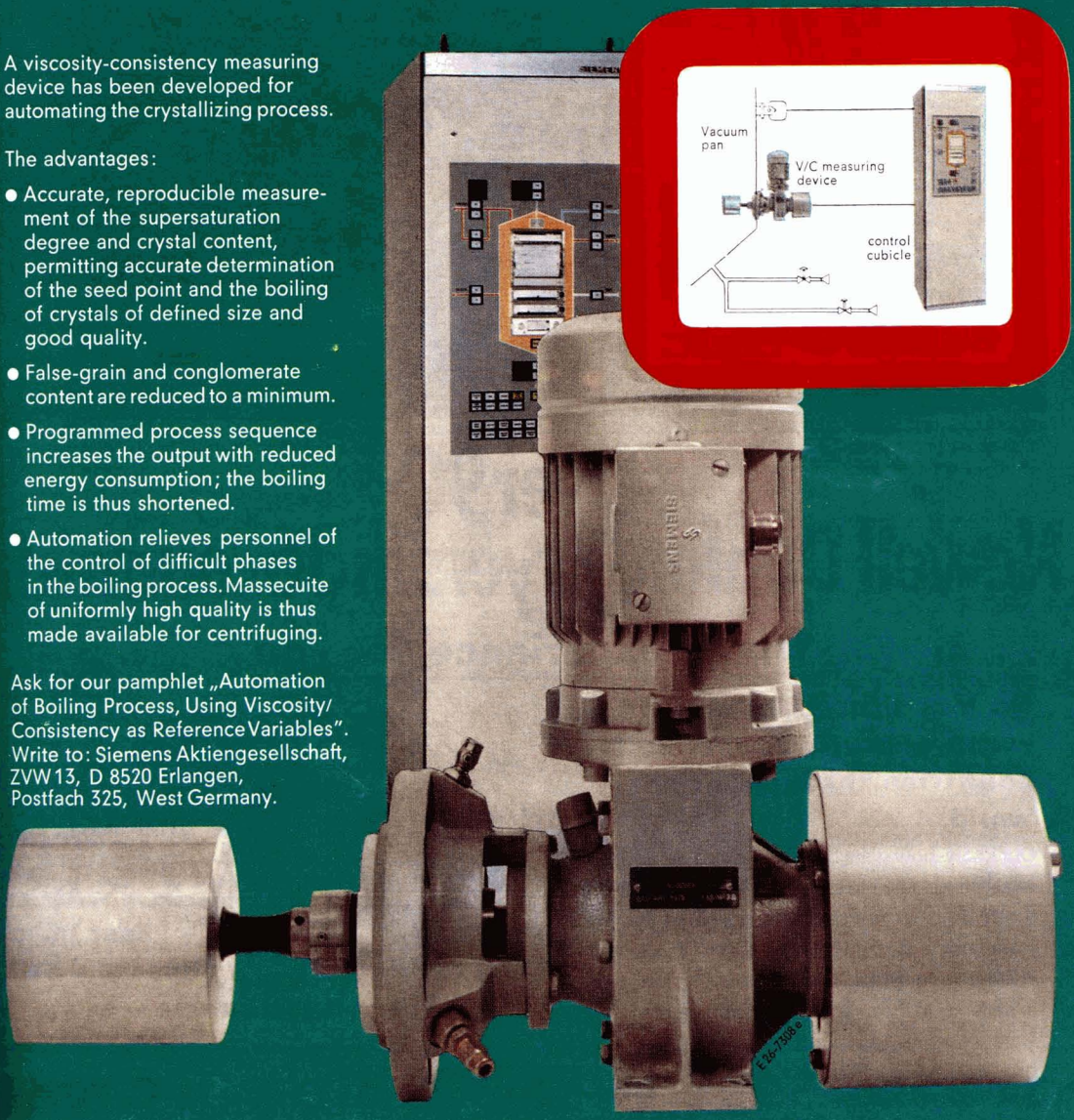
Improved Sugar Boiling Process Control

A viscosity-consistency measuring device has been developed for automating the crystallizing process.

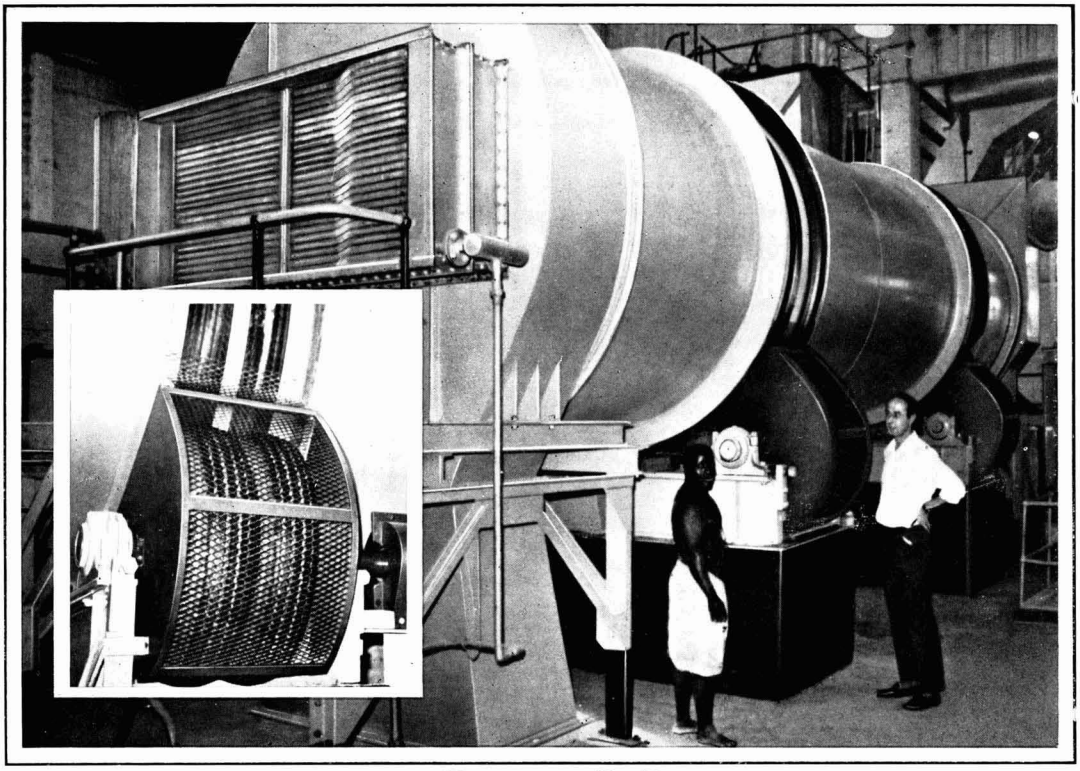
The advantages:

- Accurate, reproducible measurement of the supersaturation degree and crystal content, permitting accurate determination of the seed point and the boiling of crystals of defined size and good quality.
- False-grain and conglomerate content are reduced to a minimum.
- Programmed process sequence increases the output with reduced energy consumption; the boiling time is thus shortened.
- Automation relieves personnel of the control of difficult phases in the boiling process. Massecuite of uniformly high quality is thus made available for centrifuging.

Ask for our pamphlet „Automation of Boiling Process, Using Viscosity/ Consistency as Reference Variables". Write to: Siemens Aktiengesellschaft, ZVW 13, D 8520 Erlangen, Postfach 325, West Germany.



with automatic equipment from Siemens



Over 90 Newell Dunford dryers in 36 countries

That's experience for you

No less than 2,000 tons of sugar per hour in 36 different countries throughout the world.

Our know-how goes back over 30 years, our experience stretches across the world, where we have designed and supervised the manufacture of drying plants tailored to our customers' individual requirements. Our long experience in the design and manufacture of Rotary Louvre, Cascade Dryers and Coolers has led to the very latest developments - including the use of pneumatic rubber tyres, which make for quieter, more reliable running and the minimum of maintenance.

The service, before and after installation, is all you would expect from Newell Dunford - the world leaders.

The Nitty-Gritty Group

Newell Dunford Engineering Ltd.

143 Maple Road, Surbiton, Surrey

Telephone: 01-546 7799 Telex: 22413 Telegrams: Lindaresco Telex London

relatively rapid contraction and expansion of the resin beads by alternately drying and wetting the sample several times. The percentage of broken beads produced with Peterborough resin (Dec. 1970) using this method was increased from 8% to 13% after it had been bleached, showing that sodium hypochlorite had reduced the strength of the resin.

By microscopic examination of the resin during hypochlorite treatment it was observed that, although immediate frothing occurred at the resin surface, bleaching was not detectable in the first 2 hours after which a bleached zone spread gradually inwards through the beads over the next 12 hours.

It was considered however that, by stopping the reaction at an intermediate stage, it may be possible to obtain a clean-up of resin without significantly affecting its strength.

A series of 10 cm^3 samples of Peterborough (Dec. 1970) resin contained in 125 × 15 mm glass columns were treated at a flow rate of 1 cm^3 per minute with 25 cm^3 aliquots of sodium hypochlorite solutions increasing stepwise in concentration from 0·25% to 12%. The columns were then washed free from sodium hypochlorite with 100 cm^3 of deionized water at 3 cm^3 per minute.

Analysis of the treated resin samples is recorded in Table IV.

Table IV. Effect of concentration of sodium hypochlorite on the characteristics of fouled Peterborough resin (Dec. 1970)

Sodium hypochlorite concentration (%)	*Capacity % on new resin*	*Calcium leakage (ppm)**	*$t_{\frac{1}{2}}$ (minutes)*	*Broken beads % w/w*	
				Before strength test	*After strength test*
0	73	13	18	3	11
0·25	74	—	15	—	—
0·5	74	—	6	—	—
1·0	78	—	4	—	—
2·0	83	4	4	3	6
4·0	90	4	4	3	6
6·0	92	4	4	4	9
8·0	92	4	4	—	—
10·0	95	4	4	5	13
12·0	96	4	4	5	17

*Tested with Peterborough thin juice containing 21 ppm calcium

As the concentration of sodium hypochlorite increased, the resin capacity increased and the leakage and $t_{\frac{1}{2}}$ decreased but at the same time the amount of broken beads increased and the resin strength decreased. At 6% sodium hypochlorite the resin strength begins to fall off and the further increase in capacity is small so that 6% would appear to be the optimum concentration for clean-up of this sample of resin.

Procedure for the clean-up of fouled resin

At Peterborough, storage tanks of only 1 bed volume were available for special treatment. Laboratory experiments in December 1970 showed that capacities of about 90% of the capacity of new resin and $t_{\frac{1}{2}}$ values of 4 minutes could be obtained by treatment of resin samples with 6% hypochlorite for 1 hour. These conditions were therefore selected provisionally for the factory treatment.

No significant rise in temperature was recorded during the clean-up of the resin but as the factory decalcification columns are lagged to prevent heat loss, as a precaution, in case there was a rise in temperature owing to heat of reaction, the previous experiment was repeated at 80°C. The results were similar to those obtained at room temperature and there was no significant loss of resin strength.

Application of the clean-up procedure in the factory

Before proceeding to the full-scale clean-up in the factory decalcification plant, a fairly large laboratory-scale trial was carried out using seven litres of a composite sample of resin comprising equal amounts taken from all three columns at Peterborough at the end of the 1970/71 campaign.

The composite resin sample, placed in a 9-inch diameter QVF glass column, was well stirred and then backwashed to remove the large amounts of second carbonatation precipitate with which it was contaminated. When clear from precipitate the water was drained to the top of the resin, 7 litres of a 6% solution of sodium hypochlorite were run onto the column which was allowed to drain only until the water had been displaced from the resin voids as shown by the appearance of hypochlorite in the effluent. The reaction was allowed to proceed at room temperature for an hour and the resin was stirred about every 15 minutes by air blowing. Some frothing occurred but the foam height was not excessive and was considered unlikely to cause trouble in the factory, and little chlorine was evolved.

After treatment there was about $\frac{1}{4}$ inch of white precipitate on the top of the resin and this was removed by backwashing for one hour at a rate of 8 litres per minute after the resin had been washed free from excess sodium hypochlorite with about 10 bed volumes of water.

The clean-up procedure increased the capacity of the resin from 34% to 80% of that of new resin while the time to half capacity ($t_{\frac{1}{2}}$) was decreased to 5 minutes from more than 1 hour. The treatment was less efficient than with the mid-campaign sample (Table IV), presumably owing to the increased amount of fouling which had taken place in the second half of the campaign.

Using a series of sodium hypochlorite solutions of increasing concentration it was established that an optimum concentration of 10% sodium hypochlorite was required to remove the fouling from the composite sample and after treatment a value of 4 minutes was obtained for $t_{\frac{1}{2}}$ with a capacity of 86% that of new resin.

After the cleaned-up resin had been allowed to stand in water for about 24 hours it was noticed that brown colouring material was leached out of it and it was considered that a further wash should be included to remove this.

The effects of 10% sodium hypochlorite solution on the unprotected metal parts of the decalcification plant and on the protective coatings were assessed in

the laboratory before its use in the factory and, while the protective coatings were unaffected, unprotected mild steel was subject to attack but it was considered that this would be slight in the time taken to carry out the clean-up procedure.

The clean-up procedure was applied first to column 1 at Peterborough and the characteristics of the cleaned resin were assessed before application of the same procedure, by the factory personnel, to columns 2 and 3.

During the campaign, leakage of the GP filters at the beginning of each cycle led to contamination of the columns with 2nd carbonatation precipitate and, if significant amounts were left on the resin after backwashing, it was standard practice to dissolve this using 1 or 2 carboys of hydrochloric acid. To avoid the possibility that any of the resin was in the acid form, which would react with sodium hypochlorite to produce chlorine, the column was regenerated before clean-up.

The column, which contained 235 ft^3 of resin, was drained to just above the resin bed and then about 1440 gallons of 10% sodium hypochlorite solution was pumped onto the resin while the column output was run to waste until sodium hypochlorite appeared in the effluent when the drain was closed.

The sodium hypochlorite solution was delivered in bulk as a 10% solution directly into an empty hydrochloric acid storage tank which had been carefully washed free from acid. The solution was pumped to the column over about 2 hours; ideally the transfer should have been much faster but the rate was limited by the pump capacity.

When all the sodium hypochlorite had been added the resin bed was gently agitated by air blowing for about 1 hour.

The temperature of the bed rose during the reaction until after 40 minutes it had almost reached 80°C and sufficient cold water was pumped as a backwash into the column to cool the contents to 50°C. After 1 hour the bulk of the spent sodium hypochlorite was washed to waste with 1 bed volume of water and then the column was backwashed with water at a rate of 300 $gal.min^{-1}$ for about 30 minutes. The column was allowed to drain to the level of the bed and a sample of resin was taken for assessment; then, after being allowed to stand for about 24 hours, the column was washed free from the brown colouring material leached from the resin.

The results obtained for resin samples after clean-up are recorded in Table V. Since treatment the resins were in service for a further campaign and their characteristics after the 1971/72 campaign are also recorded.

Table V. Comparison of resin characteristics before and after clean-up at Peterborough

Sample	*Column No.*	*Capacity % on new resin*	*$t_{\frac{1}{2}}$ (minutes)*	*Broken beads % by weight)*
Before clean-up 1971	1	22	>60	5
	2	44	>60	5
	3	24	>60	4
After clean-up 1971	1	82	4	4
	2	83	4	4
	3	86	4	6
After service in 1971/72 campaign	1	78	5	9
	2	70	7	10
	3	68	8	19

Clean-up of the resin in the factory installation has increased the resin capacities from 22–44% to 82–86% and the times to half capacity have been decreased from more than 1 hour to the value of 4 minutes as obtained with new resin.

There would appear to have been a small decrease in resin strength as shown by the increase in the percentage by weight of broken beads after the cleaned resin had been in service during the 1971/72 campaign.

(*To be continued*)

The determination of moisture in raw sugar

By N. R. PIPER

The Colonial Sugar Refining Co, Ltd., Central Laboratory, John St., Pyrmont, New South Wales, Australia 2009)

Introduction

THE standard method of determining raw sugar moisture for the Australian sugar industry is by air oven drying at 98°C for five hours. This procedure is time-consuming because of the required drying time, and is subject to errors such as the slow deterioration of the sugar at the temperature used. Here, as in other countries, considerable time and effort has been invested in attempts to find more rapid, precise and accurate methods for measuring raw sugar moisture. Unfortunately, it has not yet been possible to find any two methods which give identical results.

OOSTHUIZEN[1] in 1969 compared the results of raw sugar moistures determined by oven drying at 105°C for three hours and the Karl Fischer titration methods of MCCOMB[2] and BENNETT *et al.*[3]. He reported that

[1] *Proc. 43rd Congr. African Sugar Tech. Assoc.*, 1969, 146–150.
[2] *Anal. Chem.*, 1957, **29**, 1375.
[3] *I.S.J.*, 1964, **66**, 109–113.

the oven method consistently gave values lying between those of the two Karl Fischer methods. BENNETT's method is said to determine the "surface + bound" moisture on the outside of the crystal, while the MCCOMB method determines total water after dissolution of the sugar crystals in formamide. OOSTHUIZEN suggested that the difference between the "surface + bound" or external moisture and the oven moisture results was due either to deterioration of the sugar during drying (which could register as a weight loss) or to the migration of moisture within the crystal to the surface and its subsequent evaporation during the drying period.

Contemporaneously with OOSTHUIZEN's work, we had begun investigating the relationships which exist between the sugar moisture results obtained by oven drying at 98°C for five hours, vacuum oven drying at 70°C for 16 hours, and the Karl Fischer methods of BENNETT *et al.* and MCCOMB. Constituents defined and examined as possibly influencing these relationships were: internal moisture content of the crystals (defined as the difference between the total moisture determined by MCCOMB's method and the external moisture determined by BENNETT's method), reducing sugar formation and deterioration during drying, and other raw sugar constituents of unknown composition which may be volatile under the drying conditions employed (termed "volatiles" in this paper).

EXPERIMENTAL

Apparatus

The Karl Fischer titrations were carried out using a Metrohm "Combi-Titrator 3D" automatic titrator fitted with an airtight titration vessel and operating in the dead-stop titration mode.

The vacuum oven was manufactured by the National Appliance Company, Portland, Oregon, USA and was operated at less than one inch Hg pressure using a "Dynavac 2" two-stage rotary high-vacuum pump.

Reagents

Commercially available Karl Fischer reagent was used in this work. Two brands were used: May and Baker (water equivalent approx. 4 mg/ml) and Merck (water equivalent approx. 5 mg/ml).

Formamide was supplied by British Drug Houses Ltd. (approx. 0·03% water) and Merck (approx. 0·02% water).

Anhydrous methanol was supplied by the same two companies, each having a water content of approx. 0·01%.

Procedure

Oven methods: 5 g raw sugar was used for each oven or vacuum oven moisture determination. The sugar was weighed into a clean, dry metal drying dish (complete with lid). After drying the sample under the specified conditions, the lid was placed on the dish before it was removed from the oven and the dish was kept closed during 30 minutes cooling in a desiccator and subsequent weighing. All oven and vacuum moisture values were the average of six replicates.

Total moisture (Karl Fischer—formamide titration): 5 g amounts of sugar or, in the case of determinations carried out on dried sugar, the sugar remaining after the drying of 5 g of sugar, were used in these determinations. The sugar was dissolved in 50 ml formamide in a closed vessel using a magnetic stirrer. The sugar was completely dissolved in 50–55 minutes and a standard stirring time of 55 minutes was used.

Blank corrections were made by titration of 50 ml formamide after 55 minutes' stirring in a closed vessel. The speed of stirring was found to be critical, since this determined the rate of absorption of moisture by the formamide from the air space in the vessel. For this reason, stirring speed was tightly controlled.

The water equivalent of the Karl Fischer reagent was determined by titration of a weighed amount of water in a blank formamide solution which had been titrated previously to a zero end-point. Water equivalents carried out in methanol using the same procedure gave identical values. All total moisture values were determined in triplicate.

External moisture (Karl Fischer—methanol titration): 5 g amounts of sugar, or the amount of sugar remaining after drying 5 g of sugar (for determinations on dried sugar) were slurried with 30 ml methanol in a closed vessel and stirred with a magnetic stirrer. OOSTHUIZEN titrated such solutions immediately, eliminating crystal grinding and absorption of moisture from the air space in the vessel. Trials carried out in this laboratory showed that the surface moisture results increased steeply with time during the first 10–15 minutes stirring and thereafter increased gradually at a steady rate. It appears that the syrup layer surrounding the sugar crystals requires 10–15 minutes to dissolve fully. The subsequent gradual increase with time is probably the result of crystal grinding (expected to be slight) and absorption of moisture from the airspace in the vessel.

As in the case of the formamide titrations, stirring rate was critical and was carefully controlled. Titration of sugar slurries and solvent blanks were carried out after 15 minutes' stirring.

All determinations were made in triplicate.

RESULTS

Factors influencing oven and vacuum oven moisture values

One hundred and eight raw sugars were selected for analysis, representing the analysis ranges: pol 97·3–99·0, reducing sugars 0·2–0·7%, ash 0·2–0·6% and oven moisture 0·2–0·8%. The following constituents were determined:

Oven moisture, vacuum oven moisture, external moisture (by Karl Fischer—methanol titration), total moisture (by Karl Fischer—formamide titration), internal moisture (by difference between total and

external moistures), vacuum oven "volatiles" (non-water volatile material defined by the difference between vacuum oven moisture and external moisture), oven "volatiles" (defined by difference between oven moisture and external moisture), reducing sugars and total, external and internal moistures and reducing sugar concentrations in the oven-dried and vacuum oven-dried samples.

The results were analysed by computer to find any correlations which might exist between constituents. Straight line relationships with high degrees of correlation were found for total moisture *vs.* oven moisture, total moisture *vs.* vacuum oven moisture, external moisture *vs.* oven moisture, external moisture *vs.* vacuum oven moisture and oven moisture *vs.* vacuum oven moisture. In round terms, the relationships were:

(i) oven moisture (%) = surface moisture (%) + $\frac{\text{surface moisture (\%)}}{40}$ + 0·055

(ii) vacuum oven moisture (%) = surface moisture (%) + 0·030

(iii) oven moisture (%) = total moisture (%) + $\frac{\text{total moisture (\%)}}{10}$ − 0·055

(iv) vacuum oven moisture (%) = total moisture (%) + $\frac{\text{total moisture (\%)}}{10}$ − 0·075

(v) oven moisture (%) = vacuum oven moisture (%) + $\frac{\text{V.O.M. (\%)}}{30}$ + 0·020

The standard error of the left-hand side value ranged from 0·027% for (v) to 0·045% for (iv), the remaining values being closely grouped between 0·035% and 0·037%. With such poor precision, it is clear that one "moisture" value cannot be adequately determined from another using these equations.

The amount of non-water "volatiles" (vacuum oven or oven) varied greatly from sample to sample, being very small in some cases and ranging up to 0·15% (for oven) and 0·11% (for vacuum oven). From the above equations, it can be seen that the "volatiles" content is at least vaguely related to the moisture content. This is to be expected since the "volatiles" are almost certainly components of the syrup layer and the amount of syrup will be directly related to the amount of external moisture in the raw syrup.

No correlation could be found between "volatiles" and the initial reducing sugar concentrations, the change in reducing sugars concentration or the internal moisture content of the sugar. It appears that these factors and the deterioration of sucrose on heating contribute little to the total "volatiles".

One other correlation was found during the trials. A relatively significant linear relationship was found to exist between the change in internal moisture on heating and the initial internal moisture content. The significance of this is discussed later in this paper.

The importance of drying time in oven methods

Four sugars were used to determine the changes in moisture values which occur with time during drying. Total, external and internal moistures and vacuum oven or oven moistures were measured at intervals during oven drying of raw sugar over 20 hours and vacuum oven drying over 40 hours. As in the previous trial, oven moistures for each drying period were obtained as the average of six replicate determinations, after which the residual total and external moistures of the dried sugars were determined by Karl Kischer titration (triplicate determinations by each method), using the dried sugar residues.

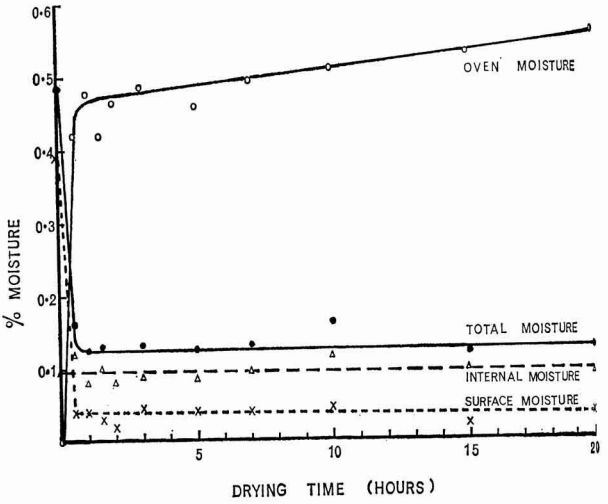


Fig. 1. Oven drying of sugar at 98°C

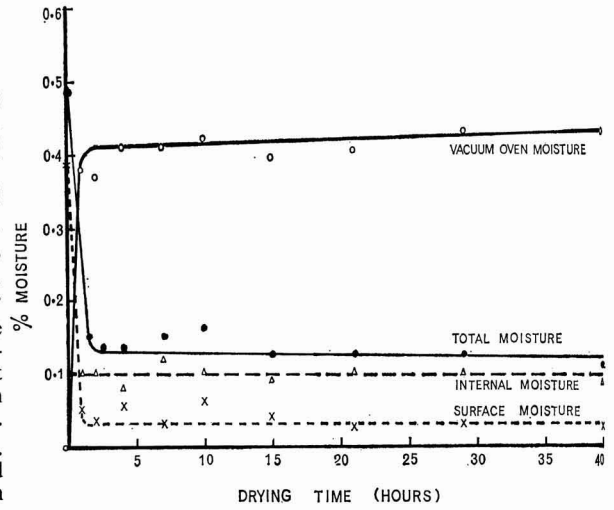


Fig. 2. Vacuum oven drying of sugar at 70°C

The results of the four sugars were combined and averaged to reduce the effect of experimental errors and to produce a representative sugar sample. The moisture curves resulting from this are shown in Figs. 1 and 2.

From the figures it can be seen that essentially all of the external moisture is removed within the first hour of oven or vacuum oven drying. Internal moisture remained unchanged throughout the entire period of each drying trial, indicating that no detectable migration of internal moisture to the surface of of the crystal had occurred.

The apparently irreducible amount of external moisture on the crystals could have three sources:

(i) grinding of the crystals during the Karl Fischer—methanol titration could release internal moisture which would then be determined as external moisture,

(ii) absorption of atmospheric moisture during cooling in the desiccator and subsequent weighing of the sample, or

(iii) external moisture locked within the dried syrup or within the airspace of a cage of crystals which had cemented together during drying.

This last possibility is discounted on the basis that the amount of moisture remaining is the same for both sugar dried at 98°C and sugar dried under vacuum at 70°C. This is highly unlikely if (iii) was the source of the moisture. The first possibility, although it may provide a small component of the residual moisture, cannot be the main contributor, since this would imply that 25% of the internal moisture has been released through grinding. Visual estimations of the amount of grinding actually occurring given values of about one per cent.

The residual external moisture content is equivalent to 1·5 mg in 5 g raw sugar. Absorption of this amount of moisture during cooling and weighing is considered quite probable, particularly as transfer of the sample to the desiccator of necessity involves the admission of ambient air to the desiccator at the same time. The residual external moisture value of 0·035% is therefore almost certainly due to absorption of moisture during cooling and weighing and, as such, constitutes an error in the oven drying methods of moisture determination.

Figs. 3 and 4, based on Figs. 1 and 2, indicate something of the composition of the material lost during oven and vacuum oven drying. All of the external moisture is lost in the first hour. So, too, is the bulk of the "volatiles". The linear nature of the loss of weight with time after one hour is attributed to sugar deterioration with subsequent loss of some of the deterioration products. This loss is large at 98°C but small at 70°C, which is as expected because decomposition of sucrose at 70°C is low.

On the basis of these results, there seems to be little point in extending the drying period beyond one hour in the case of either drying method. To do so only introduces the additional error due to sucrose decomposition. Since the most unsatisfactory aspect

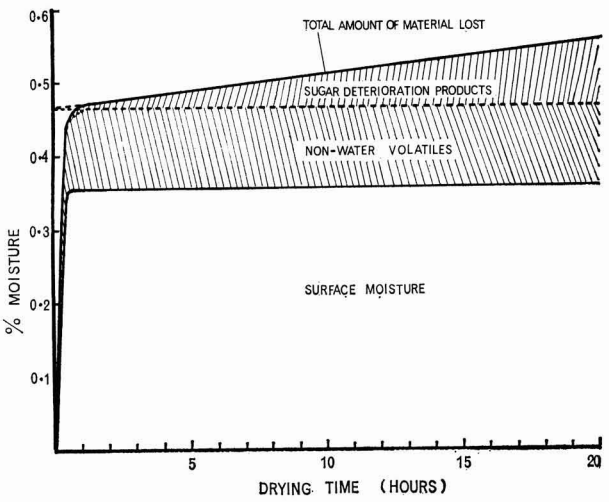


Fig. 3. Composition of material lost during oven drying

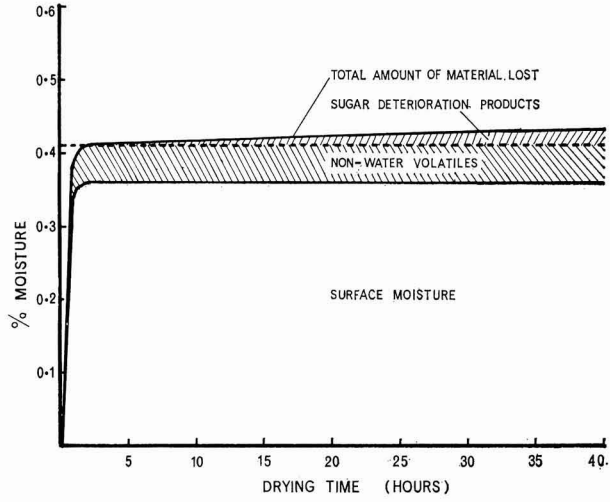


Fig. 4. Composition of material lost during vacuum oven drying

of oven drying is the length of time required, shortening the drying period could do much to improve the method as a means of determining moisture, even through it is clear that the quantity measured consists of something more than water.

Discussion

This work has established that no precise relationship exists between any two of the four methods tested that would enable one moisture value to be deduced from the other. Both drying methods overestimate the external moisture content of the sugar by including in the determination materials

other than water which are volatile under the drying conditions employed.

The internal moisture content of the representative "average" sugar in the second trial remained constant at about 0·095% during drying. However, in the first trial, results for individual sugars did indicate that some internal moisture formation and migration probably does take place. Raw sugars with an internal moisture content of about 0·10% showed no nett change in moisture content on heating, while those with initial internal moisture contents of around 0·08% showed an average 0·02% gain, and those with an initial level of 0·16% showed an average loss of 0·04%. A possible explanation is that, during five hours drying at 98°C in air or 16 hours at 70°C in a vacuum, there is an average gain in internal moisture of around 0·02% probably directly related to decomposition. In a sugar that is relatively dry internally, i.e. one having a well-formed crystal structure not weakened by inclusions, this moisture cannot migrate to the surface, and nor can the original included water. The result is a nett gain in internal moisture. At an initial value of about 0·10% internal moisture, the crystal is sufficiently weakened to allow the migration of some 0·02% moisture, and the nett internal moisture is unchanged. In internally wet, and therefore relatively porous, crystals a larger proportion of the internal moisture will be lost by migration to the surface than will be gained by sugar deterioration, resulting in a nett loss in internal moisture.

The internal moisture of most Australian raw sugars lies in the range 0·08—0·12% and the contribution of the change in internal moisture to the oven moisture result can be ignored (being only about half the value of the residual external moisture resulting from absorption during cooling as mentioned earlier).

In the light of this work, the author offers the model shown in Fig. 5 as perhaps the best currently available for the study of the mechanisms of raw sugar drying.

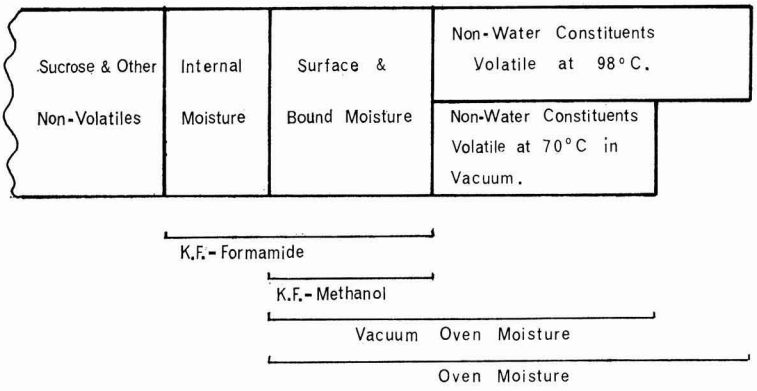


Fig. 5. Raw sugar constituents determined by various methods (ignoring sucrose deterioration during heating)

Ignoring the possibility of moisture formation inside the crystal during heating, the oven moisture methods will determine "surface + bound" moisture plus the other constituents of the syrup layer which are volatile under the drying conditions used plus the volatile components produced through the decomposition of sucrose and other constituents during the heating process. The first two components are time-independent after the first hour, but the last component is time-dependent. It therefore seems desirable to minimize the drying time to that considered necessary to remove the first two components. This will not only reduce the amount of the contribution due to sugar deterioration, but will tend to reduce the related effect of internal moisture formation and migration.

Some recent preliminary work in this laboratory indicates that drying times of one or two hours are sufficient and may prove to be more precise than longer drying times.

From the above, we suggest that any future work on oven methods of moisture determination to make them a better measure of the actual moisture contents of the raw sugars should be directed at reducing interference from the "volatile" constituents, possibly by reducing the temperature of drying while improving the efficiency of the drying process.

Summary

Four methods of raw sugar moisture determination: oven drying at 98°C for five hours, vacuum oven drying at 70°C for 16 hours and total and "surface + bound" moistures by Karl Fischer titration, were compared. No precise relationship could be found that would enable one moisture value to be calculated from another. Water contents of raw sugars during oven and vacuum oven drying were determined by Karl Fischer titration. This indicated that external moisture is removed completely during the first hour, but that internal moisture content remained essentially unchanged throughout the entire drying period. The over-estimation of external moisture by oven and vacuum oven drying arises essentially out of the volatilization of syrup materials other than water under the drying conditions used.

Acknowledgments

I would like to gratefully acknowledge the Colonial Sugar Refining Co. Ltd. for their permission to publish the results of this work.

Sugar cane agriculture

Performance of some foreign and local varieties at the Luzon Experiment Station. A. M. GALVEZ, I. L. JIMENEZ, A. M. TETANGCO and M. A. PROVIDO. *Sugar News* (Philippines), 1971, **47**, 354–358.—An account is given of 16 varieties tested during the crop year 1968–69. Results confirmed the high yielding capacity of Phil. 56226. It outshone Phil. 5333 and Phil. 5460, two standard varieties, which were also exceeded by CAC 5760, CAC 5711 and Phil. 58260. Phil. 6112 was another local variety of great promise and showing disease resistance. Tables show observed agronomic performances of local and foreign varieties at the Luzon Experiment Station during 1969–70.

* * *

Studies on the improvement of soil productivity of sugar cane fields. S. S. YANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 48.—Application of organic matter as fertilizer did not affect plant cane yields but, applied before planting, raised the soil organic matter content and increased first ratoon yields by 15% (green manure at 25 metric tons/ha) and 6% (12 tons cane trash/ha).

* * *

An analysis and comparison of sugar cane micro-climate and macro-climate. W. H. TUNG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 51.—The micro-climate within a cane field will be markedly different from general atmospheric conditions, e.g. in respect of air temperature and humidity (which change during cane growth), light intensity, especially beneath the leaf canopy, and soil temperature and moisture.

* * *

Studies on the profiles of concentration of carbon dioxide in a sugar cane field at Tainan. C. C. CHU. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 51–52. Fluctuations in the CO_2 profile changed from an L-shaped curve during the day to an S-shaped curve during the night.

* * *

Chemical weed control for short season supplementary crops grown in sugar cane farms. W. B. SZE. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 53.—The use of "Amiben" and "Nitrofen" for weed control in a peanut intercrop with cane and "Dacthal" and "Herban" ("Norea") or "Ramrod" for autumn-planted garlic in cane is discussed.

* * *

Sugar cane diseases (in Taiwan). L. S. LEU and W. H. HSIEH. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 54–56.—The incidence of sugar cane smut (*Ustilago scitaminea*), leaf scorch (*Stegonospora sacchari*), leaf blight (*Leptosphaeria taiwanensis*) in Taiwan is discussed.

* * *

Studies on sugar cane white leaf disease. III. Chemotherapy with antibiotics. S. C. LIN and W. S. TENG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 55–56. With the discovery, through electron microscopy, of mycoplasma-like bodies in the sieve tubes of cane plants affected by white leaf disease, greenhouse experiments were conducted from 1968 to 1969 to investigate whether infected seedlings or cuttings were sensitive to antibiotics of the tetracycline group. Eight different antibiotics were used. Good results were obtained with all in most cases. Symptom development was delayed 150 to 300 days or completely blocked.

* * *

Sugar cane pests (in Taiwan). Y. S. PAN, S. L. YANG, W. Y. CHENG, C. J. LIANG and H. T. TSENG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 56–59.—The following insect pests of sugar cane in Taiwan are discussed: *Epitettix hiroglyphicus* (the principal vector of white leaf disease), the grey borer (*Eucosma schistaceana*) and other borers, and the locust *Patanga succincta*.

* * *

Rat damage (in Taiwan). B. Y. WANG. *Ann. Rpt. Taiwan Sugar Expt. Sta.*, 1969/70, 60–61.—The tolerance of the albino rat (*Rattus norvegicus*) and albino mouse (*Mus musculus*) to "Warfarin" is discussed, as are the occurrence and food habits of wild rats in Taiwan cane fields.

* * *

A brief note on irrigation in Taiwan. J. F. WILLIAMS. *Taiwan Sugar*, 1971, **18**, 134–136.—The greatly increased agricultural production that has taken place in Taiwan during the last two decades has been largely due to increased irrigation. It is assumed that by 1974 projected water needs will be only slightly lower than total water supply, assuming that several projects now under way are completed in time. A table shows the distribution of irrigated and unirrigated land in Taiwan in 1968.

* * *

Relationship between rainfall and irrigation in Taiwan. H. CHANG. *Taiwan Sugar*, 1971, **18**, 137–138.—For the benefit of those not familiar with the climate of Taiwan a brief summary is presented of the characteristics of the country's rainfall and its relationship to irrigation. Total rainfall is 1500–2000 mm but distri-

bution is not ideal where cane growing is concerned. The north-east and south-west monsoons are the main controlling factors.

* * *

Irrigation and water resources development on TSC's farms. C. J. HU and S. M. LEE. *Taiwan Sugar*, 1971, **18**, 147–153.—For the purpose of stabilizing and increasing sugar production on Taiwan Sugar Corporation's farms development of water resources for irrigation is badly needed. Irrigation has become more important with the higher cost of irrigation water, increasing labour costs and changes in sugar cane cultivation. During recent years, as a result of field experiments in the farms and adoption of irrigation principles from Hawaii, the water conveyance systems and field irrigation practices have been much improved.

* * *

Partial characterization and use of a host-specific toxin from *Helminthosporium sacchari* on sugar cane. G. W. STEINER and R. S. BYTHER. *Phytopathology*, 1971, **61**, 691–695.—A toxin obtained from *H. sacchari*, the causal agent of eye spot disease of sugar cane, produced symptoms similar to those caused by the fungus and can be used for rapid, large-scale screening for resistance to the disease.

* * *

Farmyard manure and plant residues as fertilizers. ANON. *Producers' Rev.*, 1971, **61**, (9), 17–19.—It is pointed out that organic material, whether it be farmyard manure, a pea crop, cane crop residues, bagasse or other plant or animal remains, is good for a soil in certain respects. The increased organic content will improve the physical condition of the soil, whether it be clayey, loamy or sandy. It will hold more water after rains or irrigation and leaching of plant foods is reduced. But for optimum crop growth the organic material must be supplemented with fertilizer nutrients to the level of the crop's requirements.

* * *

Investigation on the physiology of flowering. R. JULIEN. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 45–53. This is a continuation of earlier work on the effects of photoperiod on flowering in *Saccharum*. The investigation was started to study the effects of photoperiod, applied at different stages of development, on flowering in one *S. robustum* clone and to elaborate on previous results obtained with *S. spontaneum*. Results are illustrated by means of figures and suggestions are made for further work, which includes a survey of all non-flowering or sparsely flowering breeding varieties.

* * *

(Cane) Breeding policy. J. A. LALOUETTE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 53–54.—1970 was a year of consolidation on the biometry side. On the plant breeding side all the practical aspects of crossing and selection were re-examined during the year. This underlined the urgent necessity for more experimental land. Three stations have been enlarged, and the release and distribution of new varieties also received close attention.

* * *

Crossing and selection. P. R. HERMELIN. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 54–55.—A summary is given of crosses made in 1970, selection of seedlings, bunch selection plots, propagation plots and first selection trials.

* * *

Variety trials. J. A. LALOUETTE and L. C. Y. L. S. CHONG. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 56–57.—Summaries of variety trials results are tabulated, with information on varieties rejected as susceptible to gumming disease and others resistant to the disease which are being re-tested.

* * *

Results in final variety trials. P. HALAIS and G. ROUILLARD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 58–62.—Results of final variety trials are discussed; from them it is concluded that varieties of commercial importance are M 93/48, M 442/51, M 13/56, N:Co 376 and S 17 which have characteristics suited to various ecological conditions. The last variety is being rapidly extended, from 3% of new plantings in 1969 to 37% in 1970.

* * *

The residual effect of calcium silicate applications on cane growth. Y. W. Y. CHEONG. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 63–68.—The beneficial results from application of calcium silicate observed with plant cane and first ratoons was found to continue to second ratoons and is expected to continue with later ratoons. Whether the application would be economical, however, depends on the varietal response; with M 93/48 response was good but with Ebène 1/37 silicate application was not economical.

* * *

A check on the present practice of foliar diagnosis as carried out on a plantation scale. Y. W. Y. CHEONG. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 68–69. A check on leaf nutrient contents after fertilizer treatment in accordance with initial measurements, shows that the system currently used in Mauritius is working well, with the correct fertilizer recommendations being given in the majority of cases and with incorrect recommendations in a few cases, as expected from the foliar diagnosis system.

* * *

Quantitative nitrogen requirements of four cane varieties from foliar diagnosis data. P. HALAIS and P. NABABSING. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970. 70–74.—Statistical study of responses to nitrogen fertilizer by individual varieties in areas belonging to three ecological groups has been used to develop a rough guide to fertilizer needs in relation to the cane tonnage expected.

* * *

Moisture relations of some Mauritius soils. P. Y. CHAN and E. Z. ARLIDGE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 74–78.—Available water capacity

of soil is defined in terms of field capacity, permanent wilting point, bulk density and depth of soil supplying water to the cane roots. An account is given of techniques for determining these factors which can provide a basis for ensuring that water supplied by sprinkler irrigation is not too much, causing leaching of nutrients, or too little, depriving the plant.

* * *

Studies on soil structural stability. P. Y. CHAN. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 78–81. The low inherent structural stability of Dark Magnesium Clay—one soil type in Mauritius—presents problems because of rapid compaction of the subsoil even after deep tillage, waterlogging after heavy rain or over-irrigation, rapid breakdown of aggregates by raindrops on the soil surface, and erosion of ridges with exposure of the cane roots. Remedies include the use of shallow furrows and ridges which should follow the contours of sloping ground. Cane trash should also be used to protect the solid surface and perhaps improve stability by incorporation within it.

* * *

Gumming (disease of cane). C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 83–87.—A severe outbreak of the disease in 1970 confirmed its dissemination as a result of cyclones. Fields of susceptible varieties such as M 147/44 acted as a source of inoculum from which the disease spread. Resistance of M 377/56 broke down and prohibition of planting of this variety has been recommended. Work is reported on breeding for resistance to the disease and on a project for inducing mutation in M 377/56 cane by gamma-radiation in the hope of obtaining a resistant cane.

* * *

Leaf scald. C. RICAUD and M. E. PAULO. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 87–92.—Leaf scald infection had been of minor importance but there was an upsurge in 1970. A survey was carried out on diseased plants and a number of strains of differing virulence were isolated. Apparently symptomless cane also proved to carry the pathogen and could act as a source of infection by cutting knife to susceptible varieties.

* * *

Chlorotic streak. C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 92–94.—The causal agent of the disease is as yet unidentified and control must be based on cultural practices to delay re-infection after hot-water treatment of cane setts. Attempts at biological control of the vector through addition of organic matter (muds or molasses) to the soil have failed. A fungus resembling the family *Lagenidiaceae* has been isolated in roots of diseased plants grown in water-logged soil and its association with chlorotic streak is to be investigated.

* * *

Yellow spot. C. RICAUD and S. SULLIVAN. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 94–96. The most effective way of application of "Benlate" for control of the disease was investigated. Monthly sprays gave about 40% control and early sprays seemed more effective than those applied later. Sprays applied during and after the peak period of infection had little effect. The cane yield and recoverable sucrose content were reduced by the disease but not greatly; however, application of two early sprays, especially to highly susceptible varieties, could be economical.

* * *

Smut. C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 96–97.—Smut has become of little importance in Mauritius as a result of the replacement of susceptible by resistant varieties. An outbreak occurred in 1970 in fields of M 99/48 cane; diseased stools were rogued and the fields are to be uprooted and the cane replanted with the resistant variety M 31/45.

* * *

Pineapple disease. C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 98–99.—Comparison was made between the standard "Agallol" and "Benlate", a non-mercurial fungicide. Both gave significant control of the disease with S 17 variety; with M 93/48 "Benlate" was superior.

* * *

Miscellaneous diseases. C. RICAUD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 99–100.—Nurseries and sett hot-water treatment tanks were set up on the island to counter ratoon stunting . Germination has been variable, and it has been found that fermentation in the hot water tanks has reduced the pH to as low as 4·5 which might be a cause of germination failure. Addition of an organo-mercurial has been effective in reducing this pH drop. A number of Mauritius varieties have been sent to Madagascar for Fiji disease resistance testing. The importance of knife sterilization during harvesting, to prevent spread of gumming disease, is discussed, and the use of "Iosan" disinfectant for this purpose described.

* * *

The scale insect. J. R. WILLIAMS. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 111–113.—This cane pest was less abundant than usual but many badly attacked fields were reported. An account is given of attempts to introduce and establish two natural enemies or parasites from East Africa.

* * *

Rats as cane pests. M. A. RAJABALEE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 114–116.—Work is reported on relative damage caused by the brown and the black rat and of the preference shown for different baits (used in waxed "biscuits"). Crushed or cracked maize was most favoured by the rats and preferred to rice. Chicken meal was not attractive. The crumbling of "biscuits" in the field, due to moisture, was rectified by using paraffin wax of higher melting point.

Weed control. G. McINTYRE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 117–124.—Work on weeds and weed control during the year is described under the following headings: evaluation of new herbicides, herbicides *vs.* hand weeding, and small plot pre-emergence trials with new herbicides. Six herbicides were compared with DCMU. Good weed control was obtained with G.S.14254, G.S.14259 and G.S. 13529.

* * *

Notes on experiments conducted with ripener CP 41845. H. R. JULIEN and G. McINTYRE. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 130–133.—Trials with three varieties showed different responses according to their richness and the optimum amount and time of application also varied. Detailed investigations are required for each individual variety.

* * *

Preliminary trials with the "Target-Master" sprinkler. M. HARDY. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 133–134.—Advantages of the "Target-Master" sprinkler over the "Boom-o'-Rain" sprinkler are discussed on the basis of comparative trials, and its growing popularity for irrigation of cane is noted.

* * *

Cultivation of maize in ratoon cane interlines. Effects on sugar yields. G. ROUILLARD. *Ann. Rpt. Mauritius Sugar Ind. Res. Inst.*, 1970, 134–136.—The yield of cane grown with a maize intercrop was reduced by an amount equal to the weight of the maize; since market value of maize is about the same as that of cane and since it requires additional expenses, is susceptible to cyclones and harbours borers, it does not seem advisable to grow it as an intercrop in Mauritius.

* * *

The position in regard to sugar cane varieties cultivated in the State of São Paulo. A. G. AZZI. *Brasil Açuc.*, 1971, **78,** 282–285.—Information is condensed in the form of tables showing acreage and percentage for each variety cultivated, the total area being 34,662,062 hectares. The variety CB 41-76 continued to be the most widely grown variety with 34·7% of the total area of cane cultivated. Co 419 with 5·52% showed further decline, being susceptible to smut.

* * *

The importance of phytosanitary measures in the control of pests. J. A. RIBEMBOIM. *Brasil Açuc.*, 1971, **78,** 319–321.—The operation of phytosanitary measures and their importance is discussed, with an account of the sampling required to observe the extent of infection by harmful insects. A form used to record the findings is reproduced.

* * *

Scheduling irrigation intervals using meteorological data. L. M. ARCEO. *Sugarland* (Philippines), 1971, **8,** (6), 12, 31, 34.—A summary is made of the way in which water is held in the soil and made available to the cane plant through its roots. From meteorological data, evapotranspiration data can be calculated and with daily rainfall deducted can establish a water balance useful in assessing the need for irrigation and the amount of water to be applied.

* * *

Selection studies in sugar cane at the single stool stage: ratooning ability of clones. J. A. MARIOTTI and O. GIMENEZ L. *Rev. Ind. Agric. Tucumán*, 1971, **48,** (1), 7–16.—The object of this work was to investigate the possibility of early selection at the single stool stage, based on data from the first crop. Ratooning was studied, and it was found that limited ratooning ability was a serious obstacle to early selection at the single-stool stage.

* * *

Relationship between rainfall, sugar cane production and nitrogen fertilization. F. A. FOGLIATA and R. A. DIP. *Rev. Ind. Agric. Tucumán*, 1971, **48,** (1), 17–28. Results are given of 6 years of observation and experiment (1965–70). There were highly significant interactions between yields of cane or sugar, water and applied nitrogen.

* * *

Deterioration of harvested sugar cane on storage: a method for its prevention. S. BOSE, K. C. GUPTA, S. MUKHERJEE and L. SINGH. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 11–20.—Experiments are reported on the deterioration of stored cane in northern India over a period of several months. As might be expected, it was greatest during the hot weather. Storage for a period of only 24 hours caused considerable loss in recoverable sugar. The loss, however, can be prevented by spraying the cut ends with formalin solution which inhibits the growth of the bacteria at the exposed surface. As formalin is a harmless disinfectant it is unlikely to create toxicity in the juice.

* * *

Cane development in Uttar Pradesh. K. KAR. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 21–28. With increasing pressure on land for cereal requirements it is considered essential to improve cane production so that the targets are reached without substantial increases in existing cane areas. Methods of achieving this are discussed under various headings with special emphasis on new cane varieties.

* * *

Potash fertilization of sugar cane. II. Effect of potash manuring on the chemical composition of cane juice. A. P. GUPTA and S. P. SHUKLA. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 31–35.—A field experiment is reported which was designed to study the variation in chemical composition of cane juice by manuring with potash at different levels. Only one cane variety, CoS 510, was used. A significant decrease in organic non-sucrose such as starch, gum and nitrogen and inorganic constituents such as calcium, magnesium and sodium was observed, which is important from the technological or manufacturing point of view.

A new promising cane variety—Co 6806. S. N. G. RAO and S. C. SHARMA. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 43–55.—This variety, a cross between Co 775 and Co 798, is a cane of high yield and good quality, resistant to red rot, smut and to low temperatures. An account is given of trials under North Bihar conditions where it achieved an average of 71·66 metric tons/acre and a pol of 15·50% at maximum maturity.

* * *

Deterioration of cane cultivation in Maharashtra. J. A. GUMASTE. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 57–59.—Figures are given showing how the yield of cane and sugar per acre has steadily deteriorated in the State during the last decade. Likely causes for this decline are discussed, one of them being the deterioration of the variety Co 419, which held its superiority for about 15 years, but has been severely affected by grassy shoot disease.

* * *

A study of the chemical composition of cane juice of B.O.14 variety with age. S. C. SHARMA and N. S. GUPTA. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 63–76.—An exhaustive study of the juice of this variety during the ripening period was carried out. Data indicated that the best results could be obtained by crushing this variety during the period from 29th December to 9th March.

* * *

Studies on the occurrence of azotobacter in different soil types of sugar cane growing tracts and nitrogen fixation capacity as influenced by the addition of calcium carbonate and mannitol. M. K. SRIVASTAVA and K. SINGH. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 81–90.—Azotobacter population was found to be at its maximum in 0–15 cm soil depth and decreased with depth. This applied to all the soils studied. The best combination of nitrogen fixation proved to be that of 1 g calcium carbonate + 2 g mannitol for all types of soil and all depths. Some soils fixed more nitrogen than others.

* * *

The importance of the sugar cane variety used for seed. M. PINEDA L. *Bol. Azuc. Mex.*, 1971, (259), 15–17. Points to bear in mind in selecting seed cane are discussed, such as the all-important question of variety and whether this should be early, medium or late-maturing. The state of the stalks and buds is important, as is the location of the seed cane fields, since this concerns transportation costs.

* * *

Economics of the application of herbicides in cane fields. A. VELASCO P. *Bol. Azuc. Mex.*, 1971, (259), 19–20.—Herbicide application by cane farmers is sometimes considered undesirable because of the expense involved; however, it may be a profitable measure by giving a higher yield of cane the value of which is greater than the cost of the treatment. A sample calculation for determining whether the treatment is economical is presented.

* * *

Division of Soils and Agronomy. K. C. LEVERINGTON. *71st Ann. Rpt. Bureau Sugar Expt. Sta.* (Queensland), 1971, 24–33.—Matters discussed include economics of fertilizer use, lime trials, silicates, nitrates in water, irrigation scheduling, water requirements of cane, soil amelioration, water table studies and work with porometers and drainage lysimeters. In regard to nitrogen application after molasses it was found in one area that at least 90 lb N per acre was necessary for optimum sugar yields following the application of molasses at 5 tons per acre to the soil at the time of ratooning. A first application of 30 lb N produced virtually no response, suggesting that it had been utilized by micro-organisms in the decomposition of the molasses and not released early enough to assist in crop growth. The effective contribution of nitrogen to the crops from the molasses application was only of the order of 30–60 lb per acre. The analysis of samples of soil from plots treated with various pesticides was completed during the year. Differences in the rates of loss of "Dieldrin" with different soils were very apparent.

* * *

Division of Plant Breeding. J. C. SKINNER. *71st Ann. Rpt. Bureau Sugar Expt. Sta.* (Queensland), 1971, 34–40.—In the report of this Divison it is pointed out that the 1970 crossing season was poor at Meringa owing to sparse arrowing, a strong contrast to the good season of 1969 when 636 bi-parental crosses were performed. With regard to cross pollination technique all crosses were maintained in drums or plastic containers using plastic bag liners to enclose the solution. The liner technique, which was developed in Mauritius, was tested at Meringa during 1969 and 1970, and was found to be equal to the standard Hawaiian method used in the past. Other matters discussed are selection, evaluation of parent varieties, quantitative genetics experiments, Brix selection, pot yield trials, environmental effects on varietal performance, mutation breeding etc.

* * *

Division of Entomology. B. E. HITCHCOCK. *71st Ann. Rpt. Bureau Sugar Expt. Sta.* (Queensland), 1971, 41–47.—In this report it is pointed out that the soldier fly was again the most important pest but losses have decreased as more land is been treated with insecticides. This is illustrated by means of a table. Other pests discussed are cane grubs, once the major pest but now rated third in importance, the large moth borer (*Bathytricha truncata*), army worms, wireworms, funnel ants, black beetles, butt weevils, scale insects, cicadas and leafhoppers. Recent trials using thallium sulphate for rat baiting from the air proved disappointing; it was concluded that in this instance thallium sulphate was in some way repulsive to rats.

Sugar beet agriculture

Trace elements and large scale cultivation. S. TROCME. *Hautes Etudes Betterav. Agric.*, 1971, **3,** (12), 7–16. The trace elements of significance in sugar beet cultivation are discussed. It is pointed out that over the years with sugar beet, as with other crops, fertilizing has been concerned with the major nutrients, such as nitrogen, phosphorus and potassium while trace elements have been neglected. In this paper the trace elements concerned with sugar beet and discussed at some length are zinc, boron and manganese. The peculiar effect that boron deficiency may have on sugar beet, completely altering the morphology of the leaf, is well illustrated by means of a photograph.

* * *

The "chisel" and the preparation of sugar beet land. E. DALLEINNE. *Hautes Etudes Betterav. Agric*, 1971, **3,** (12), 17–24.—The many advantages of the large tractor-drawn spike or "chisel" harrow in the preparation of land for sugar beet are discussed, as is the possibility of its replacing ploughing under some conditions.

* * *

The chief pests of sugar beet in Spain and methods of control. J. ISART. *Graellsia Rev. Entomol. Iber.*, 1969, **24,** 239–252; through *Biol. Abs.*, 1971, **52,** (22), 12240.—The distribution and importance of the chief pests, including viruses, insects, nematodes, rodents and fungi are surveyed. Methods of improving control for each of these groups are discussed. In general the productivity of sugar beet in Spain is low but there are some enterprises which, owing to mechanization and pest control, have high productivity. The average consumption of sugar per head of the population in Spain is about 25 kg p.a., compared with 35–40 kg for the rest of Europe and 50 kg or over for some countries.

* * *

Predicting double-cross sugar beet performance. G. A. SMITH and R. J. HECKER. *Crop Sci.*, 1971, **11,** 106–108; through *Plant Breeding Abs.*, 1971, **41,** 1062.—Thirty-five double crosses, 15 single crosses and 6 top crosses were developed from 6 inbred lines used to test 5 methods of predicting the performance of double crosses. The mean of the 4 nonparental single crosses of any double cross was the most consistently reliable method for predicting root yield and percentage sucrose. Percentage purity of juice was best predicted by the mean of all single crosses of the plants involved in any double cross.

Uptake of magnesium and other fertilizer elements by sugar beet grown on sandy soils. M. J. DURRANT and A. P. DRAYCOTT. *J. Agric. Sci.* (Cambridge), 1971, **77,** 61–68; through *Soils and Fertilizers*, 1971, **34,** 718.—Experiments on 10 sites are reported, sugar beet being fertilized with magnesium sulphate (0–100 kg/ha). Magnesium increased sugar yields by up to 80 tons/ha. It decreased calcium concentrations in tops and roots but did not affect sodium or potassium concentrations.

* * *

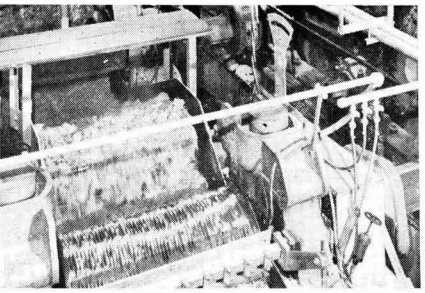
Effect of nitrogen fertilizer, plant population and irrigation on sugar beet. I. Yields. A. P. DRAYCOTT and D. J. WEBB. *J. Agric. Sci.* (Cambridge), 1971, **76,** 261–267; through *Soils and Fertilizers*, 1971, **34,** 719.—A 5-year experiment is reported. N and plant populations increased yield greatly, on average, but irrigation had relatively little effect. In all years sugar yield was greatest with 0·6–1·2 cwt N and 17,000–32,000 plants/acre. Irrigation was beneficial in 2 out of 5 years.

* * *

Diseases of sugar beet in India. K. SINGH, S. N. SRIVASTAVA and S. R. MISRA. *Indian Sugar*, 1971, **21,** 321–326.—Diseases known to attack sugar beet in India are listed and described. They include sclerotial root rot, *Rhizoctonia* root rot, seedling root rot, *Rhizopus* root rot, *Cercospora* leaf spot, *Ramularia* leaf spot, *Alternaria* leaf spot, *Phyllosticta* leaf spot, powdery mildew, heart rot caused by boron deficiency, root knot caused by nematodes, and virus yellows (suspected but not confirmed at two locations).

* * *

Development of monogerm sugar beet seeds as influenced by soil fertility. L. R. SCHWEITZER and E. E. HARDIN. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16,** 332–340.—Successful precision planting of sugar beet has been plagued by poor seed germination since the introduction of monogerm seed. Various possible causes of this poor germination have been put forward. This study investigated the effect of several fertilizer nutrients on the occurrence of underdeveloped seeds in monogerm sugar beets. It was found that deficiencies of the major nutrients N, P and K were not responsible. Excess N fertilization accounted for only a fraction of the underdeveloped seeds. It was concluded that the problem could not be solved by fertilizer management alone.



Cane sugar manufacture

Exhaustibility of molasses. III. Jaú sugar region. J. P. STUPIELLO, A. A. DELGADO, E. R. DE OLIVEIRA and E. S. DE MORAES. *Brasil Açuc.*, 1971, **78,** 577–595. Samples of molasses collected from the 10 sugar factories of this region were analysed at 15-day intervals, a total of 10 samples per factory. The analytical methods used are described and results tabulated and discussed. From the data, which were for Brix, total solids, ash, total sugars, and viscosity index, were calculated apparent purity, true purity and minimum purity, non-sucrose, non-sugar organic compounds, reducing sugars:ash ratio, exhaustibility index and sucrose loss in molasses. It was evident that the apparent and true purities were higher than the attainable purity but viscosity was not high enough to be a limiting factor and the composition was such as to permit better exhaustion. Loss of recoverable sugar was considerable and was estimated at between 3·60 and 6·52 kg of sugar per ton of cane.

* * *

Ion exclusion—an overlooked ally. J. F. ZIEVERS, C. J. NOVOTNY and E. A. SELVICK. *Proc.* 1970 *Tech. Session Cane Sugar Refining Research*, 125–143.—The advantages of ion exclusion, particularly for low-purity treatment, are discussed and results given of tests in which 80°Bx blackstrap molasses of 50 pol and 5·5% ash content was diluted to 60°Bx, softened on a cation exchange resin in Na^+ form and treated by ion exclusion using a strongly acidic cation exchange resin. The sulphated ash was reduced to 0·015%, the pol to 18 and the Brix to 27°, while the colour was still relatively high at 31°St. Subsequent decolorization on an anion exchange resin yielded a product which still contained some colour but looked and tasted like invert syrup. In a subsequent discussion, R. E. ANDERSON briefly explains the fundamentals of ion exclusion and its possible applications.

* * *

Effects of burnt cane in the sugar factory. J. M. TAMARGO T. *ATAC*, 1971, (3), 39–50.—The literature on the effects on milling, clarification, evaporation, crystallization and sugar quality is reviewed and rules recommended for adoption where the cane supply is to be burnt cane.

* * *

Application of "Metacrystallon B" (MB)—a viscosity reducer—in boiling final massecuites. T. P. SAXENA, K. K. GUPTA, R. K. DIKSHIT and A. B. LAL. *Indian Sugar*, 1971, **21,** 535–539.—Tests in which "Metacrystallon B", a surface-active agent of Indian manufacture, was added to massecuite in low-grade boiling showed that the agent gave some improvement in the form of higher *C*-sugar purity, although the effects were not as good as those obtained with another agent, "Cutol". The results are considered inconclusive, however, and further tests are to be made.

* * *

Present state of Madeira's sugar industry. R. J. LEFFINGWELL. *Sugar y Azúcar*, 1972, **67,** (1), 8, 28. The very small cane sugar industry of Madeira, where the only factory at Funchal produces half of the island's annual sugar requirements of 7000 tons, is surveyed and future prospects, if any, discussed in the light of the industry's uneconomical state.

* * *

A device for applying forced draft in a step-grate furnace. G. K. CHETTY. *Sugar y Azúcar*, 1972, **67,** (1), 20–21.—See *I.S.J.* 1971, **73,** 180.

* * *

Casa Grande sugar factory in Peru one year before the agrarian reform. G. HUSZ, G. NIEMANN and W. VON PROSKOWETZ. *Zucker*, 1972, **25,** 190–195.—A general picture is given of Casa Grande cane sugar factory, up to 1968/69 one of the largest sugar factories in the world, producing the equivalent of 900,000 tons of raw sugar per annum (it also produced white sugar). After the military coup in Peru, an agrarian reform was instituted and Casa Grande was nationalized. The bulk of the article concerns the socio-economic conditions as they applied previously to the factory workers and their families.

* * *

A new pan boiling system. R. E. DIAGO. *Sugar J.*, 1971, **34,** (9), 15–19, (10), 28.—The 3-massecuite system devised by the author[1] and introduced at Talisman Sugar Corporation in Florida is described and compared with a conventional 2-massecuite system. The new scheme has been used for five seasons.

* * *

Sugar in Australia. O. MONT'ALEGRE. *Brasil Açuc.*, 1971, **78,** 489–496.—A survey is presented of the Australian sugar industry, with mention of the various organizations concerned with cane and sugar and a brief account of the history of cane growing and processing.

* * *

Pneumatic boiler ash disposal plant. F. A. KRAMER, R. J. VAN DONGEN, W. R. WARREN and J. M. WILSON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971,

[1] *I.S.J.*, 1969, **71,** 372.

29–34.—Details are given of a bagasse furnace pneumatic ash removal system installed at Amatikulu sugar factory which, after 10 months of trials, proved unsuitable and was replaced with a hydraulic system. Reasons for failure of the pneumatic system are suggested.

* * *

An automatic system of mill sanitation. J. RAFFRAY. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 35–41.—A cane mill sanitation system involving the use of a quaternary ammonium compound ("C.M.A.") was introduced at Tongaat and Umfolozi sugar factories. The bactericide is shock-sprayed into mixed juice and 1st and 2nd imbibition juice at automatically-controlled time intervals. Results indicate a smaller difference in reducing sugars ratio between crusher and mixed juice than with the use of chlorine. Other benefits of mill sanitation, including substantial monetary savings, are mentioned.

* * *

Treatment of mill effluent and sewage with aerators at Umfolozi mill. G. G. ASHE. *Proc. 45th Congr. S. African Sugar Tech. Assoc.* 1971, 42–48.—See *I.S.J.*, 1972, **74**, 342.

* * *

The Empangeni diffuser installation 1967-1970. C. B. VAN DER RIET and R. H. RENTON. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 49–60.—Problems encountered in operation of the BMA diffuser at Empangeni and modifications carried out to improve performance are discussed. By 1970 extraction had risen to 95·23% with a loss of 1·53 pol % bagasse at a throughput of 180 t.c.h. and cane fibre content of 18·45%, compared with the manufacturer's rated performance of more than 96% extraction at 225 t.c.h. and 18% cane fibre content. However, the results in 1970 were substantially better than in previous years, particularly 1967 when the diffuser was installed.

* * *

The boiling house losses of South African diffusion factories. J. P. LAMUSSE. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 61–71.—The boiling house losses at two sugar factories equipped with diffusers (Empangeni having a BMA and Entumeni having a De Smet diffuser) are shown to have increased since the introduction of diffusion but subsequently have decreased almost to the South African average. At Dalton, which has a BMA diffuser, the losses are lower than at Jaagbaan, which is equipped with a modern milling tandem and processes cane from the same region as does Dalton. Diffusion factors which may affect boiling house losses are discussed.

* * *

Fibre—its effects on milling and processing efficiency. W. S. GRAHAM and J. R. GUNN. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 72–74.—The problems entailed in cane processing as a result of the fibre content—here covering all water-insoluble matter after removal of Brix-free water and including sand, boulders, load chains and other extraneous matter—are discussed and means of preventing damage by fibre mentioned. Most of the article is devoted to the adverse effects of sand.

Reduction of entrainment from vacuum pans and evaporators. G. ASHE. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 75–80.—Methods of preventing entrainment in vacuum pans and evaporators and of maintaining steady vacuum and steam pressure to provide high performances are described with reference to measures adopted at Umfolozi.

* * *

Dust in very high pol sugar. G. N. ALLAN and J. R. FITZGERALD. *Proc. 45th Congr. S. African Sugar Tech. Assoc.*, 1971, 127–129.—Sugar of 99·5 pol and a safety factor below 0·2, production of which started in South Africa in mid-1969, is so dry that considerable dust formation takes place, possibly as a result of attrition in mechanical conveying. Use of alternative means of conveying or increase in the safety factor are two approaches made to reduce the problem. The hazards of excessive dust formation are mentioned.

* * *

Report on the Peruvian sugar industry by comparison with the Venezuelan industry. P. E. SEQUERA T. and G. SANDIGA. *Azúcar y Productividad*, 1971, **1**, (2), 7–44.—A very detailed illustrated account is given of the sugar industry in Peru, covering climatology (with notes on the geography, soils, water resources, etc. of the sugar cane regions), the sugar factories and their production, field and factory efficiencies, investments, bulk sugar handling for export, costs, harvesting, cultivation practices, mechanization, transport costs, cane cleaning at the factories, establishment of the "agrarian cooperative central for sugar production", and its organization.

* * *

A study on the phosphorus up-take in relation to clarification of sugar cane varieties in Binalbagan loam soil. S. S. GARRUCHO and J. L. T. RAMINANTAN. *Sugar News* (Philippines), 1971, **47**, 599–603.—Optical density readings of clarified juice from seven cane varieties grown under identical conditions including application of stated quantities of N, P and K showed that in four cases there was correlation between clarification performance and phosphate content, whereas with the other three varieties the optical densities were higher than would have been expected according to the findings of others that the higher the phosphate content the better is the clarification.

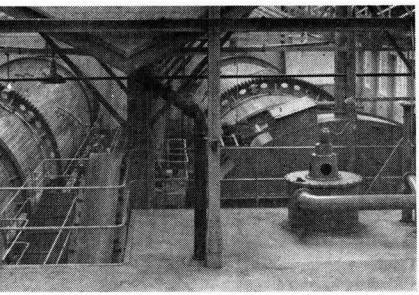
* * *

Improvements in the quality of South African export sugar. M. MATIC. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 194–202.—Work carried out at the Sugar Milling Research Institute in South Africa on improving the quality of raw sugar for export is described[1].

* * *

Automatic control in the sugar factory. M. C. FOREST. *Rev. Agric. Sucr. Maurice*, 1971, **50**, 203–213.—Automatic control of cane sugar factory processes and the various types of control equipment available are discussed.

[1] See ALEXANDER: *I.S.J.*, 1972, **74**, 227–203.



Beet sugar manufacture

Spontaneous decomposition of molasses during storage. M. FRIML. *Listy Cukr.*, 1971, **87**, 255–258.—A case of spontaneous decomposition of beet molasses at a Czechoslovakian sugar factory is reported in detail and measures to prevent future incidents are suggested on the basis of information in the literature and analyses of molasses samples.

* * *

Progress of sugar losses during beet storage. J. C. CHARTIER, P. DEVILLERS, M. LOILIER, R. CHABLAY, J. Y. GUYOT, G. MESNARD and C. DE WILDE. *Sucr. Franç.*, 1971, **112**, 381–392, 437–443, 499–504, 555–559. See *I.S.J.*, 1972, **74**, 85.

* * *

Which factors in Steffen molasses desugaring require particular attention with regard to "cold" precipitation? S. BÖTTGER. *Zeitsch. Zuckerind.*, 1971, **96**, 549–553, 615–618.—Among factors considered are the lime quality, the ratio between molasses non-sucrose organic matter and ash (values of which are quoted for various beet sugar countries), molasses invert sugar, the effect of processing molasses from other factories as well as the factory's own molasses, the possibility of intermittent molasses processing (the advantages and disadvantages of this are discussed), the optimum amount of molasses to process (5·5% of the beet slicing capacity should be used as basis, it is suggested), molasses dilution (this should strike a balance between too much water at which adsorption of non-sucrose matter increases and too little, when difficulties arise in calcium trisaccharate filtration because of too high a viscosity), and the temperature at which "cold" precipitation takes place (5–9°C, and certainly not above 12°C). A continuous process developed by Raffinerie Tirlemontoise S.A. is described and advice is given on how to obtain the maximum quantity of easily filterable and washable trisaccharate and a minimum sugar loss in filtration. Attention to the various factors will enable a maximum sugar yield to be obtained from Steffen molasses, i.e. at least 75% of the molasses sugar.

* * *

New process for deliming thin juice without regenerating agents and waste water. E. H. FELBER. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 279–288.—The BMA-Gryllus ion exchange process for thin juice deliming is described and some results from a Hungarian sugar factory discussed. Costs of the process, in which the juice Ca^{++} ions are exchanged for Na^{+} ions by passing it through a resin (preferably of the macroporous type) which is then regenerated by recycling treated thick juice, are only slightly higher than those of evaporator boiling-out. The results show an average deliming efficiency of 84·3% for a juice containing an average of 136·5 mg CaO/100°Bx.

* * *

The application and utility of magnesium exchange in the beet sugar process. K. W. R. SCHOENROCK. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 299–312. Trials at the Mini-Cassia and Nyssa sugar factories of Amalgamated Sugar Co. indicated that replacement of alkali ions with magnesium ions by cation exchange treatment of intermediate green syrup increased sugar extraction by some 0·5–0·6% on beet. Results are given in graph and tabular form.

* * *

Modern waste water treatment plants for the sugar industry. R. BEELITZ. *Die Lebensmittelind.*, 1971, **18**, 453–457.—After a survey of the properties and amounts of the various waste waters in a sugar factory, details are given of schemes for mechanical treatment of flume and wash water. Brief descriptions of various techniques for waste water treatment are followed by a short report of the situation in East Germany and other Eastern Bloc countries. Future requirements and prospects conclude the article.

* * *

The development of automation of technological processes and automation in the sugar industry. S. GINAL. *Gaz. Cukr.*, 1971, **79**, 295–298.—After a discussion of automatic control in industry generally, the author examines the position in the sugar industry and considers the various parameters in beet diffusion, carbonatation, evaporation and boiling which have been the subject of automatic control in Poland.

* * *

Automatic controls at Hrušovany sugar factory in Czechoslovakia. J. OLEDZKI. *Gaz. Cukr.*, 1971, **79**, 299–302.—Details are given of the automatic controls at this sugar factory, slicing 4000 tons of beet/day, which was supplied by Poland and started operations in the 1970/71 campaign.

* * *

Development trends in sugar industry technology. S. ZAGRODZKI. *Zeitsch. Zuckerind.*, 1971, **97**, 14–17. Amongst the aspects considered are continuous crystallization by a system described previously[1], inter-campaign processing of thick juice, and the

[1] *I.S.J.*, 1971, **73**, 76–77.

construction of larger beet sugar factories (up to a slicing capacity of 20,000 tons of beet/day) with three juice stations each about 30 km from a central factory and forming the three points of a triangle. Two schemes suggested involve, in one case, delivery of the beet to the factory and, in the other, delivery of the beet to each juice station.

* * *

Planning and expansion of Wissington sugar factory. ANON. *Zeitsch. Zuckerind.*, 1971, **97**, 17–21.—See *I.S.J.*, 1972, **74**, 3–6.

* * *

Examination of sugar incrustation on the surface of vacuum pan walls. I. S. GULYI *et al. Sakhar. Prom.*, 1971, **45**, (12), 10–12.—Laboratory tests showed that the quantity of crystal sugar adhering to vertical plates of various materials after heating in artificial massecuites for a given time at 70°C increased with time and with fall in crystal size. Differences were found between the various materials regarding crystal adhesion, the order from maximum adhesion downwards being: stainless steel, steel, brass, "Pertinax" (a paper-base urea resin laminate) and "Teflon". Treatment with epoxy resins, various varnishes or water-repellent greases did not reduce adhesion, the rate of which rose with surface dirtiness.

* * *

Vacuum pan modernization with the aim of preventing failure. I. I. PRILUTSKII, P. I. ISHCHENKO and L. N. ZUBAKOVA. *Sakhar. Prom.*, 1971, **45**, (12), 13–16. Details are given of design modifications worked out for vacuum pans of Soviet construction involving the syrup feed valve, the pan bottom slide valve and the jointing between the pan shell and floor.

* * *

Stabilization of processes in a tower diffuser using a control computer. B. A. EREMENKO *et al. Sakhar. Prom.*, 1971, **45**, (12), 26–30.—Information is given on a computer programme for the tower diffuser at Lokhvitskii sugar factory, control of which is a function of raw juice Brix, specific cossette load and beet slicer throughput. Computerized control has resulted in a loss of 0·32% on beet and a juice Brix of 13·9° at a draft of 128·4% and a daily throughput of 2214 tons compared with 0·36% loss and a juice Brix of 12·4° at 143·9% draft and a daily throughput of 1974 tons of beet.

* * *

Effectiveness of using forced ventilation for sugar beet piles. A. KOSTENKO and A. GONCHAR. *Sakhar. Prom.*, 1971, **45**, (12), 42–44.—Some data are presented showing the advantages of using forced ventilation at Kamenets-Podol'skii and Makovskii sugar factories over a number of years (16 years at the latter factory).

* * *

The economic effect of using forced ventilation of sugar beet. A. A. VASIL'EV, M. M. VISSARIONOV, N. A. GORYAINOV and Z. F. STRIZHKOVA. *Sakhar. Prom.*, 1971, **45**, (12), 44–46.—Advantages of forced ventilation used during a number of campaigns at Meleuzovskii and Karlamanskii sugar factories are demonstrated by tabulated data which are discussed. Daily losses at the latter factory have been well below the norm values.

* * *

Lime kiln reconstruction. A. F. DERYAVKO. *Sakhar. Prom.*, 1971, **45**, (12), 47–49.—Re-designing the lime kilns at a number of Soviet sugar factories has permitted higher efficiency with a rise in waste gas CO_2 content from 28 to 32% and has prevented air seepage. Limestone and coke charging are now automatic.

* * *

The most important factors in cold precipitation during molasses desugaring by the Steffen process. S. BÖTTGER. *Sucr. Belge*, 1972, **91**, 3–15.—See *I.S.J.*, 1973, **75**, 87.

* * *

Liquid sugar production from beet molasses by the "Reggiane L.S." process. P. BALDASSARI. *Sucr. Belge*, 1972, **91**, 17–26.—See *I.S.J.*, 1972, **74**, 183.

* * *

Effect of various methods of treating growing beet on the processing quality of sugar beet roots. J. ŠIMON. *Listy Cukr.*, 1971, **87**, 271–274.—Five-year field tests showed that the use of herbicides had no significant reducing effect on beet sugar content compared with mechanical weeding, any sugar content decrease being more a result of competition with weeds not killed by chemical treatment.

* * *

Thermal processing of juices. F. N. DOBRONRAVOV and Z. D. ZHURAVLEVA. *Sakhar. Prom.*, 1972, **46**, (1), 15–17.—Treatment of unfiltered 1st carbonatation juice with live steam in a hydrocyclone increased the filtration coefficient, settling rate and purity and reduced the colour compared with juice not steam-treated. Optimum conditions found from tests were: saturated live steam temperature 140–150°C and feed pressure 2–2·5 atm (at least 0·1–0·3 atm lower than the juice feed pressure) and contact time no greater than 1 sec. Under these conditions colloid coagulation and precipitation were maximum. Before 2nd carbonatation the juice was heated to 102°C. Among alternative schemes described is steam treatment of raw juice in an otherwise conventional scheme with or without predefecation mud removal by hydrocyclone.

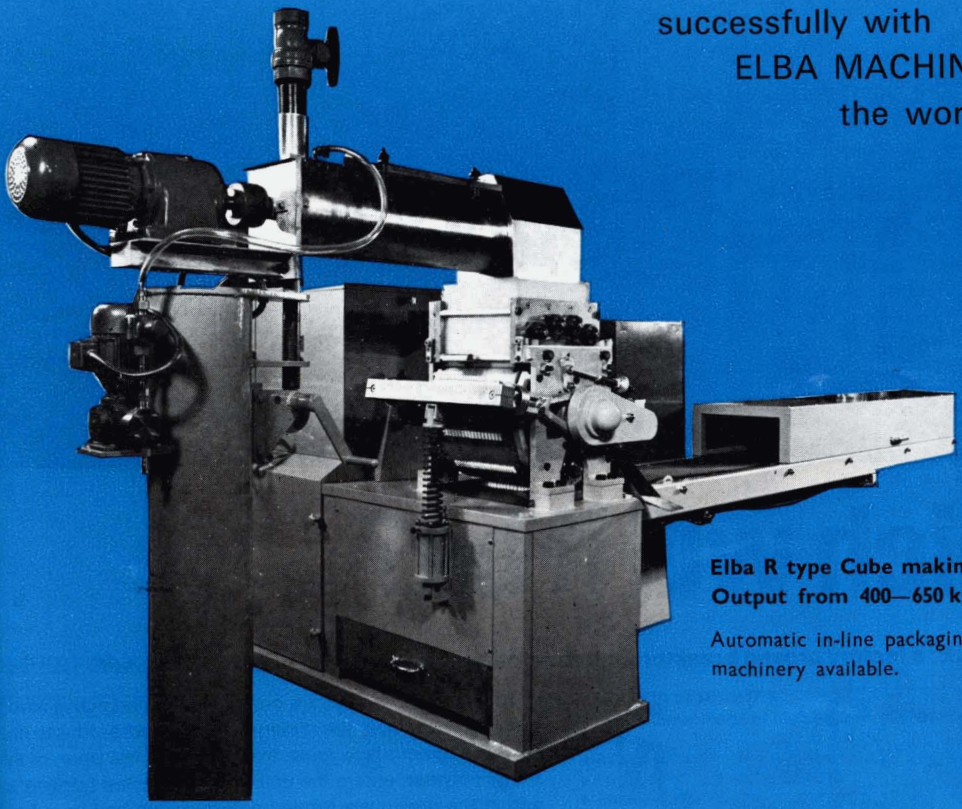
* * *

Effect of 2nd carbonatation juice standing on removal of calcium and magnesium salts. M. S. ZHIGALOV and N. D. TANTSYURA. *Sakhar. Prom.*, 1972, **46**, (1), 18–20.—Standing juice for 15 min in a cylindrical tank with conical bottom placed between the 2nd carbonatation vessel and the pump feeding to the filter station reduced the concentration of Ca-Mg salts in the filtered juice by an average of 20–25%, of which the greater proportion comprised slightly soluble salts, particularly Mg, the concentration of which was reduced to less than 50% of the original. The treatment thus reduced scale formation.

elba

CUBE SUGAR PRODUCTION....?

successfully with
ELBA MACHINES
the world over



Elba R type Cube making machine
Output from 400—650 kg/hour

Automatic in-line packaging machinery available.

For years we have been specialized constructors of cube making machines.

The three basic models have a capacity ranging from 80 to 650 kg/hour.

Each machine can be completed with a cartoning or individual cube-wrapping machine, thereby achieving a complete line operation.

If it's cubes or tablets—it's ELBA

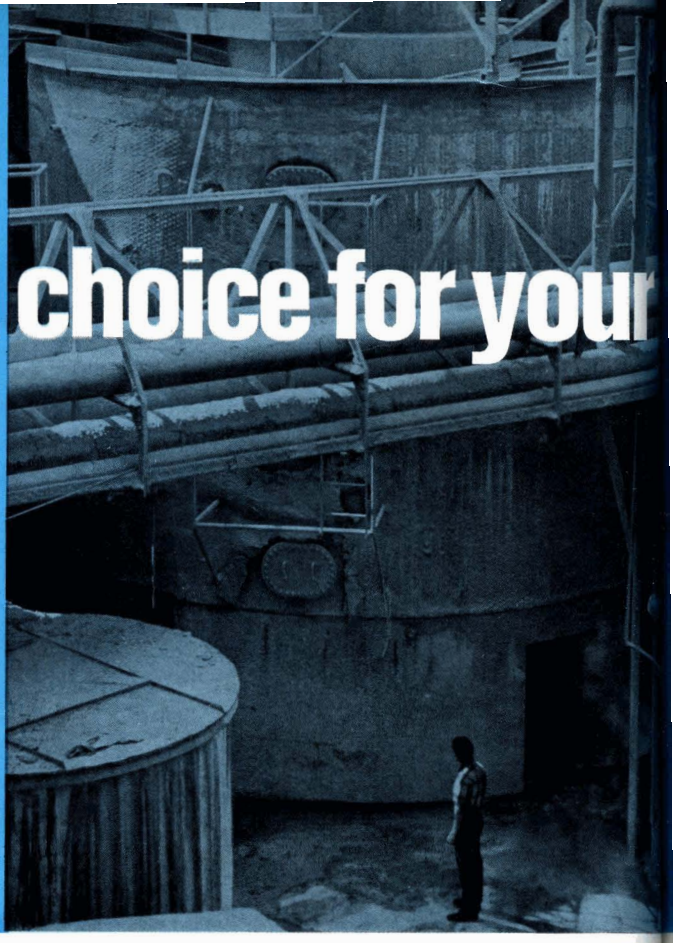
ELBA MACHINEFABRIEKEN B.V.-P.O. BOX 21 - HUIZEN (N-H) - HOLLAND
tel: 02152-1956
cables: elbamachines-huizen

Manufacturers of tableting and cubing machines.

For beet sugar factories throughout the world...

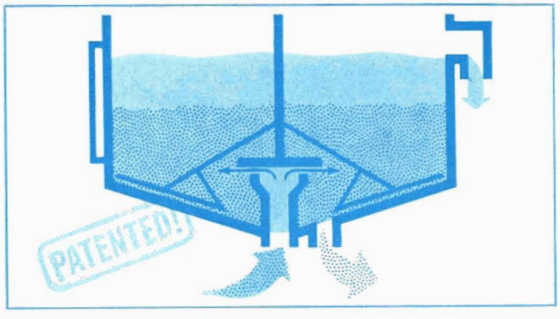
You have a choice for your

This →



Which will it be?

THE PRINCIPLE: a factory proved breakthrough for clarification of first carbonation effluent!



Introducing the feed into a previously formed active sludge drastically reduces the distance the settled products must travel. Incoming feed juice, treated with a few ppm. of synthetic polymer, enters the unit and is deflected horizontally within the previously formed active sludge bed by a baffle plate. The resulting flow pattern is a rolling one, with juice percolating and filtering upward as particles agglomerate and settle. As juice continues to enter the unit, the clarified effluent is taken off the top. The line of demarcation between sludge blanket and clear effluent is quite sharp; thus it can be used for control of sludge withdrawal. A sludge rake aids further compaction.

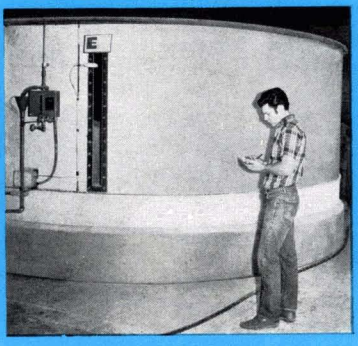
THE ENVIRO-CLEAR SYSTEM IS LESS COSTLY TO PURCHASE... TO INSTALL... TO OPERATE... TO MAINTAIN THAN DIRECT-FILTRATION UNITS!

THE OPPORTUNITY: Phone, cable, write our authorized licensees and inquire about our RENTAL TEST PROVING UNIT for your factory!

FOR COMPLETE INFORMATION ON THE NEW GENERATION OF SETTLER-CLARIFIERS FOR BEET SUGAR FACTORIES:

liquid/solids separation:

or This→



ENVIRO-CLEAR Clarifier

THE PERFORMANCE: faster, smaller, simpler, better!

COMPARATIVE SIZE DATA (NOMINAL VALUES) APPLICATION, 1st CARBONATION		
	ENVIRO-CLEAR SETTLER	CONVENTIONAL SETTLER
Diameter, feet	14	26
Height, ft., liquid straight side	4.5	17.75
Number of trays	1	4
Settling area, sq. ft.	154	2100
Volume, cu. ft.	777	9400
Retention time, minutes	7.2	88
Flow rate, U.S. GPM/sq. ft.	5.2	0.38

ONE TENTH THE SIZE — ONE TENTH THE TIME

This comparison also can be applied to (1) heated cold Steffen filtrate or (2) beet flume water.

SEPARATION IN MINUTES!

- eliminates storage of high-volume dilute sucrose at elevated temperatures and alkalinity
- avoids undesirable side-reactions
- speeds start-up and shut-down
- immediate response to corrections
- less stock in process

SMALLER, SIMPLER, BETTER!

- reduces losses
- saves valuable plant space
- produces separation as good as or better than conventional units
- slashes maintenance costs through simplicity of design and operation

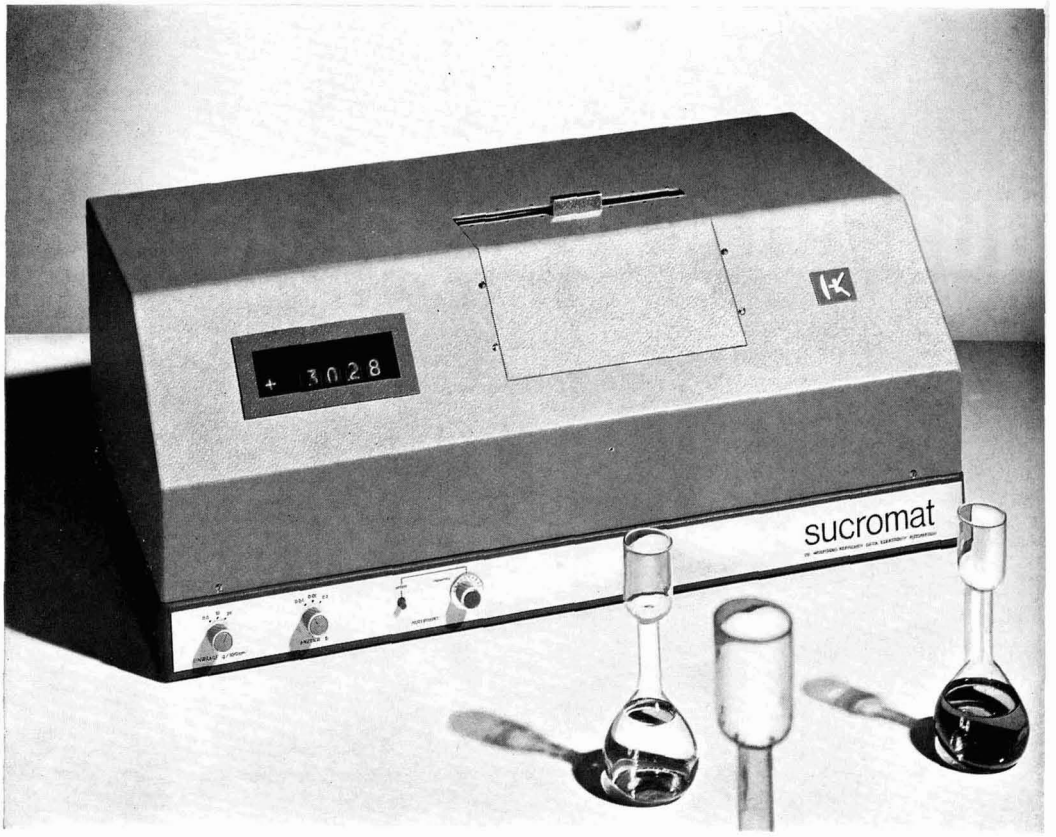
FRANCE-ITALY-SPAIN-BELGIUM
Fives Lille-Cail
7, Rue Montalivet
Paris 8e, France
PHONE: 265.22.01-742.21.19
TELEX: FIVCAIL65328
CABLE: FIVCAIL PARIS

AUSTRIA-FEDERAL REPUBLIC OF GERMANY-IRAN-NETHERLANDS
Stork-Werkspoor Sugar N.V.
Steenbakkersweg 25
Hengelo (0), The Netherlands
PHONE: (05400) 5 43 21
TELEX: 44485 CABLE: STOWESUGAR

U.S.-CANADA-U.K.
ENVIRO-CLEAR COMPANY, INC.
1251 Avenue of the Americas
New York, New York 10020
212 489-9060
Cable: ENCLEAR

OTHER COUNTRIES OF THE WORLD: CABLE OR CALL ANY OF THE ABOVE.

ENVIRO-CLEAR COMPANY, INC.
A SUBSIDIARY OF Amstar CORPORATION



The automatic sugar polarimeter **sucromat** *has built-in reliability*

When we developed the **sucromat** some years ago, we had the choice of three different optical systems to realize automatic balance:

1. Servo-rotated analyser.
2. Servo-driven quartz wedge compensator.
3. Feedback controlled Faraday compensator.

Our experience led us to system number one which combines accuracy with reliability.

The servo-rotated analyser principle has the advantage of a scale which is nearly independent of temperature. As power consumption of the **sucromat** is only 72 watts due to its modern electronics containing extensively reliable integrated circuits, there is no need for ventilators and air filters which cause maintenance problems. Equipped with a dust- and splash-proof case, the compactly designed **sucromat** withstands all climates and tough ambient conditions.

The optical system chosen for the **sucromat** offers a wide measuring range of ± 120° S for versatility of applications in the beet and cane sugar industries. Sample tubes of reasonable length (200 mm) are used to produce an optical signal which is sufficiently large to resolve 0.01° S without noise and zero point drift problems. In addition, the **sucromat** can easily be checked with quartz control plates of certified accuracy.

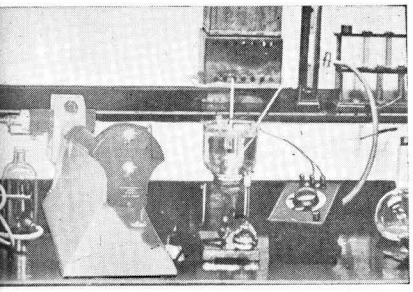
Digitizing of rotated analyser position is performed by a shaft encoder. Results are continuously displayed by an electronic up-and-down counter which is completely free of the zero point drift and calibration errors common to digital voltmeters.

Both the opto-mechanical and the electronic systems of the **sucromat** are manufactured by us. This guarantees unlimited availability of competent service.

International success of the **sucromat** proves that our conception is right.

For more information and references write to:

DR. WOLFGANG KERNCHEN
OPTIK-ELEKTRONIK-AUTOMATION
D-3011 LETTER-HANNOVER
WEST-GERMANY



Laboratory methods & Chemical reports

Homogeneous and heterogeneous acid hydrolysis in the sugar industry. J. SZEJTLI. *Cukoripar*, 1971, **24,** 181–189.—The effects of temperature and of acid and sugar concentration as well as other reaction parameters on sucrose, raffinose and melibiose hydrolysis rates are examined with 60 references to the literature. Mechanisms of both homogeneous and heterogeneous hydrolysis of sucrose (the latter as in ion exchange treatment) are described. Rupture of the glycosyl-fructosyl bonds in raffinose is considerably more rapid than in sucrose, while the galactosyl-glucose bond is much more stable than is the glycosyl-fructosyl bond.

* * *

Studies on colour formation in cane juice as influenced by nitrogen manuring. A.P. GUPTA, S.P. SHUKLA and A. D. SHARMA. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 1–9.—Polyphenols and amino-acids in cane juice were found in tests to increase with the amount of nitrogenous fertilizer used, with the resultant formation of darkly-coloured compounds during clarification. Ammonium sulphate was found to lead to greater coloration than did calcium ammonium nitrate.

* * *

Some observations on non-sugars in syrups and their effect on the loss of sugar in final molasses. D. L. N. RAO, M. A. SALAM and S. G. RAO. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 141–150.—Trends in syrup non-sugar contents and molasses pol over 3 seasons at the authors' sugar factory are discussed. The tendency is for non-sugars to fall slightly from November to January, to rise slightly until February and then to increase sharply until April. Molasses pol showed approximately the same pattern, while syrup purity rose steeply to a constant during January-February and then fell just as steeply until April. While the non-sugars are inorganic until January, organic non-sugars (colloids) are more evident from January onwards, partly as a result of the use of polyelectrolytes as flocculants.

* * *

A revised formula for evaluating mill sanitation performance. T. K. MUKHERJEE. *Proc. 37th Conv. Sugar Tech. Assoc. India*, 1970, 343–347.—For evaluation of inversion loss in cane milling as a result of bacterial action, a formula is proposed in which the mill sanitation factor (MSF) is given by $\frac{R_2(100-R_1)}{R_1(100-R_2)} \cdot \frac{100}{e_{125}}$, where R_1 and R_2 are mixed juice and primary juice purities, respectively, and e_{125} is reduced mill extraction. The formula is suggested in place of the ERQV formula $\frac{(1{\cdot}4R_1 - 40)}{(1{\cdot}4R_2 - 40)}$ which is found to favour high purity juices and indicate lower inversion losses than does the proposed formula.

* * *

Dependence of syrup amino-acid composition on beet storage period. A. YU. GADZHIEV, A. R. SAPRONOV and M. V. RAIKHINSHTEIN. *Sakhar. Prom.*, 1971, **45,** (11), 8–10.—The contents of named amino-acids in dilute beet syrup from three beet varieties were measured by separation using cation exchange followed by quantitative determination by paper chromatography. They increased with time of storage, initial differences becoming less marked by the end of the test period. Increase in syrup and molasses colour during the period was attributed to increase in noxious nitrogen which led to melanoidin formation. Although by March the amino-acid and melanoidin contents of beet fall, molasses colour continues to increase through formation of invert sugar alkaline decomposition products; the invert content in the stored beet increases as more sucrose is decomposed.

* * *

Investigation of granulated sugar colouring matter. I. F. BUGAENKO, I. P. SLAVGORODSKAYA and A. I. LAPKIN. *Sakhar. Prom.*, 1971, **45,** (11), 15–16. Colouring matter in white sugar produced from cane raws was separated by anion exchange, gel filtration and dialysis through a colloidal membrane to yield, after final vacuum drying, a dark brown powder of 5000 M.W. and a light brown powder of 1000 M.W., for which empirical formulae are given as $C_{16-17}H_{22-23}O_{10}N$ and $C_{16-17}H_{23-24}O_{10}N$ from analyses. Ultra-violet spectra for the original sugar solution, the eluate from the ion exchange resin and the two powders showed one maximum for each in the vicinity of 260 nm. Infra-red spectra revealed large hydroxyl quantities as well as methoxyl groups. The findings indicate that the sugar's colour was caused by melanoidins.

* * *

Determination of reducing sugars in the presence of hydroxymethyl furfural. B. N. ERSHOV. *Izv. Vuzov, Pishch. Tekh.*, 1971, (4), 156–157.—The method described is based on the fact that hydroxymethyl furfural (HMF) in invert syrups has the same reducing power as does glucose, so that the glucose content is given by the difference between reducing matter and

HMF contents. The HMF concentration is found spectrophotometrically (after solution dilution to a HMF content of 1–6 mg/litre) by measuring the optical density at 283 nm and calculating $\frac{D_{283} \cdot 126 \cdot 1000}{16{,}700}$, where 126 is the HMF molecular weight and 16,700 is its extinction. Allowance for the HMF content is then made in subsequent ebulliostatic determination of the reducing sugars without the need for HMF extraction. The accuracy increases as the glucose: HMF ratio rises.

* * *

Rôles of peptides in melanoidin formation in sugar manufacture. I. F. BUGAENKO and M. MUKHAMED. *Izv. Vuzov, Pishch. Tekh.*, 1971, (5), 32–34.—Fractionation by gel filtration and light absorption measurements were used to investigate melanoidin formation from invert sugar solutions heated in the presence of peptides. Differences were found between the products formed in the presence of peptides and glycine and between these and the products formed from invert sugar alkaline degradation products[1].

* * *

The mechanism of colour removal by ion exchange resins: adsorption from solution in model systems. J. C. ABRAM, D. COOKSON, K. J. PARKER, C. C. PRESTON and J. C. WILLIAMS. *Sucr. Belge*, 1971, **90**, 525–531.—See *I.S.J.*, 1972, **74**, 87.

* * *

A study of changes in the marc content of the sugar beet during storage. R. E. WYSE and S. T. DEXTER. *J. Amer. Soc. Sugar Beet Tech.*, 1971, **16**, 289–298. The effects of storage conditions on beet marc (the insoluble residue after extraction with water) were investigated. Appreciable cell wall degradation took place only when desiccation, sprouting and rotting occurred. Variety of beet appeared to be a significant factor, while harvest date had no effect on marc stability. Tests with ^{14}C-labelled sucrose showed that in a root maintained in good physical condition, substantial re-synthesis of the cell wall materials occurred in a residue washed with 80% ethanol. The root dry solids was divided into four fractions based on solubility in water at various temperatures and stability in storage.

* * *

The formation of D- and L-lactic acid during the (sugar) manufacturing process. H. SCHIWECK and L. BÜSCHING. *Zucker*, 1972, **25**, 7–12.—See *I.S.J.*, 1972, **74**, 88.

* * *

Methods of checking ion exchange membranes for their suitability to demineralize factory sugar solutions. F. PERSCHAK. *Zucker*, 1972, **25**, 13–15.—Details are given of a method for determining the ion transport numbers of ion exchange membranes, technique for analysing membranes and a method for determining the demineralizing properties with middle juice at constant current density. Some results are tabulated.

* * *

The evaluation of sugar cane in South Africa. A. C. BARNES. *Producers' Rev.*, 1971, **61**, (11), 37–47.—See *I.S.J.*, 1972, **74**, 346.

* * *

The heat of crystallization and activity coefficients of sucrose in saturated aqueous solutions. J. FERNÁNDEZ B. and L. BALLESTER. *CubaAzúcar*, 1970, (July/Sept.), 23–27, 56–59.—See *I.S.J.*, 1971, **73**, 40–43.

* * *

Sulphated ash: conductivity factor in sugar. I. E. DE CASTRO and J. DE O. BARBOSA. *Brasil Açuc.*, 1971, **78**, 479–484.—Sulphated ash measurements were made by the A.O.A.C. method on samples of demerara sugar (of 95·7–98·6 pol and 0·38–0·82% moisture) and on samples of crystal sugar (98·7–99·9 pol and 0–0·09% moisture). Corresponding measurements were made of the conductivity of solutions of the sugars (at 5% and 25% concentration, respectively), and the results plotted on graphs which showed linear relationships. From the graphs were obtained factors of 0·0021 for demerara sugar and 0·0009 for crystal sugar which applied to the measurements; the latter factor compared with a corresponding value of 0·00053 in the literature.

* * *

Determination of α-amino nitrogen in sugar beet and sugar factory juices. N. KUBADINOW and L. WIENINGER. *Zucker*, 1971, **25**, 43–47.—See *I.S.J.*, 1972, **74**, 120.

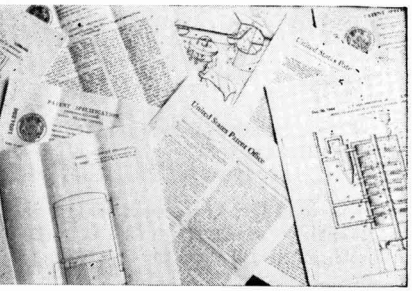
* * *

The biochemistry and use of the beet constituent, betaine. W. STEINMETZER. *Zucker*, 1972, **25**, 48–57. The occurrence of betaine in sugar beet and other plants is surveyed and metabolic paths leading to betaine biogenesis in sugar beet are described. The exact path followed can be decided only after measurement of the enzymes and substrates participating in the reaction. The use of betaine as animal fodder is examined, and other uses discussed, including application of betaine hydrochloride to help in HCl secretion in the stomach as well as for treatment of arteriosclerosis and liver disorders. Its possible use in industrial microbiological processes is also suggested. 138 references are given to the literature.

* * *

Determination of the optimum frequency of beet sampling for true dirt content using mathematical statistical methods. M. Z. KHELEMSKII, I. A. EROSHENKO and I. YU. KLYAVIR. *Sakhar. Prom.*, 1971, **45**, (12), 37–42.—The optimum frequency of beet sampling in order to determine the dirt content has been worked out statistically and the value of this and the determination error are given for dirt contents of up to 10% and above 10%, respectively.

[1] *I.S.J.*, 1971, **73**, 377.



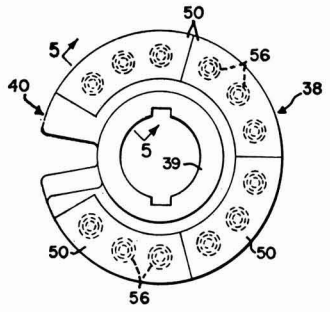
Patents

UNITED STATES

Pretreatment of vegetable matter and delignification of the refined matter with chlorine dioxide (for paper pulp production). H. D. WILDER, of Richmond, Va., USA, *assr.* ETHYL CORPORATION. **3,591,451.** 6th February 1969; 6th July 1971.—Chips of the vegetable matter (cane fibre) are pretreated by a (mechanical or chemical) pre-pulping process such as the kraft, nitric acid, bisulphite or neutral sulphite process (treatment with 5–30% w/w of Na_2SO_3 plus 3–25% w/w of Na_2CO_3 on weight of dry fibre) and refined, washed and dewatered. This gives a yield of 64–100% w/w and the pretreated pulp is reacted with 2–15% (2–7%) of ClO_2 (containing $< 30\%$ Cl_2) (at a pH of up to about 8·0) and washed before treatment with (about 4% w/w of) a water-soluble caustic material which may be an alkali metal hydroxide or carbonate, ammonia gas or ammonium hydroxide (NaOH, Na_2CO_3) at 50°–75°C (for at least ½ hr) (washing) and reacting with ClO_2 (half the amount used previously) (to give a total usage of 1–15% w/w) (at 40°–60°C for ½–4 hr). (The product is washed and again treated with aqueous NaOH for at least ½ hr at 50°–75°C, washed and reacted with half the ClO_2 used in the second treatment, at 40°–80°C for 2–6 hr and washed.) The pulp so produced has superior properties in regard to greaseproofness, tensile strength, bursting strength, tear resistance and folding endurance.

* * *

Screw press. A. W. FRENCH, of Piqua, Ohio, USA, *assr.* THE FRENCH OIL MILL MACHINERY CO. **3,592,128.** 6th June 1968; 13th July 1971.



When pressing bagasse which may contain e.g. sand, the surfaces of the screw within the press—although faced with a hard material such as "Stellite"—is subject to wear and may require dismantling of the press, removal of the screw, welding with more "Stellite" to renew the surface followed by grinding it to the proper dimensions and replacement of the screw. To avoid this downtime, which may occur during the crop, the surface of the screw is provided with removable sections 50, cast out of "Stellite" and shaped so as to follow the helix of the screw. The sections are provided with a fixing mechanism such as bolts 56 cast into their rearward faces and held by nuts after being located in holes in the screw body. When the faces are worn the sections can be removed and replaced individually without removing the screw from the press, the screw being turned to bring each section to the position where it can be reached.

* * *

Screw press for cane. K. HEINRICH, of Wevelinghoven, Germany. **3,595,162.** 26th November 1969; 27th July 1971.—The press of the type described in US Patent 3,590,730[1] is operated to subject the material to a maximum pressure of 250–700 atmospheres so that the solid material is extruded in a substantially dry condition, the juice content of the cane having been caused to flow in the opposite direction to the cane to be discharged upstream of the large diameter end of the pressure chamber.

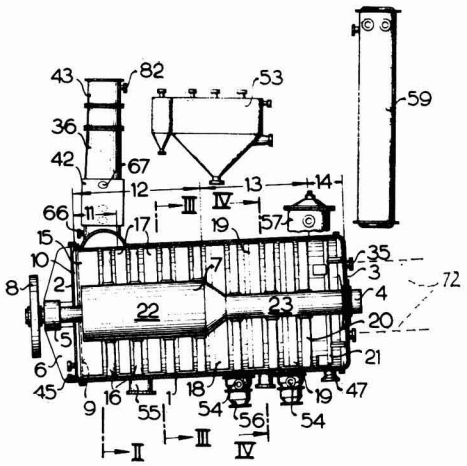
* * *

Beet scalding. E. LANGEN and H. WEDDECKE, of Grevenbroich, Germany, *assrs.* MASCHINENFABRIK BUCKAU R. WOLF A.G. **3,595,695.** 4th December 1969; 27th July 1971.

The scalder is in the form of a cylinder 1 having closed ends 2,3. A bearing 5 supported by webs 6 in end 2 and a bearing 4 in end 3 support a shaft 7 rotated by drive mechanism 8. The cylinder is divided into three sections 12, 13 and 14. In the first of these the shaft 7 has a wider diameter portion 22 reducing to a narrower portion 23 in the other sections. A screen 9 surrounds the shaft at the start of section 12, forming a juice chamber 10, while the shaft carries scraper section 15 and stirring arms 17 which rotate between interruptor bars 16 attached to the interior of cylinder 1 and located by rings which surround the shaft portion 22. Similar arms 18, 19 and bars 20 are provided in section 13, while in section 14 is located a dished annular baffle behind

[1] *I.S.J.*, 1973, **75**, 61.

which diffusion juice is delivered by pipes 72 to inlet ports 35 and is uniformly distributed into section 14.



Fresh cossettes are supplied to pipe 43 leading into the filling zone 11, juice being withdrawn from chamber 10 through port 45 and pumped into the cossette feed which is delivered into the cylinder by a screw conveyor within the feeding pipe. The mixture passes through the counter-current flow zone 12 into the cross-current flow zone 13 where additional heating is obtained by admitted juice so as to give a temperature of 67–75°C. It subsequently passes to the mash zone 14 where the stirring device 21 converts the cossettes and juice to a pumpable mixture which is withdrawn through port 47 and sent to the diffuser. Juices withdrawn from chamber 10 and from the cossette feed port are sent to the foam separation device 53 while their temperatures are raised by means of the heat exchanger 59.

* * *

Cane topper. S. R. MAKEHAM and K. L. RUBACK, of Bundaberg, Queensland, Australia. **3,596,447.** 5th February 1969; 3rd August 1971.

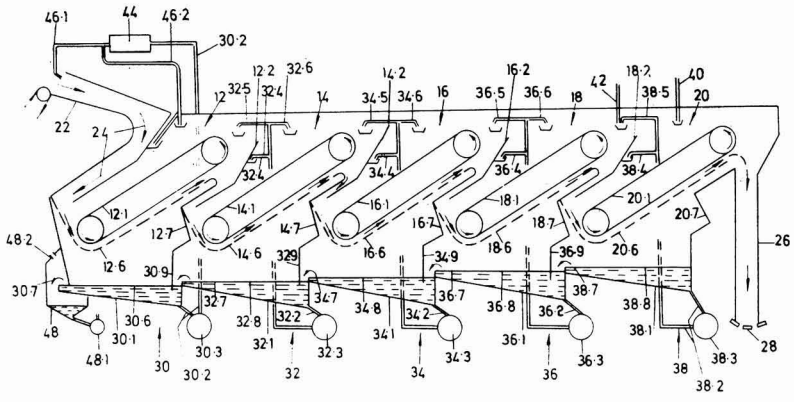
* * *

Cane harvester. C. M. CRUZ F., R. RODRÍGUEZ V. and D. PÉREZ A., of Havana, Cuba. **3,599,404.** 8th April 1969; 17th August 1971.

Cane diffuser. A. VAN HENGEL, of Westville, Natal, South Africa, *assr.* HULETT'S SUGAR CORPORATION LTD. **3,597,163.** 21st October 1969; 3rd August 1971.

The diffuser is divided into a number of sections 12, 14, 16, 18, 20 each of which contains a conveyor such as 12·1. Fresh material enters the unit through port 22 and is directed into the bottom of section 12 where it is raised by the conveyor and is discharged onto guide plate 12·2 which delivers it to the base of section 14. Thus the bed is completely re-orientated, so eliminating plugging and prevention of percolation. Eventually, the bagasse is discharged by conveyor 20·1 through chute 26 to a conveyor system 28 for removal.

The bottom of each section is formed by a stationary screen 12·6, 14·6, etc., and below this a juice reservoir vessel, 30·1, 32·1, etc. From the second of these, juice is sent by pump 32·3 through the recirculating system whereby it is separated into three appropriate proportions and delivered by spraying sections 32·4, 32·5 and 32·6. The first delivers juice to the material



at the bottom of conveyor 14·1, the second to material overflowing from the top of section 12 and the third onto material near the top of conveyor 14·1. The juice percolates through the bed of material under the conveyor and returns through the screen 14·6 into reservoir 32·1. Transfer from one reservoir to another is by overflow under gravity through ducts 30·7, 32·7, 34·7, etc. so that in the event of a hold-up in the cane supply the circulating system can continue to operate without the reservoirs becoming empty. In addition, the juice transferred is from the richest end of the reservoir. Water is supplied through pipe 40 and press juice from a bagasse press through pipe 42. Juice overflowing from reservoir 30·1 collects in chamber 48 and is sent to process by pump 48·1. Juice sent for recirculation by pump 30·3 passes through pipe 30·2 to a heater 44; heated juice is distributed onto the material in section 12 and is also sent by pipe 46·1 to mix with the incoming fresh material, thus raising its temperature to a suitable level.

reader inquiry service

If you wish to receive further information on the products and services mentioned in the advertisements please fill in the inquiry section of this card and post it to us.

reader inquiry service

Please arrange for me to receive without obligation further details of the products referred to below which are advertised in your.....19..... issue.

Advertiser	Product	Page

Signature.....

Block Letters

NAME ..... Date.....

Position.....

Firm.....

Address .....

photocopy service

We are able to supply one photocopy, for research or private study purposes, of most of the original papers abstrated in this journal. It should be noted that these are not translations but are in the original language of publication, which may not be English. Please ask us to quote you the cost of your requirements, indicating whether surface or air mail delivery is to be provided.

photocopy service

Please submit your pro-forma invoice for the supply of one photocopy of each of the following original papers, abstracts of which appeared in your.....19..... issue.

Page	Author(s)	Title

Air Mail/Sea Mail

Signature.....

Block Letters

NAME ..... Date.....

Position.....

Firm.....

Address .....

additional subscriptions

To receive additional copies of *The International Sugar Journal* all you need do is to complete the card with details of the subscription required, and return it with your remittance of £3.00 or U.S. $10.00 for supply by surface mail.

additional subscription order

Please send a further copy of your journal each month to the address below, starting with the issue

.....19.....

Block Letters

.....

.....

.....

.....

.....

Signature.....

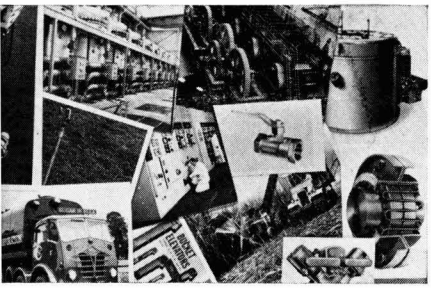
Date.....

I enclose cheque/draft/M.O./P.O. for £3.00/$10.00.

Reader Inquiry Service,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.
England.

Photocopies Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks,
England.

Subscriptions Dept.,
The International Sugar Journal Ltd.,
23a Easton Street,
High Wycombe, Bucks.,
England.



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.

New Toft cane harvesters. Toft Bros. Industries Ltd., Bundaberg, Queensland, 4670 Australia.

Three new fully field-tested cane harvesters have joined other production models to give six chopper-type machines available from Toft for the 1973 season. By fitting engines of different horsepowers to these six models, a range of harvesters is provided capable of handling most cane and field conditions, even those encountered in extremes of soft wet soils, peaty mucks, slopes that were previously thought too difficult, and cane grown in a furrow or on a ridge.

The Toft "Robot Mark II" harvester has been developed from the "CH364 Robot" model. The engine has been shifted to a central position which allows the primary elevator to be shortened and the rear elevator to be lowered; this gives the machine a low profile and added stability. The works have been simplified by streamlining the feed rollers and introducing a floating roller giving more positive cane feed. All this allows the machine to be shortened by 3 feet from its predecessor.

Fig. 1. Toft "Robot Mark II" chopper harvester

A completely redesigned topper is a major breakthrough; simple in design and practical in operation, it severs the tops cleanly from the cane, when they are chaffed and blown to the ground. The depositing of the chaffed tops does not in any way interfere with the other operations going on during the harvest

Cleaning of the cane has been improved by combining both extractor fans and blowers to full advantage. Transmission is hydrostatic and all feeding and chopping operations are hydraulic; this protects the machine from the damage which would be caused if the drive were mechanical by belt or chain should rocks, etc. enter the machine.

It carries on the Toft tradition of strength and ruggedness and is available with Perkins, GM or Caterpillar engines of two different sizes up to 250 h.p.

The Toft "Robot Mark II Full Track" harvester has the same excellent cutting ability as the rubber-tyred model using the same principle and methods. It is designed for areas with flotation problems and is mounted on full tracks, each track driven individually by a hydrostatic motor. All the harvesting mechanism is positioned between the tracks, eliminating problems of bobbing, excessive length and awkward design. Having 11½ feet of 20-inch track on the ground gives the machine only 6 p.s.i. ground pressure, making it very suitable for wet conditions or peaty muck soil. This machine is also available with a variety of engine makes and horsepowers. It still uses the proven feeding and chopping system but incorporates a new ground cutting device which eliminates the base cutter discs, using knives on spinning feet; this cutting action goes a long way in preventing stones or dirt being fed into the machine and loaded with the cane.

All new units are tested on Toft's own plantations; Toft's are cane growers and understand the practical application of sugar cane harvesting and harvesters. The development section is continuously working on new machines and ideas which, when fully tested on machines operating on the Toft plantations, are incorporated in standard production harvesters.

Special machines are also developed and manufactured; one such is the huge machine weighing approximately 65 tons developed for the Hawaiian sugar industry. This was designed for cutting and cleaning cane at a rate of 150 tons per hour but figures released by Hawaiian Commercial & Sugar Co., of Puunene, Maui, show that cutting rates up to 206 tons of cane per hour were achieved during tests in October 1972.

The Toft "CH364 Robot" cane harvester has been retained in the range because of its popularity and extremely good performance in 1972 both in Australia and in numerous overseas countries. The "CH364 Robot" half-track harvester is also being retained; this is identical to the wheeled model except for the

half-track device which is interchangeable with rubber-tyred wheels. The half-tracks are suitable for conditions where flotation is needed but which are not extreme enough to warrant full tracks. Ground pressure with this machine is below 10 p.s.i., so giving no soil compaction.

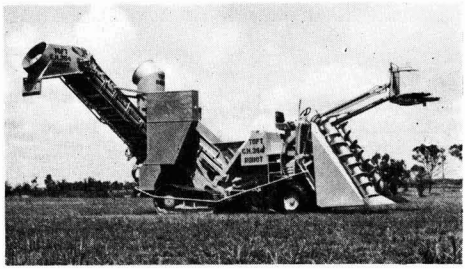


Fig. 2. Toft "CH364 Robot" half-track chopper harvester

This machine has also been successfully introduced into countries where cane is grown in the furrow for irrigation purposes; by replacing the single front wheel with dual wheels, the harvester stays on the ridged inter-row in these conditions. Because the machine is fitted with a single base cutter there is no problem in cutting the cane in the bottom of the furrow.

All these harvesters are designed to cut a single row of cane, apart from a new double-row machine, quickly turning at the end to come back to the next row or rows. This eliminates the time-consuming dead travel on headlands which restricts the machine's capacity. Such machines are ideal for flat or gently undulating country but do entail problems on extreme slopes. Toft's have, however, introduced a model with a wide rear axle across which the machine slides, giving added stability on steep slopes, but still retaining the ability to cut a single row and then move to the next row without going round the block of cane. This machine is achieving a high cane cutting rate in hilly country where mechanical harvesting was thought to be impossible a few years ago.

Fig. 3. Toft J250 whole-stalk harvester

Although whole-stalk harvesting is gradually being replaced in Australia by the chopper system, there are still many countries growing sugar cane where the whole-stalk system is favoured. For these, the Toft J150 and J250 whole-stalk harvesters and two whole-stalk loaders continue in production with the benefits of long-established design.

* * *

Contents gauges. KDG Instruments Ltd., Crawley, Sussex, England.

The "Thames-tronic" contents gauge consists of an electronic transmitter responsive to the pressure of the liquid head in a tank, with a power supply unit and an indicator which may be located up to 1500 m from the storage vessel. The transmitter is suitable for installation on vessels of various shapes and sizes up to a nominal liquid height of 20 m, and a s.g. correction control provides for adjustment of calibration with change of liquid density. Mains operation is used for continuous indication, while battery-operated versions are available for instantaneous or sustained indication.

* * *

Cleaning systems. Euromekan AB, Sweden; Speed-O-Klene Equipment Co. Ltd., Bedford, England.

The "Euroclean" modern high-pressure cleaning and disinfecting systems include standard models ranging from small portable units to large mobile equipment developing extremely high pressures. Each unit includes power unit, high-pressure pump and an injection system easily adjustable to give accurate dilution. Specially-formulated chemicals of high concentration are designed to give maximum penetration in the shortest possible time. For removal of sugar as an impurity, the recommendation is an alkaline product of pH 12·7 containing a maximum of 2·4% P_2O_5 plus clean water.

* * *

Equipment for massecuite boiling. Ditmar Zonen N.V., Amersfoortsestr. 70, Soesterberg, Holland.

"Ditmar" pan boiling controls include the TBR recorder, which registers the massecuite circulation rate and, since this is related to massecuite Brix, permits control with faster boiling and more and higher quality crystals; the TBR.S, which is identical to the TBR but has semi-automatic liquid feed control; the TBR.T, which records both massecuite velocity and temperature; the TBR.TS, which is the same with semi-automatic feed control as with the TBR.S; the TBR.TC, which is the same as the TBR.T plus massecuite temperature control; the TBR.TC.S with semi-automatic feed control; the TBR.DW56, which is the basic TBR combined on the same panel with a recorder/controller actuating a steam valve for massecuite temperature proportional control; the TBR.DW56.TC, which is as the TBR.DW56 but the massecuite temperature is controlled by means of a valve through which water flows to the barometric condenser; the TBR.DW56.VC, in which the temperature controller of TBR.DW56.TC is replaced by a vacuum recorder/controller; and the TBR.S.DW56, TBR.S.DW56TC. and TBR.S.DW56.VC, which are the same as the TBR.DW56, TBR.DW56.TC and

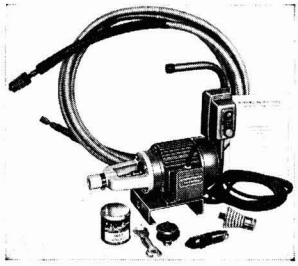
TBR.DW56.VC, respectively, but with semi-automatic feed control.

Apart from details of the above units and their application, Catalogue 68 gives information on "Ditmar" slurry mills, which are available as a 1500 cm^3 model (Type SMAC) operated by a 1/6-hp motor and a 5000 cm^3 model (Type SMAC5) operated by a $\frac{1}{3}$-hp motor. Also described in the catalogue are the SB seeding valve and two types of vacuum pan: a calandria pan with annular steam distribution and feed through four ports spaced regularly apart, and a coil pan equipped with a screw pump mounted at the massecuite discharge which sucks the massecuite from the outlet and passes it up through four 10-inch pipes discharging beneath the coils, thus improving the natural massecuite circulation and yet requiring much less energy than a forced circulation system. The system, which can also be used to transfer heavy massecuite to the crystallizer and to feed massecuite when cutting to an empty pan, can be installed on any existing pan.

* * *

Electric boiler tube cleaning equipment. Rotatools (U.K.) Ltd., Brookfield Drive, Liverpool, L9 7EG England.

Rotatools (U.K.) Ltd. have re-designed their range of tube cleaning machines for the sugar industry to give greater efficiency. The new S.2 series of electric tube descaling units embody the latest metric range of totally-enclosed, fan-cooled, continuously-rated motors conforming to B.S.S., I.E.C. and V.D.E. specifications. The push-button starters, manufactured to the same specifications and embodying single-phasing protection (3-phase) as well as overload and under-voltage protection, are ambient-temperature compensated. All flexible drives are manufactured to the same high standards and are protected



by overload shear pins. The power units are obtainable with outputs of 1·5 kW (2 hp), 2·2 kW (3 hp), 3 kW (4 hp) and 4 kW (5·5 hp), speeds of 1500, 1800, 3000 and 3600 rpm being available according to voltage, which is adequate for all tube bores from $\frac{3}{4}$ to 4 inches regardless of scale conditions. All A.C. voltages are accommodated. The machines (the Model H.T. is shown in the illustration) are available in various forms, e.g. with carrying handles, mounted on small steel trollies or made to be suspended.

PUBLICATIONS RECEIVED

"SUGAR BULLETIN". A. & W. Smith & Co. Ltd./The Mirrlees Watson Co. Ltd., No. 1 Cosmos House, Bromley Common, Bromley BR2 9NA, England.

The latest available issue of "Sugar Bulletin" gives a brief report on progress in the construction of Central Río Yaracuy in Venezuela and reproduces comments on cane mill roller shaft failures, first published in the Mirrlees Bulletin in 1937 but still considered applicable. An illustration shows three 48 × 30-inch 1000 rpm fully-automatic centrifugals being erected prior to shipment to Woodford Lodge in Trinidad.

* * *

"AMBER-HI-LITES". Rohm and Haas Co., Philadelphia, Pa., 19105 USA.

Issue No. 131 of "Amber-Hi-Lites" continues with helpful hints in ion exchange technology; the main subject here is fouling of ion exchange resins, and particular attention is drawn to ways of preventing this in the case of calcium sulphate, silica, hydrous oxide, iron, manganese, aluminium and oil.

* * *

POWER TRANSMISSION PRODUCTS. Renold Ltd., Renold House, Wythenshawe, Manchester M22 5WL, England.

A 12-page brochure, No. L-RL 714, gives information on chains and wheels, gears and gear units, variable-speed systems, couplings, clutches and brakes made by firms in the Renold Group.

* * *

"GETTING THE BEST FROM CHAINS". Ewart Chainbelt Co. Ltd., Colombo St., Derby, England.

This is the title of a check-list from Ewart Chainbelt which is aimed at helping maintenance and plant engineers to get the best out of chain conveyors. It lists 12 points (apart from the obvious one of the need for regular lubrication) to which great attention should be paid in their operation.

* * *

Beet diffuser gear and path rings assembly.—David Brown Gear Industries Ltd. have received an order from A. F. Craig & Co. Ltd., of Paisley, Scotland, for a 26-ft diameter combined spur gear and path ring to be installed at one end of an RT4 beet diffuser intended for the York sugar factory of the British Sugar Corporation Ltd. A separate path ring (to be located towards the opposite end of the drum), spur pinion and four sets of double trunnion roller bogies are also to be made by David Brown Gear Industries; the bogies will be floor mounted and paired to run with the path rings, at each side of the diffuser, so as to spread the surface loading of the drum and achieve an equal distribution of the 1080 tons total weight.

* * *

Cane loader trials.—Two cane loaders manufactured by S. K. H. Ltd., of Prees, Whitchurch, Shropshire, England, are shortly to undergo extensive proving trials, one in Trinidad and the other at Mumias, Kenya. The loader, operated by one man, has a continuously rated capacity of 20 t.c.h. and a maximum speed of 17 mph. The grab capacity is 1000 lb[1].

* * *

Centrifugals for Cuba.—An order for fully-automatic batch centrifugals to the value of £275,000, received last August by Thomas Broadbent & Sons Ltd., of Huddersfield, Yorks., England, was followed last January by further Cuban orders worth £102,000.

* * *

Soc. Fives Lille-Cail.—This well-known French company, which specializes in the design and manufacture of complete beet and cane sugar factories and supplies all major factory equipment, as indicated in a handsomely printed coloured brochure, announces the formation of an associate company in the UK, Fives Lille-Cail (U.K.) Co. Ltd., of Albany Building, 47 Victoria St., London SW1H 0EQ, England.

---

[1] *See also I.S.J.*, 1971, **73**, 350.

Brevities

The late P. G. Berdeshevsky.—Peter Berdeshevsky died in January at his home in New York. He was 78. He was born in Russia but received his education in France and the U.S.A. He was a co-inventor of the Sucro-Blanc process which was used for over 30 years for white sugar production in the cane sugar factories of tropical countries until overtaken by newer technology. In the 1920's he was invited to Palestine to determine if cane sugar was a feasible crop; his findings were that it was not. After the founding of the State of Israel he was involved in the designing of her beet sugar factories. A familiar figure at meetings of sugar technologists, he will be missed by the many friends he made in his long career in the industry.

* * *

Tate & Lyle Ltd. and the British beet sugar industry.—With the entry of the UK into the European Economic Community and the phasing out of the supply of Australian sugar to Britain after 1974, the quantity of raw sugar to be refined by Tate & Lyle Ltd. will be reduced. The company feels that in compensation it should be allowed to enter the British beet sugar industry and it is reported[1] to have proposed that it should be allowed to acquire some of the British Sugar Corporation's factories. Alternatively it is suggested that all or part of the Government's 36% shareholding in the Corporation should be passed to Tate & Lyle on appropriate terms. It is recognized as an expensive and commercially unsound proposition to create a new beet processing business in the UK. But the Corporation is certain to resist strongly any suggestion that it should divest production to Tate & Lyle and would argue that even if Tate & Lyle's ambition were supported by the Government, who hold a dominant stake in the Corporation, B.S.C.'s duty was to all its shareholders.

* * *

Hawaii sugar industry investment.—Speaking before the Sugar Club of New York, Mr. E. B. HOLROYDE, President of the Hawaiian Sugar Planters' Association of Honolulu, described the investment programme of the state's sugar industry—the largest in the USA—which will total some $60,000,000 this decade, in order to maintain its share of the country's growing market[2]. The programme includes factory consolidations linked in some cases to company mergers leading to larger, more efficient units. The total number of factories in the industry is being reduced from 24 to 18 and the number of companies from 22 to 19. About 14,000 acres of new cane fields will be brought into production by 1980, offsetting to a large extent the loss of three marginal producers during the first half of the 1970's; the land coming into production will be substantially more productive than that lost. Production increases are expected from sugar cane ripening chemicals now in large-scale field testing which are expected to give increases of from 1/3—1/2 ton of sugar per acre, compared with current yields of 10–11 tons of sugar per acre. New methods of cleaning harvested cane provide a minimum increase of 5% sugar recovery while new irrigation methods, which also stretch water resources, permitting some expansion of acreage and providing lower operating costs, are also likely to help improve crop yields. Hawaiian sugar production during the past ten years has been the best in the industry's long history and the islands anticipate production during the next ten will equal or better the record period.

* * *

EEC import quotas for African associates[3].—The EEC Foreign Ministers have agreed in principle to grant the Community's 19 African associates a small annual sugar quota from 1973. The quota will be around 8000 tons, although the associates had asked for 50,000 tons. The quota is meant as a temporary measure pending definition of the Community's policy on sugar imports from developing countries after the Commonwealth Sugar Agreement expires in 1974.

Thailand sugar exports, 1972[4]

	1972 (*metric tons, tel quel*)	1971
France	13,440	—
Hong Kong	15,746	—
Japan	34,961	44,810
Jordan	19,998	—
Malaysia	72,693	5,000
Nepal	5,987	—
Pakistan	41,978	—
Saudi Arabia	20,214	—
Singapore	2,031	17,790
Sri Lanka	76,531	—
Sudan	28,002	—
USA	16,808	16,572
Vietnam, South	68,918	60,828
Yugoslavia	9,501	—
	426,808	145,000

EEC Commission fines on sugar companies[5].—The EEC Commission investigation into the activities of European sugar manufacturers[6] concluded that they were a flagrant breach of the community's competition policy and announced the heaviest fines ever imposed for infringements of Articles 85 and 86 of the Treaty of Rome. The fines on 16 of the EEC's leading sugar manufacturers and traders totalled 9 million units of account (about £3,750,000) and included fines of 1·5 million units on Raffinerie Tirlemontoise S.A., 1 million each on Sucres et Denrées and Eridania Zuccherifici Nazionali S.p.A., and fines of 100,000–800,000 on the other firms. Four companies (Raffinerie Tirlemontoise, Coop. Ver. Suiker Unie, N.V. Centrale Suiker Mij. and Südzucker-Verkauf G.m.b.H.) are additionally being charged with abusing their dominant position. All the firms involved are expected to contest the Commission's decision before the European court of justice in Luxembourg and a spokesman of the Tirlemont company said it would attack both the way the commission had drawn up its case and the substance of its findings.

* * *

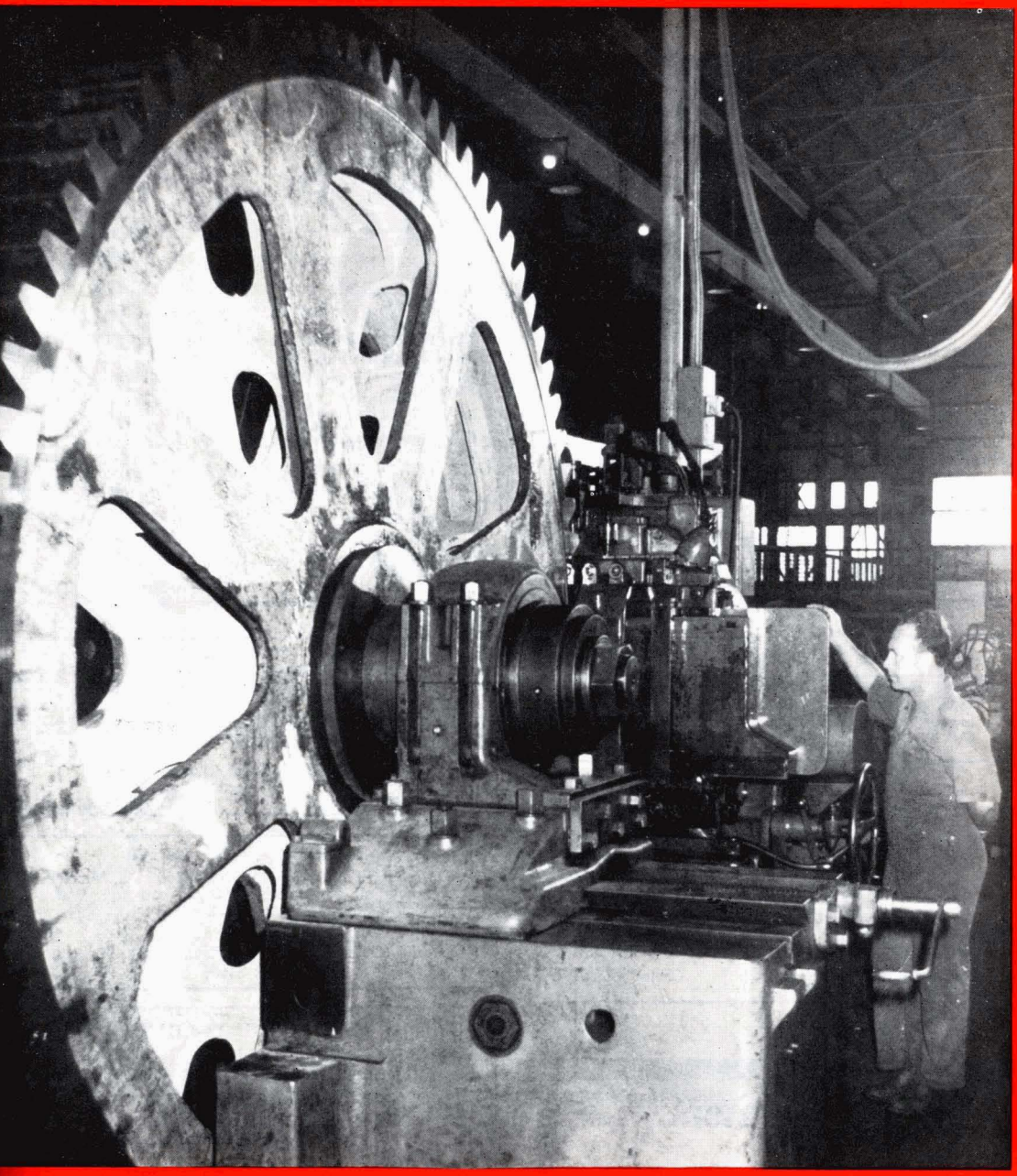
Kenya sugar project[7].—Construction work on the K£7,500,000 sugar factory at Mumias in Kenya's Western Province is progressing well and the management anticipates that it will be operating on schedule in July. The Mumias Sugar Co. Ltd. has stated that of the required nucleus estate of 7500 acres of cane, some 5500 acres are already planted. About 1500 farmers around the estate have planted about 5,500 acres in addition; the outgrower scheme is to encourage a total of some 4000 farmers within an 8-mile radius of Mumias to plant about 20,000 acres of cane. The factory's output will be 45,000 tons a year initially, rising to 70,000 tons from 1976. Kenya imported more than 80,000 tons of white sugar in 1972 and estimates for 1973 indicate a need to import 130,000 tons to meet local demand.

* * *

Barbados sugar crop, 1972[8].—The total production of sugar, fancy molasses and vacuum pan molasses for the 1972 crop was substantially lower than in 1971 and below the five-year (1967–71) average. A summary of provisional results shows that 11 sugar factories crushed 999,124 tons of cane and produced 108,588 tons of sugar. The ratio was 9·22 tons to one ton of sugar; comparative figures for the 1971 crop were 1,147,238 tons of cane and 130,343 tons of sugar with an average recovery of 8·8 tons of cane to one ton of sugar.

[1] *The Times*, 1st December 1972.
[2] *Willett & Gray*, 1972, **96**, 382.
[3] *Reuters Sugar Rpt.*, 10th October 1972.
[4] C. Czarnikow Ltd., *Sugar Review*, 1973, (1110), 11.
[5] *The Times*, 18th December 1972.
[6] *I.S.J.*, 1972, **74**, 384.
[7] *Standard Bank Review*, December 1972, 7.
[8] *Barclays International Review*, November 1972, 48.

NDERLAND GEAR PLANER CUTTING A LARGE SPUR GEAR



FOR ALL HEAVY MILL GEARING
SPUR, SINGLE OR DOUBLE HELICAL,
CONTACT

WALKERS LIMITED

CONSULTANTS
DESIGNERS
ENGINEERS

MARYBOROUGH QUEENSLAND AUSTRALIA

Index to Advertisers

FOR THE BUYERS' GUIDE SEE JANUARY ISSUE pp. xxvii-xliv

This system doesn't play games with sand.

It's no child's play to get the sand out of raw juice, before it can get further into the system to cause erosion and clogging. Dorr-Oliver has a full-grown solution.

The DorrClone® Desanding System.

The DorrClone System, with its unified package design and its simplicity of operation, is one of the most efficient methods of desanding ever available to the sugar industry.

It achieves maximum sand removal with minimum sugar loss.

DorrClone is an old hand at the sand game. It offers you these proven advantages: • Reduces erosion in piping, pumps, valves and vessels. • Reduces sand loadings in filters, clarifiers and heater passes. • Minimizes sugar loss. • Low initial cost—can utilize existing raw juice pump and other equipment. • Low maintenance and operating costs due to few moving parts. • Removal of fine as well as coarse material—designed for separating most sand over 325 mesh.

Sand and sugar are a costly combination. The name of the game is profit. Call or write Dorr-Oliver, 77 Havemeyer Lane, Stamford, Conn. 06904.

We'd like to help you be a big winner.

DORR OLIVER

Printed by JOHN ROBERTS & SONS, Salford, Manchester; and published by the Proprietors, THE INTERNATIONAL SUGAR JOURNAL LTD., at 23a Easton Street, High Wycombe, Bucks. Entered at the New York Post Office as Second-Class Matter.

PRINTED IN GREAT BRITAIN.